OSTEOARTHRITIS HEALTH PROFESSIONAL TRAINING MANUAL

EDITED BY
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Osteoarthritis Health Professional Training Manual

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Preface

Our expanding global population is aging amid an obesity epidemic. These conditions provide the perfect combination of factors to drive the surging prevalence of osteoarthritis (OA), which rose by 113.25% from 247.51 million in 1990 to 527.81 million in 2019.[1] OA is a chronic disease that affects the tissues of moveable joints and is the most common form of arthritis. People with OA often present with pain, stiffness, and reduced ability to take part in everyday physical and psychosocial activities. OA is recognized as a leading cause of global disability and a major threat to healthy aging.[2]

The best evidence, first-line treatments for OA are well established: education and self-management support, physical activity and exercise, and weight control.[3–5] However, the translation of this care into clinical practice has been poor. Data show the delivery of best evidence OA care is commonly impeded by gaps in the knowledge and skills of health professionals.[6,7] Currently, health professionals lack access to interdisciplinary, international training programs on how to diagnose and manage OA. This context motivated the development of this book.

It has been our privilege to work with esteemed international osteoarthritis experts who have synthesized contemporary evidence from clinical practice guidelines, systematic reviews, and randomized trials to develop content that supports the knowledge and skills of health professionals managing people with OA. *Osteoarthritis Health Professional Training Manual* provides a wonderful opportunity for health professionals to engage with creative yet practical expert content and improve their confidence in their delivery of best evidence OA care.

The Osteoarthritis Training Manual for Health Professionals is based on the "Core Capability Framework for Qualified Health Professionals to Optimise Care for People with Osteoarthritis" by Hinman et al. from the Osteoarthritis Research Society Research International, Joint Effort Initiative.[8] The framework is based on the agreement of an interprofessional (18 disciplines), international (31 countries) Delphi Panel of expert researchers, clinicians, and consumer representatives.[8] The core capabilities were mapped to 10 areas of clinical expertise, which now form the individual chapters of the manual, with specific emphasis on taking a person-centered approach to increasing the uptake of effective lifestyle and self-management interventions by people with OA. Indeed as William Osler (1849–1919) observed "*it is much more important to know what sort of patient has a disease than what sort of disease a patient has.*"

The 10 chapters of the Osteoarthritis Training Manual for Health Professionals are arranged in a logical order to support fundamental knowledge and skills for OA care. That said, the chapters are also designed to "stand-alone" so may be read in any order. The first three chapters present the etiopathogenesis and prevalence of OA, communication skills to support person-centered care, patient assessment techniques, and viewing OA management through the lens of multimorbidity. The next three chapters address the core components of OA management, including education and support for self-management and lifestyle changes, physical activity and exercise, and weight control. Chapters seven to nine present the best evidence for other rehabilitative treatments, pharmacotherapy, and surgery. The final chapter provides guidance on fostering collaborative working between health professionals to best support people with OA and highlights opportunities for future professional development.

The Osteoarthritis Training Manual for Health Professionals is the first to offer a comprehensive resource to guide the best evidence management of OA for health professionals of any discipline or setting. There are other classic textbooks in our field that focus on disease knowledge and its management, but their target audience is not necessarily clinicians trying to improve their capabilities for managing persons with osteoarthritis. This key differentiating factor is important as our focus is on upskilling clinicians to optimize care—not just enhance interesting knowledge. The manual does not assume prior knowledge or any specific scope of practice. The content is intentionally broad in its coverage and provides an opportunity for those new to the field and involved in generalist care all the way through to those for whom OA is their speciality. It is also suitable for students from medical, nursing, and allied (other) health disciplines.

It has been our pleasure working with the distinguished group of authors responsible for the development of the chapters. We hope you find the content enriching and that it enhances your knowledge and care for people with

osteoarthritis. Ultimately it is they who we serve and who underpinned our motivation for this text in an effort to enhance the care that they receive while empowering them to manage their own health. After all, as William Mayo (1861−1939) said: "*The aim of medicine is to prevent disease and prolong life; the ideal of medicine is to eliminate the need of a physician.*"

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Chapter 1

Introduction to OA, communication, and person-centered care

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Clinical practice points/evidence summary:

- It is a common misconception for people to believe that osteoarthritis is a 'wear and tear' disease associated with pain and disability that inevitably worsen over time
- In fact, osteoarthritis-related pain and disability are influenced by modifiable biopsychosocial factors
- Osteoarthritis is a complex disease affecting all structures within and around the joint
- People with osteoarthritis can be empowered with the knowledge, skills, and resources they need to get control over their symptoms and participate in the activities they value.
- The 4Cs Communication Framework can be applied to empower people seeking care through compassionate, curious, collaborative, and critical communication

Introduction

This chapter gives an introduction to osteoarthritis, how common it is, and how it may impact the individual. To optimize person-centered care and empower people to live healthy lives with osteoarthritis, effective communication skills are discussed within a clinically useful framework.

Section 1a: Etiopathogenesis and epidemiology of osteoarthritis

What is osteoarthritis?

Osteoarthritis is the most common joint disorder and can cause joints to feel stiff and painful.[1] Osteoarthritis used to be called "wear and tear" arthritis because it was thought that the joints gradually wore out with use and that this was inevitable as we get older. It is now known that the process of osteoarthritis is much more complicated, and that osteoarthritis is a complex disease of the whole joint, i.e., affecting the articular cartilage, subchondral bone, ligaments, capsule, synovial membrane, and periarticular muscles.[2] Although the etiopathogenesis is not completely understood, it is believed that cell stress and extracellular matrix degradation initiated by micro- and macro-injury of the joint may activate maladaptive repair responses. This includes synovial inflammation and an imbalance in the molecular destruction and repair of joint tissues leading to cartilage loss and bone remodeling, e.g., osteophyte formation, bone marrow lesions, subchondral sclerosis, and cysts (Fig. 1.1). All these changes can lead to loss of normal joint function.[3,4]

People with osteoarthritis often experience joint pain, swelling, stiffness after resting, and crepitus.[5] This can negatively impact physical activity levels and lead to loss of muscle strength, laxity of ligaments, and a feeling of weakness around the joint or joint instability (buckling or giving way). Osteoarthritis can be diagnosed clinically and/or based on imaging, but imaging is not required to make the diagnosis in patients with the typical presentation of osteoarthritis.[6] Clinically, osteoarthritis is characterized by usage-related joint pain, joint line tenderness, limitation of movement, crepitus, occasional

Osteoarthritis Health Professional Training Manual. https://doi.org/10.1016/B978-0-323-99269-5.00001-3

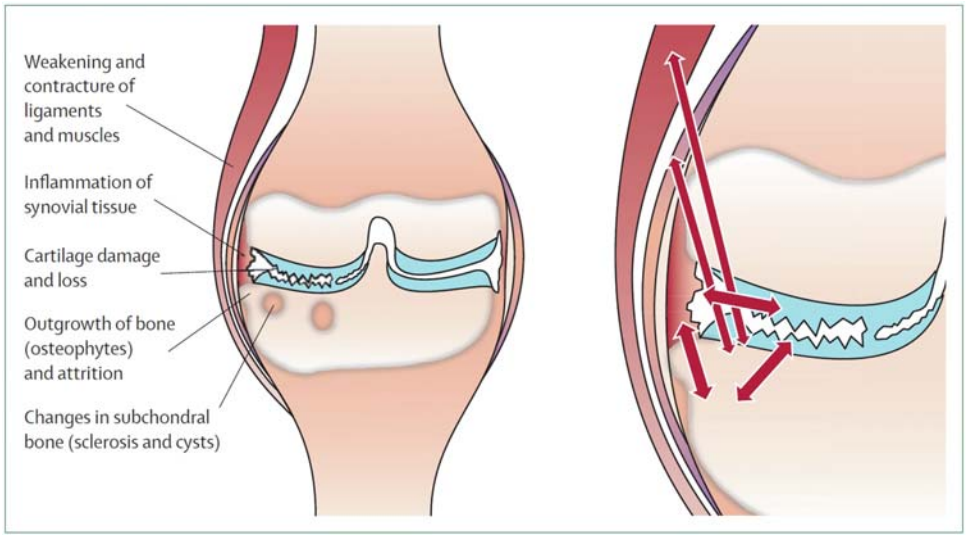

FIGURE 1.1 Schematic drawing of an osteoarthritic joint. Footnote: The different tissues involved in clinical and structural changes of the disease are shown on the left. Note that cartilage is the only tissue not innervated. On the right the bidirectional interplay between cartilage, bone, and synovial tissue involved in osteoarthritis is shown, and the two-way interaction between this interplay and the ligaments and muscles. In the interplay between cartilage, bone, and synovial tissues, one of the tissues might dominate the disease and as such should be targeted for treatment. *Reproduced from Bijlsma, Berenbaum & Lafeber. Lancet 2011;377:2115–2126.*

effusion, and variable degree of local inflammation.[4] In atypical presentations, imaging is recommended to help confirm the diagnosis of osteoarthritis and/or make alternative or additional diagnoses.[6] Typical osteoarthritis-related changes seen on conventional radiographs are joint space narrowing, osteophytes, and subchondral sclerosis.[7]

How does osteoarthritis develop?

Risk factors for developing osteoarthritis include increasing age, female sex, obesity, genetics (family history of osteoarthritis), joint injuries, surgery on joint structures, hip deformities (cam deformity or acetabular dysplasia), knee malalignment, increased biomechanical loading of joints (e.g., obesity or heavy work activities), knee extensor muscle weakness, and low-grade systemic inflammation.[1,8,9]

Osteoarthritis is typically described as a heterogeneous disease with a wide range of underlying pathways and can be considered as a syndrome rather than a single disease. Each risk factor might instigate a different pathway leading to osteoarthritis, e.g., factors promoting the development of osteoarthritis in older adults may be different from those factors that promote osteoarthritis after a joint injury or in obese individuals.[9] Different subgroups, or phenotypes, of osteoarthritis, have been suggested. These include posttraumatic, mechanical overload, inflammatory, metabolic alteration, aging/cell senescence, genetic, and pain.[9,10] However, more research is needed to validate these phenotypes.

How common is osteoarthritis?

Osteoarthritis affects about 6% of the global population or more than 500 million people worldwide.[11] The global prevalence of hip and knee osteoarthritis is expected to increase due to the population aging and obesity.[10] Osteoarthritis can develop in any synovial joint but is most commonly seen in the joints of the hip, knee and hand.[10]

Classification criteria for hand, hip, and knee osteoarthritis have existed for some time,[12–14] and osteoarthritis can be classified as radiographic osteoarthritis (showing structural changes) or symptomatic radiographic osteoarthritis (structural changes AND joint pain). Since nearly half of patients with radiological features of osteoarthritis have no symptoms and vice versa,[10] the prevalence of radiographic osteoarthritis and symptomatic osteoarthritis will differ.

The prevalence of osteoarthritis is not only dependent on the criteria used, but also the joint site, the age category, sex, and the country of interest.[15] In the U.S Framingham Study Community Cohort, the age-standardized prevalence of radiographic hip osteoarthritis was 20% and symptomatic hip osteoarthritis was 4%;[16] and the age-standardized prevalence of radiographic hand osteoarthritis was 41% and symptomatic hand osteoarthritis was 13%.[17] In a Swedish study of adults (age 56–84), the prevalence of radiographic knee osteoarthritis was 25% and symptomatic knee osteoarthritis was 11%.[18] The prevalence of hip and hand osteoarthritis, but not knee osteoarthritis, is higher among women compared to men[15] (Fig. 1.2). The lifetime risk of developing symptomatic osteoarthritis is approximately 50% for the knee joint, 25% for the hip joint, and 40% for the hand.[19–21]

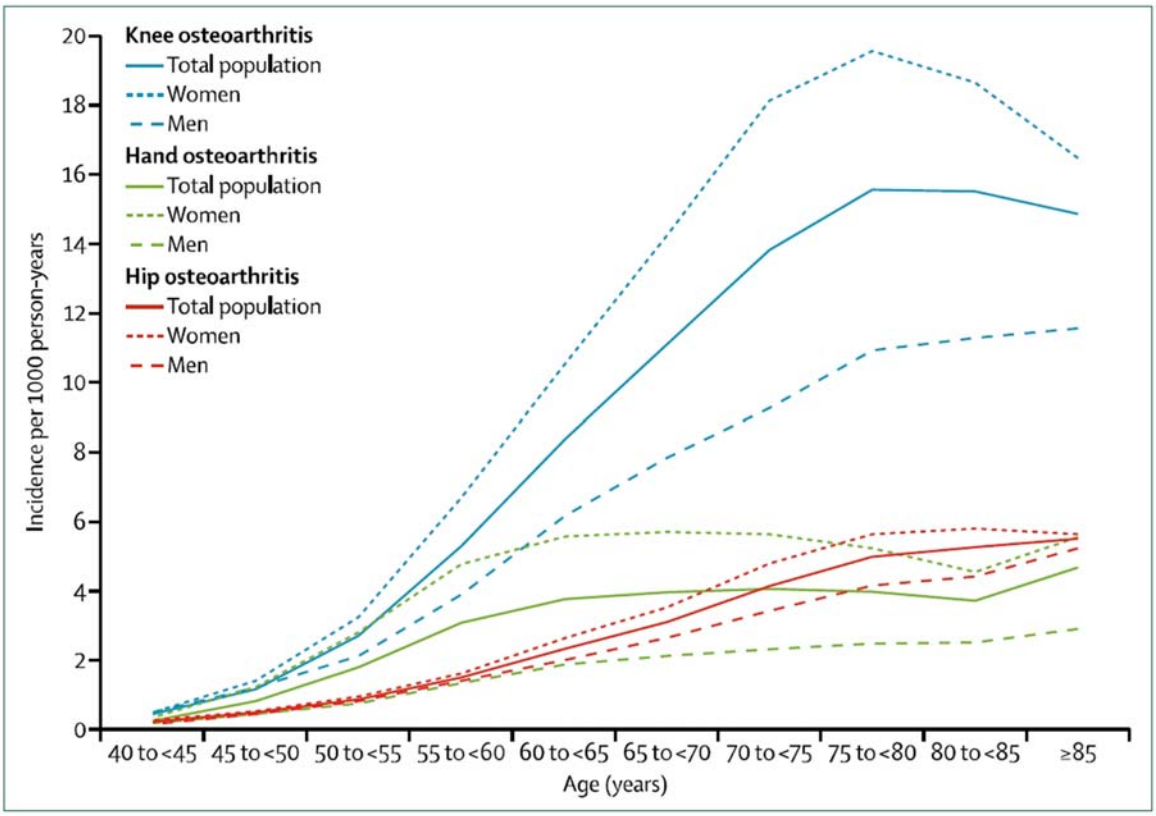

FIGURE 1.2 Osteoarthritis incidence. Footnote: Age-specific and gender-specific incidence (per 1000 person-years) of knee osteoarthritis (white), hand osteoarthritis (black), and hip osteoarthritis (gray). These data are representative of the general population from Catalonia (Spain). *Reproduced from Prieto-Alhambra et al. Ann Rheum Dis 2014;73:1659–1664.*

Osteoarthritis may occur in a single joint or in multiple joints. In a Swedish registry data study (age 45 years and older), among the people with doctor-diagnosed osteoarthritis in any joint location (except the spine), 27% had osteoarthritis in multiple joints.[22]

Impact and burden of osteoarthritis

People with osteoarthritis may experience different levels of severity of disability due to osteoarthritis; from having a mild impact with intermittent pain and minimal impact on daily activities to a severely disabling chronic pain and loss of function. However, the impact and burden of osteoarthritis are not static, as the levels of pain and disability can come and go (fluctuate/wax or wane), and "flare-ups" of the condition are common. In contrast to what many patients think, joint replacement is not the inevitable outcome for most patients.[23–25] Longitudinal studies have reported high interindividual differences in the course of osteoarthritis structural progression, symptoms, and functional limitation, raising the possibility of different long-term trajectories, of which not all may be progressive.[26] A study that followed adults over 50 years of age with symptomatic knee osteoarthritis for up to 6 years identified five different pain trajectories[26] (Fig. 1.3).

For many people with osteoarthritis, the levels of pain and disability due to osteoarthritis have a significant impact on their day-to-day functioning. The long-term consequences of experiencing persistent pain and disability due to osteoarthritis could be activity limitations, participation restrictions, sleep interruption, fatigue, depressed or anxious mood, and ultimately loss of independence and reduced quality of life.[5]

People with osteoarthritis are more likely to have other chronic conditions compared to individuals without osteoarthritis (67% vs. 56%) with the most common comorbidities being stroke, peptic ulcer, and metabolic syndrome.[27] Osteoarthritis is considered a serious condition as it causes premature aging with loss of functioning in society, increased risk of premature mortality, both directly as well as due to its associated comorbidities.[5] Further, it imposes large limitations on major daily life activities such as moving around, doing household chores, and for participation in work and other activities. Previous research has shown that participants with osteoarthritis reported greater pain, disability, depression, and

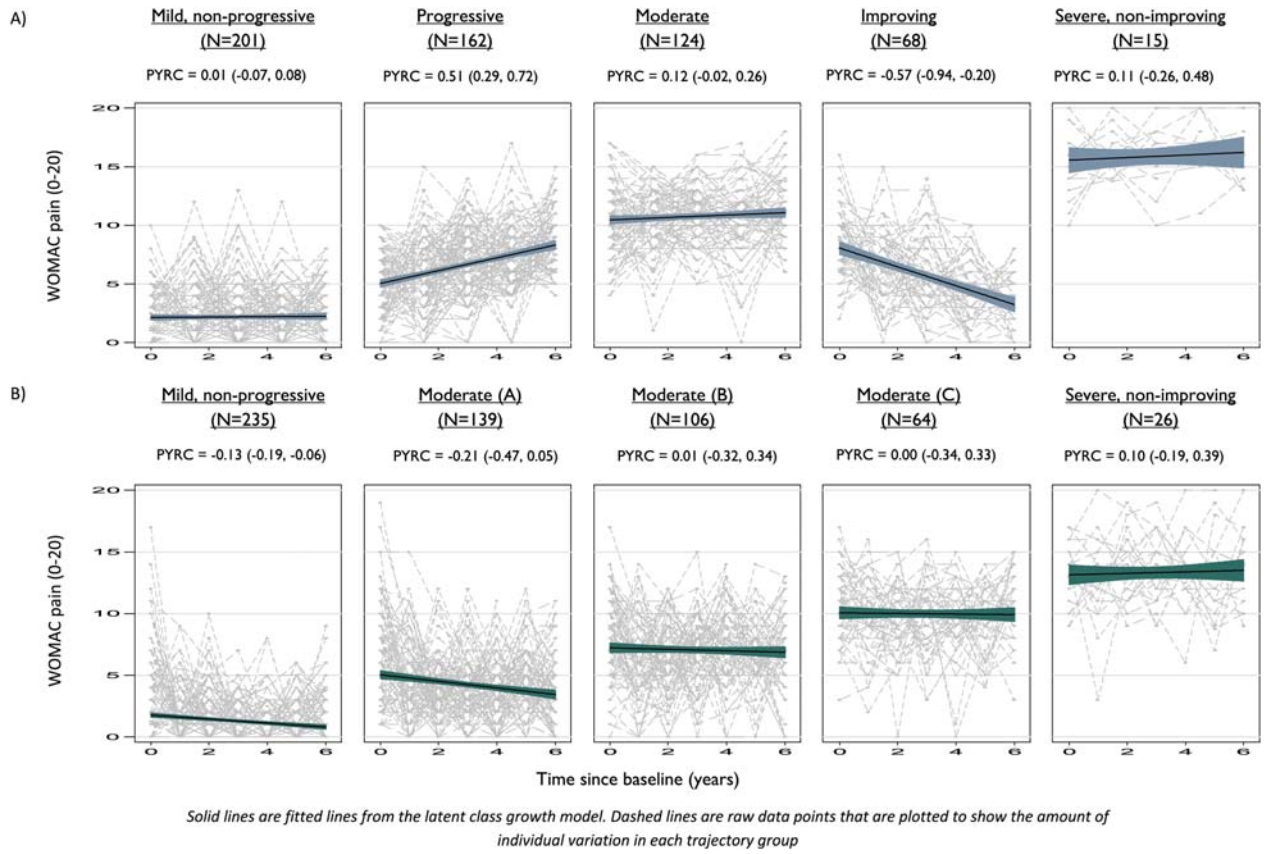

FIGURE 1.3 WOMAC Pain Scores by Trajectory Group Membership for (A) CAS-K and (B) Matched OAI Sample (n = 570). Footnote: PYRC = Per-year rate of change in WOMAC pints; 95% confidence interval in brackets. *Reproduced from Nicholls E et al. Osteoarthritis Cartilage. 2014 Dec;22(12):2041−50.*

sleeplessness than those with rheumatoid arthritis.[28] People with osteoarthritis have greater participation restriction and activity and work limitations than those without osteoarthritis. In a Swedish population-based register study, people with knee osteoarthritis had an almost twofold increased risk of sick leave and about 40%−50% increased risk of disability pension compared with the general population.[29]

Section 1b: Communication skills that support best evidence osteoarthritis care and Section 1c: person-centered care

What is best evidence osteoarthritis care?

Best evidence osteoarthritis care comprises education around self-management and activity-based interventions for all people with osteoarthritis, including weight management where indicated, with joint replacement surgery reserved for a minority of people with advanced signs and symptoms of osteoarthritis.[30,31] However, a range of social, cognitive, behavioral, and system factors can hinder participation in best evidence care. These include the experience of pain and disability, common misconceptions about osteoarthritis, the presence of comorbidity such as obesity, clinician biases, referral pathways, and reimbursement models. In this section, we will discuss these factors within the framework of a person-centered care approach.

What is person-centered care?

The experience of osteoarthritis is influenced by complex interactions between structural, physical, affective, cognitive, social, lifestyle, and comorbid health factors.[32,33] Many of these factors are modifiable and within an individual's control, and therefore, clinical practice guidelines recommend a person-centered care approach.[30,31] A person-centered care approach involves understanding the multidimensional nature of the health experience in the context of each individual,

supporting individuals to make sense of their experience within their own unique context and developing an individualized management plan aligned to their personally relevant goals and preferences.[34] Achieving this requires effective communication.[35]

Effective communication meets care-seekers' needs to both understand (their cognitive needs) and be understood (their affective or socioemotional needs),[36] and their preferences for clinicians who are compassionate, curious, critical and collaborative.[37–39] The 4Cs communication framework draws on existing models of clinical communication,[40] theories of health beliefs[41] and patient empowerment[42] to provide clinicians with knowledge and strategies to support the delivery of person-centered osteoarthritis care (see Fig. 1.4).

Compassionate communication

Fundamental to person-centered care is an acknowledgment of the physical, social, and psychological dimensions of the osteoarthritis experience.

Osteoarthritis impacts participation in valued life activities.[37] The inability to participate in paid employment or a reduction in work hours can affect financial security; disengagement from leisure activities and increased sedentary time can lead to social isolation; and difficulties fulfilling traditional family roles can impact on one's sense of self.[37] Further, sleep disturbance associated with osteoarthritis can lead to mood disruption; while the perception that osteoarthritis is an inevitable part of aging that one must "learn to live with" can lead to fear and despair for the future.[43] As such, people living with osteoarthritis commonly describe themselves as "less valuable" or "a partial person"[37] and are 1.3 times more likely to experience poor mental health than those without the condition.[44]

Evidence suggests that some clinicians do not perceive osteoarthritis as a serious health condition and will prioritize other comorbidities such as diabetes and heart disease, which they perceive to present more immediate health threats.[45] However, the impact of osteoarthritis on physical activity and psychosocial well-being can significantly limit people's ability to effectively manage comorbidities.[37] The experience of having symptoms of osteoarthritis "ignored" by clinicians can be distressing.[37]

Distress, fear, mood disruption, and sleep disturbance can themselves heighten the experience of pain and disability.[46] Therefore, understanding the impact of osteoarthritis for each individual can assist in identifying potential targets for intervention. Discussing sensitive psychological, social, and lifestyle issues can be an emotional experience for the individual seeking care. While some clinicians perceive this as a barrier to person-centered care, the expression of emotion by individuals seeking care provides an opportunity for clinicians to display compassion.[47] This display can reduce emotional distress, improve trust and treatment outcomes.[47,48]

Compassionate communication involves not only listening to and acknowledging the unique physical, social, and psychological impacts of osteoarthritis, but also involves assurances that action can be taken to ease this impact and that the individual will be supported to achieve their goals.[49] Behaviors that have been found to improve care-seeker perceptions of clinician compassion[48] are presented in Box 1.1.

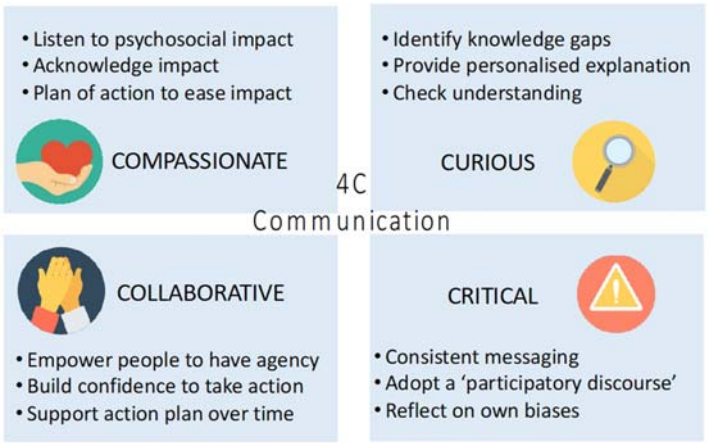

FIGURE 1.4 4C Communication framework.

BOX 1.1 Behaviors that demonstrate compassionate communication.

i) Sitting rather than standing
ii) Maintaining eye contact
iii) Listening without interruption
iv) Displaying curiosity about the individual and their life context (e.g., *"What impact is this experience having on you? How are you coping* with this?")
v) Recognizing opportunities for compassion including nonverbal emotional cues and responding to these opportunities through touch, verbal statements of validation, and normalization (e.g., *"This must have been hard for you", "It is common to feel this way"*)
vi) Verbal statements of assurance that the individual has the full attention and support of the clinician who will work with them to achieve their goals (e.g., *"I'm here for you, let's work together"*)

Curious communication

Person-centered care provides individuals with information about the osteoarthritis experience in a way that makes sense to them, does not heighten distress, and is tailored to their informational needs.[35]

According to health belief theory, individuals try to make sense of health symptoms by drawing on a set of beliefs about how the body functions in a given context.[41] This belief set is comprised of beliefs about what the symptom is (*identity beliefs*); what causes it (*causal beliefs*); what the consequences will be (*consequence beliefs*); how controllable it is (*control beliefs*); and how long it will last (*timeline beliefs*). How people make sense of their symptoms informs how they respond to the symptoms, including what actions they take. An example of common sense making among people with osteoarthritis is presented in Fig. 1.5.

Widespread myths about osteoarthritis have been documented in a number of clinical and nonclinical settings.[43] These myths can contribute to low uptake of best evidence care[50] and heighten the burden of disease by catalyzing a downward spiral of disability and distress.[51] Common myths include:

Myth 1: *Pain is always a sign of damage.* People of all ages, both with and without pain in geographically diverse settings, consistently believe that pain signals a damaged body part that needs to be healed or fixed.[37,43,52] These beliefs are deep-seated in society, children from an early age learn that pain is an alarm system that protects us from actual or potential threat.[43,53] However, pain can also occur in the absence of nociception or injury and becomes unhelpful when it persists beyond normal tissue healing times and prevents people from engaging in valued life activities.[46,54]

Myth 2: *I need an X-ray to see inside the joint.* People commonly perceive there is a linear pathway from diagnosis to treatment to resolution of symptoms and believe that imaging is necessary to enter this pathway.[55,56] However, findings on imaging are poorly associated with the pain experience[57] and the inappropriate use of imaging can lead to unnecessary downstream investigations and invasive treatments, including surgery.[58] Further, while people seeking care and clinicians

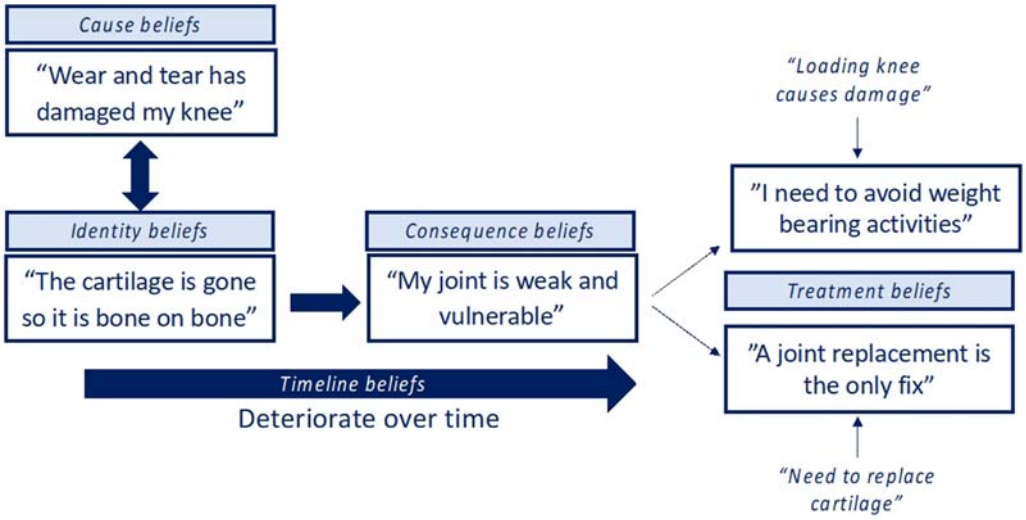

FIGURE 1.5 Common sense making among people with osteoarthritis.

often resort to imaging for fear of missing serious underlying pathology, the misinterpretation of results (such as interpreting normal age-related changes as pathological) may lead people to catastrophize about the meaning of pain and fear for the future.[59]

Myth 3: *Pain only gets worse over time.* It is common for people to believe osteoarthritis is a degenerative disease that follows a downward trajectory and will only get worse with aging over time. However, multiple trajectories of osteoarthritis exist, including trajectories of stability and also of recovery,[26,60] with evidence that these trajectories can be positively influenced by nonsurgical interventions.[61–63]

Myth 4: *Weight-bearing damages your joints.* Once evidence of structural changes in the joint has been observed, people commonly perceive their joints as vulnerable to damage and will avoid weight bearing activities to prevent (further) harm. However, weight bearing is safe for people with osteoarthritis and appropriately dosed exercise provides mechanical loading that is essential in maintaining a healthy joint.[64]

Myth 5: *A joint replacement down the track is inevitable.* People commonly believe that there is little they themselves can do to "fix" a "worn out" joint other than to prevent further damage until it can be surgically replaced. The dependence on biomedical interventions focused on ameliorating diseased tissue can lead to feelings of helplessness.[37,65] However, by addressing the modifiable biopsychosocial factors that contribute to the experience of osteoarthritis (e.g., level of physical activity, muscle strength, diet, sleep), people can be empowered to get control over their symptoms and in many cases, can avoid the need for surgery.[61,63]

Curious communication involves uncovering misconceptions or gaps in understanding that drive unhelpful behavioral and emotional responses by asking people questions about the specific beliefs they hold[50,51] (see Table 1.1). It is important to recognize that some people may hold implicit beliefs that may only be revealed through exposure to certain behaviors (postures, movement, or activity). Guided behavioral experiments may be a useful adjunct to the clinical interview (for further detail, readers are directed to Caneiro et al. 2020[53]). Questions should also explore individuals' expectations, goals, and values.

Once any misconceptions/gaps in understanding have been identified, they can then be filled with a diagnostic explanation that addresses each belief dimension and is clearly linked to an action that empowers individuals toward their goals (see Table 1.1). This explanation should avoid diagnostic terms that have been shown to have unintended meanings to people seeking care[43,66] including 'degeneration' ("*I will end up in a wheelchair*"), 'wear and tear' ("*I need to limit weight bearing*"), and 'bone on bone' ("*I need a joint replacement").* This process of providing people with a new understanding of their situation uses an individuals' own story and words to explain how multidimensional factors (e.g., level of physical activity, muscle strength, diet, sleep) set up a vicious cycle of pain, distress, and disability.[34] This cycle then acts as a barrier to achieving valued goals. During this process, clinicians can adopt motivational interviewing techniques[67] and empowerment language (see Collaborative communication below) to encourage individuals to reflect on what they could do to break this vicious cycle and achieve their goals. The clinician can then collaborate with the individual to prioritize goals and set clear and realistic strategies to achieve them.

The provision of information should be tailored to the individual for content and delivery.[68] In Europe, North America, and Australia, over half of the population has inadequate and problematic health literacy skills.[69–71] Individuals with lower health literacy, from culturally and linguistically diverse backgrounds, and/or lower socioeconomic backgrounds are more likely to experience osteoarthritis and experience a higher burden of disease.[72,73] The 'check, chunk, check' rubric can help tailor communication to individuals' levels of understanding;[40,74] *Check:* the individuals' understanding, cognitive capacity, linguistic skill, and desire to know more. *Chunk:* information in appropriately sized packages, using visual aids, metaphors, and written information as appropriate. *Check:* the individual can be asked to 'teach back' to the clinician what they have heard to check understanding. To facilitate the learning process, people can be directed to evidence-based online resources (e.g., https://www.jointaction.info; https//www.myjointpain.org.au/; https://www.versusarthritis.org/about-arthritis/conditions/osteoarthritis).

Critical communication

Critical communication requires clinicians to reflect on the way they think and talk about osteoarthritis and how this may impact the person seeking care. There is evidence that a minority of clinicians continue to explicitly endorse myths about osteoarthritis[75] and that this may influence their treatment recommendations. For example, some surgeons may offer joint replacement to relieve suffering as they perceive a lack of nonsurgical care options for osteoarthritis[76] The experience of receiving conflicting information about how to manage osteoarthritis is common and can lead to confusion and distress.[77] While most clinicians do not explicitly endorse myths, some may inadvertently perpetuate them through the discourses they use to talk about osteoarthritis.

TABLE 1.1 Making sense of osteoarthritis.

Belief dimensions	How does this person make sense of their situation?	Example diagnostic explanation
Identity	What do you think is going on in your body? What have you been told is going on?	"Joint changes observed on imaging are common among pain-free people. This means that other factors are also important in explaining the symptoms you are experiencing.
Causal	What is your understanding of the cause of your symptoms?	Many of these factors are things that you can have control over such as strength, flexibility, body weight, sleep and also your mood.
Consequence	What do you think the symptoms mean? What do you do when you feel the symptoms? How does this impact on your ability to do the things that are important to you?	It is common for people to avoid doing certain activities when they feel their symptoms. However, being active is really important. Graduated weight bearing exercise is not only safe for people with osteoarthritis; it is necessary for the health of your joint and for your own general health.
Control	How much control do you have over your symptoms? What do you think it will take to gain control?	Building your confidence to move, becoming strong and active can improve your symptoms. It can also reduce the need for surgery.
Timeline Goals & values	How do you see yourself in the future? What are your goals? What do you need to achieve them?	Let's work together on a plan to address the factors that you can have control over and support you to do the activities you enjoy, so that you can be healthy and active into the future."

Clinicians who use an impairment discourse can reinforce unhelpful beliefs about physical activity, imaging, and passive interventions.[43] An impairment discourse is characterized by mechanical analogies in which unhealthy joints are likened to "un-oiled engines" or "worn out brake pads" in a car. As "machines," joints are perceived to "wear out" and "break down" over time and are considered unsafe to use beyond their "used by date." The perception that all joints have a "used by date" suggests that osteoarthritis is a normal part of aging and an experience that people should not complain about, but learn to "put up with" until severe enough for an expert "mechanic" to pull out the worn out part and replace it with a new one.[43] The impairment discourse focuses on what people can't do because of osteoarthritis and prioritizes amelioration of disease as the primary health outcome.

An alternative to this way of talking is a participatory discourse.[43] According to a participatory discourse, "participation" (involvement in valued life activities) is the ultimate health outcome, rather than the absence of disease. Healthy joints are those that enable people to "participate" (be involved in) valued life activities and therefore, joints can be "healthy" regardless of signs and symptoms of osteoarthritis. A participatory discourse draws on the language of empowerment (see "Collaborative communication" below) and shifts the focus away from what an individual can't do *because of* osteoarthritis to how individuals can be supported to live active, engaged lives *with* osteoarthritis (see Fig. 1.6).

Beyond reflecting on how one thinks and talks about osteoarthritis, critical communication involves reflecting on how one thinks and talks about people experiencing osteoarthritis and considering any stereotypes one may hold toward people seeking care. This may include, for example, people suffering from comorbid mental health conditions, chronic pain conditions, or who may be overweight. Weight stigma in particular can be common among clinicians.[78] This can manifest through the explicit stereotyping of individuals who are overweight as lazy and difficult to treat, the primary emphasis on diet, and lack of exercise as the main causes of overweight, or more implicitly through lack of confidence working with people who are overweight.[79] Individuals seeking care who perceive weight stigma may disengage from care and experience poor physical and psychological outcomes.[80] To address weight stigma, clinicians need to be aware of the issue of weight stigma, portray an understanding of the complex determinants of weight, neither ignore nor overemphasize discussions about weight, and engage in compassionate and collaborative communication strategies.[81]

Collaborative communication

Individuals who have agency over their own decisions and actions have better health outcomes than those who are dependent on others for decision-making and engage in passive treatments.[82] Collaborative communication positions the individual seeking care as an expert in their own experience and positions the clinician as a "coach" who collaborates with the individual and their family to ensure they have the resources and capacity needed to navigate the health journey.[43,83] This can be facilitated by harnessing the language of empowerment.

While clinicians commonly use the language of "help," this may reinforce the "helpee's" image of themselves as deficient and dependent on others to "fix" them.[84] Therefore, in place of "how can I help you?" clinicians can adjust their

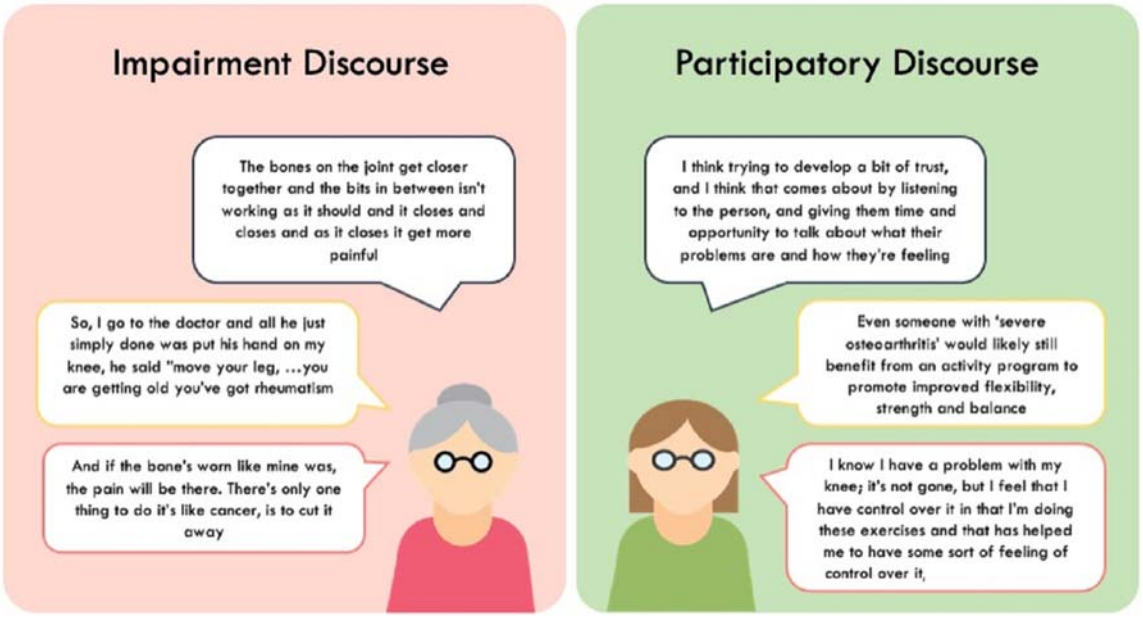

FIGURE 1.6 Osteoarthritis discourses.

language to empower individuals as capable of self-directing e.g., "What is your goal for today?', "What concerns would you like to address today?" It is common for people with osteoarthritis to perceive that they lack control over their symptoms, disease course, and/or treatment, and this can be reflected in the language they use.[43] Individuals may refer to their bodies and pain in the third person, using phrases such as "the knee" and "it."[43] To encourage ownership and agency, clinicians may explicitly ask individuals to make "I" and "my" statements such as "my knee" and take opportunities to attribute feelings and actions directly to the individual by adopting an active instead of passive voice (e.g., "How do you feel about that?" rather than "How does that make you feel?"[84] All individuals have strengths, capacities, and resources. Rather than focusing on what individuals can't do, e.g., "What activities do you have difficulty with?", clinicians can adjust their language to empower individuals' sense of self as competent and resourceful by focusing on what people are able to do, without denying that problems exist.[84] For example, clinicians may ask: "When are there times you are feeling a little less pain than usual?"; "Your situation sounds overwhelming, how do you cope with it? How are you able to keep doing the things that are important to you?"

Person-centered care involves working together with individuals to set personally relevant goals that are consistent with best evidence care and developing a realistic plan to achieve them. When establishing goals, clinicians can encourage individuals to identify enablers that may assist them in carrying out agreed tasks within an agreed time frame.[85] In order to act on the management plan and sustain action over time, individuals need to be ready to take action, think the actions are important enough to do, have confidence to do them, and have sufficient knowledge about what they are trying to do and why.[85] In their role as "coach," it is the clinician's responsibility to actively assess, build, and reinforce readiness, importance, confidence, and knowledge throughout the planning and action process. This may be done through reflective and motivational questioning e.g., "What do you understand about how being active can benefit you? How confident are you in becoming active and strong? What would encourage you to become more active?" Equipping individuals with the skills they need to implement the action plan, including strategies to manage their symptoms, is important. This can be facilitated through coaching individuals over time to progress gradually according to their goals, level of conditioning, and perceived control over their symptoms.[53] Involving family and friends in developing and implementing the action plan may support sustained behavior change.[86]

What are additional considerations in the uptake of best practice osteoarthritis care?

A number of barriers exist to participation in best practice osteoarthritis care. A common criticism is that person-centered care is time-consuming and thus not cost-effective. However, person-centered care elicits care seeker's concerns more quickly, avoids unwarranted imaging and costly invasive interventions, and improves treatment adherence, therefore proving more cost-effective in the long term.[87]

Around the world, common system-level barriers to uptake include referral pathways that make it easier to refer to surgical than nonsurgical care, inappropriate funding models including limited reimbursement for best evidence care, and long wait times for specialist or allied health appointments.[88–90] These factors limit access to care and disproportionately affect those who are already disadvantaged, such as those living outside of urban areas, from culturally and linguistically diverse backgrounds and/or with limited financial resources.[88] To address these barriers, system strengthening through the development and implementation of national health policy focused on osteoarthritis and aligned with population health needs is recommended.[91]

At a service level, there is a lack of appropriate resources to support best practice care delivery.[88] This includes culturally appropriate self-management materials related to healthy diet, weight loss, pain management, and exercise. Among Indigenous peoples around the world, osteoarthritis remains an unmet health need.[92] With a higher risk factor profile for chronic disease, Indigenous peoples are more likely to experience osteoarthritis and experience a higher burden of disease; but are less likely to seek care for it than non-Indigenous peoples.[72,93] In Australia, Indigenous people continue to report feeling unsafe, experiencing racism, and having difficulties understanding or being understood by clinicians.[94,95] Working together with Indigenous leaders and communities to design and implement culturally appropriate osteoarthritis care is a priority to improve access to best practice care and health outcomes for Indigenous peoples.

Concluding remarks

Osteoarthritis is a common health condition associated with substantial individual and societal burden. Clinicians can play a critical role in reducing individual and societal burden by improving participation in best practice care. Adopting a

person-centered care approach founded on effective communication, clinicians can support people to gain control over their symptoms and go on to live healthy lives with osteoarthritis.

Key points

- It is a common misconception for people to believe that osteoarthritis is a 'wear and tear' disease associated with pain and disability that inevitably worsen over time.
- In fact, osteoarthritis-related pain and disability are influenced by modifiable biopsychosocial factors.
- Osteoarthritis is a complex disease affecting all structures within and around the joint.
- People with osteoarthritis can be empowered with the knowledge, skills, and resources they need to get control over their symptoms and participate in the activities they value.
- The 4Cs Communication Framework can be applied to empower people seeking care through compassionate, curious, collaborative, and critical communication.

Multi-choice questions

Which of the following is true about osteoarthritis?

A. Pain and disability always get worse with aging, over time
B. Pain is a sign that damage is occurring in the joint
C. Exercise is beneficial for joint structures
D. A joint replacement is needed to resolve pain and disability

A participatory discourse is characterized by:

A. Mechanical analogies that liken joints to machine parts
B. The amelioration of disease as the ultimate outcome
C. A focus on what is preventing people from participating in valued activities
D. A focus on what people can do to live engaged lives with osteoarthritis

An example of empowering language is:

A. "How can I help you today?"
B. "It sounds like the joint has been painful this week"
C. "What are you having difficulty with?"
D. "How are you able to keep doing the things that are important to you?"

Uptake of best evidence care would be improved by:

A. The implementation of culturally appropriate health services and resources
B. Better funding models for surgical care
C. Earlier referrals for imaging
D. Increasing the number of clinicians working in osteoarthritis care

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Chapter 2

Module 2: history taking and physical assessment

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Brief introduction to the chapter

This chapter comprises two sections. History taking focuses on history taking, including the art of communication in medical history taking and the core components that are required to undertake holistic history taking. Physical assessment focuses on the physical assessment, including how to prepare for and systematically undertake the physical assessment. Suggested content of the physical examination for three joints commonly affected by osteoarthritis are provided, namely the knee, hip, and hand.

History taking

Introduction

Medical history taking has been described as "the most powerful, sensitive and versatile instrument available to health care professionals.".[1,] It is crucial for accurate diagnosis of osteoarthritis, ruling out serious underlying medical conditions, and identifying problems that people are experiencing because of their symptoms, including their ability to participate in society, and to enjoy a reasonable quality of life.[1] Obtaining a full holistic medical history through a biopsychosocial perspective,[2,3] backed up by clinical examination findings, is therefore a prerequisite for sound clinical decision-making and tailoring of treatment according to mutually agreed goals. Good communication skills are key to successful history taking. This includes both verbal and nonverbal communication with the individual, but also in terms of written communication with regard to clear, accurate, and concise note taking.

Within this chapter, the art of communication in medical history taking, including the types of questions to ask, the importance of listening, and probing will be summarized. Core components of holistic history taking will then be addressed, including origin and onset of the condition, pain and other symptoms, the role of comorbidities, and the impact of the condition on the individual's life. Use of screening for "red flags" to rule out serious pathology will be summarized, as will the use of recognized person reported outcome measures, and key elements of written documentation and note taking. A case example will be provided showing the type of information that might be obtained from medical history of an individual presenting with possible osteoarthritis.

The importance of communication in eliciting accurate information

Communication is critical to successful history taking. Adopting a clinician-centered approach, where the healthcare professional leads the interview with a series of closed-ended questions, is likely to be limited in terms of the amount and detail of information obtained.[4] A person-centered approach, involving person-led conversation and the individual answering questions based on their knowledge, feelings, and understanding is therefore optimal.[5] Numerous techniques can be embedded within a person-centered medical interview to elicit detailed and rich information, including:

Osteoarthritis Health Professional Training Manual. https://doi.org/10.1016/B978-0-323-99269-5.00008-6

TABLE 2.1 Techniques that can be employed with person-centered communication.[1]

Technique	What it involves	Example
Active listening	Active listening is a dynamic process that involves hearing what is said *as well as* processing, interpreting, and understanding the message. The healthcare professional consciously chooses to give the individual attention, free from external interruptions (e.g., ringing telephone) and internal distractions (e.g., biases, prejudices, judgment).	You ask an individual about their level of physical activity, which is low. As they explain why undertaking activity is difficult, you hear what is said but interpret it as excuses, not reasons to address. Overcome this internal distraction by being present in the moment without focusing on your preconceived ideas.
Empathy	Empathy involves intellectually identifying with the feeling, thoughts, or attitudes of another individual. Expressing empathy allows the individual to feel understood. Empathy can be expressed in several ways, including head nodding, making a statement, asking a follow-up question.	"I know from personal experience that experiencing pain for a long time can be very frustrating. How are you feeling?"
Building rapport	Building good rapport allows the individual to feel comfortable, helping to make communication more open and honest. Making appropriate introductions, interacting respectfully with the individual, and making the individual feel comfortable will help to build rapport.	"Hello Mrs Jones, my name is Emma Farman. I am your physiotherapist, and it is my job to help to look after your joint problem. To start with, I would like to ask you a few questions about your problem and what has brought you to physiotherapy. Is that OK?"
Open-ended questions	Open-ended questions require more than a simple "yes" or "no" answer. They enable the individual to describe their symptoms and experiences in detail, in their own words.	"What symptoms are you currently experiencing?" (in contrast to a closed-ended question "have you got any symptoms at the moment?")
Closed-ended probing questions	Closed-ended probing questions can have a role in eliciting specific information and to further explore or confirm specifics of a response following an open-ended question.	After asking the open-ended question "what symptoms are you currently experiencing?" and hearing the response "the front of my knee is painful," an appropriate closed-ended question might be "is the pain over your kneecap?"
Avoid leading questions	Leading questions can suggest a specific answer. They can lead the individual to provide a response that he/she thinks the health care professional wants to hear. Leading questions should be avoided.	"You do take your pain medication before you go to bed, don't you?" the individual might feel obliged to say "yes I do" even if they are not, because the question implies that they should be.
Avoid "why" questions	Avoiding "why" questions may prevent the individual feeling like they need to defend their responses. Although it may be necessary to understand the reasoning behind an individual's thoughts/actions, the wording used to elicit this information might influence their response.	Instead of asking "why do you think you need a joint replacement?" you might ask "what causes you to think you need a joint replacement?" they "what" allows the individual to reflect on their reasoning without feeling you are offering judgment.
Silence	Allowing a moment of silence after a question lets the individual reflect on the question to provide a more thoughtful, accurate response. However, silence may also indicate lack of understanding of the question; nonverbal clues will help determine the difference.	
Nonverbal communication	Nonverbal communication is the sending of messages between the health care professional and the individual without using words. It is a powerful communication method and can include: tone of voice, facial expressions, body posture and position, gestures, eye contact, appearance, overall behavior.	

- Active listening
- Empathy
- Building rapport
- Open-ended questions
- Closed-ended probing questions
- Avoiding leading questions
- Avoiding "why" questions
- Silence
- Nonverbal communication

These are summarized, with examples, in Table 2.1. A more detailed overview can be found elsewhere.[5]

A holistic approach to history taking

A holistic approach to history taking focuses on an individual's overall wellness, not just their presenting condition. Every individual will have a different experience of pain that is influenced by many factors, including other health conditions they have, their identity, knowledge, life experiences, and beliefs. Comprehensive holistic history taking is essential to establish the foundation on which a personalized management plan can be built and to optimize engagement and adherence in long term. The communication techniques outlined above are key to eliciting rich information in a holistic history assessment. Fig. 2.1 outlines key components of a holistic assessment of an individual with possible osteoarthritis, and these components are detailed below.

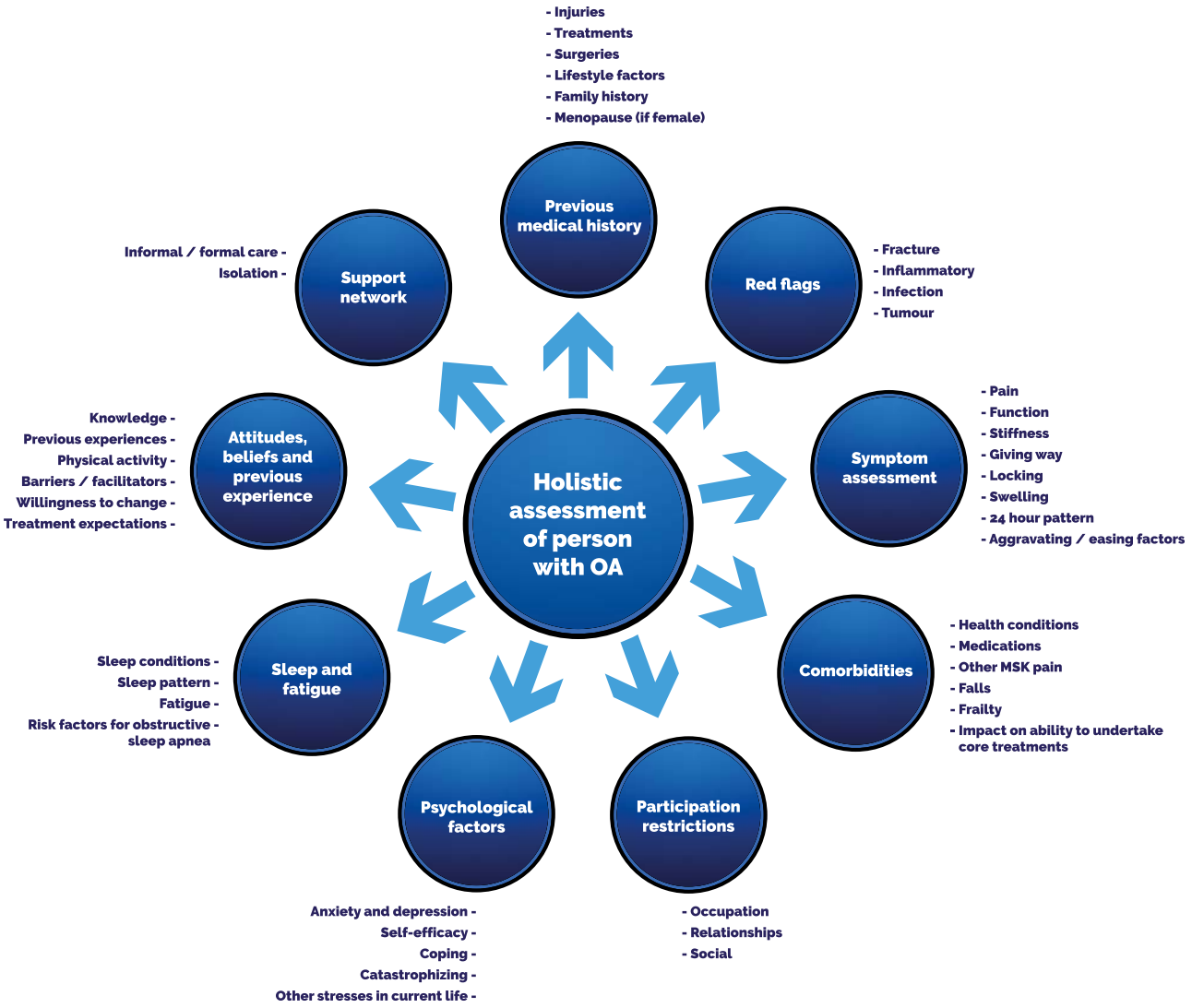


FIGURE 2.1 Key components of a holistic assessment of a person with possible osteoarthritis.

Symptom assessment

Before exploring specific symptoms in detail, it is helpful to ask the individual what their main symptoms are, how long they have experienced symptoms for, and how their symptoms have changed over the course of their condition. Asking what they think is the cause of their symptoms and what the future holds for their condition can give valuable insight.

- Pain
  - Location. Where does the individual experience pain? Use of a body chart is helpful. Is the pain local, radiating, adjacent to the joint or generalized?
  - Type. The character of the pain is important. Ask the individual to describe the pain in their own words. Commonly used descriptors are sharp, deep, achy, burning, stabbing. Is there associated numbness or tingling (may indicate nerve involvement)?
  - Use of analgesics. What analgesics do they take, how frequently, and what time of the day do they take them? Ask about both current and previous analgesic use, and the effect of these.
- Function
  - How is the individual's day to day functioning impacted? Asking the individual to describe a typical day can be a useful way of gaining detail.
  - Use of person-reported outcomes (detailed below) provides additional information about the impact on physical function.
- Stiffness. Do they experience joint stiffness? How long does this last? Osteoarthritis tends to cause localized stiffness (lasting <30 min), which can recur after sitting/lying.
- Giving way. Do they experience joint/s giving way—if so, how often does this occur; are there factors that precede this occurring? Do they fall as a consequence?
- Locking. Do they experience joint/s locking—if so, how often does this occur; are there factors that precede this occurring?
- Swelling. Does the affected joint swell? Are there factors preceding this; how long does it last?
- 24-hour pattern. What is the course of their symptoms over day and night?
- Aggravating/easing factors. Identifying what makes symptoms worse (and which symptoms are impacted), and what helps is important to guide management. Probe to identify internal and external aggravating and easing factors.

Participation restrictions

Understanding the impact of the presenting condition on the individual's participation in all aspects of their life is crucial. Questioning around the things a person would like to do, but is currently unable to, may pinpoint goals for management.

- Occupation
  - Current ability to perform their job. Is the individual's ability to perform all aspects of their job currently impacted by their presenting condition, if so how? Does this impact work relationships?
  - Long-term ability to perform their job. It is also important to consider the individual's long-term ability to perform their job—do they foresee difficulties in continuing to perform all parts of their job? What are these potential difficulties? Are there potential alternatives or adaptions that can be made within their job?
- Relationships. In addition to the impact of the presenting condition on work relationships, it is important to consider the impact on their personal (family, friends) relationships, including sexual relationships.
- Social. Enquire about the individual's social roles, do they provide care to anyone? What are their hobbies, sport, volunteer work, community involvement (including participation in religion or faith practices)?

Previous medical history

Exploring the individual's medical history provides essential information.

- Injuries. What injuries have they experienced? What was their experience of recovery from these injuries?
- Treatments. What treatments have they had for their presenting condition or other musculoskeletal pain or health conditions? What was their experience of these treatments?
- Surgeries. Have they had any surgeries; what were these for? What was their experience of surgery and recovery?

- Lifestyle factors. What are their current/previous drinking, smoking, and dietary habits?
- Family history. Do they have a family history of osteoarthritis? If so, which joints were affected?
- Menopause (if female). Are they premenopausal, menopausal, or postmenopausal? If they are postmenopausal, when did menopause occur? Have their joint symptoms changed during or after menopause?

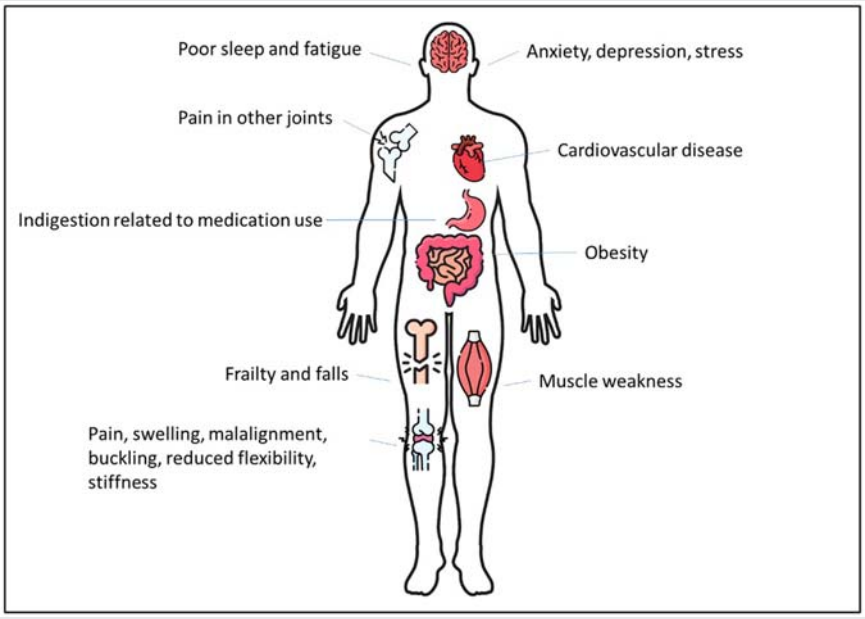
Comorbidities

People with osteoarthritis commonly have comorbidities, and these can significantly impact on symptoms and management.[6] Ascertaining a complete picture of the individual's health is crucial to best management (Box 2.1).

Common comorbidities that present with osteoarthritis include obesity, Type 2 diabetes, hypertension, cardiovascular disease, depression, and other sites of chronic musculoskeletal pain such as the lower back. The presence of comorbidities impacts management, particularly with respect to pharmacological therapy. Nonpharmacologic interventions may need to be adjusted or adapted for comorbidities, but it is worth noting that core management interventions such as exercise and weight loss can be very beneficial for several other comorbidities as well.

- Health conditions. Where possible check medical records for diagnosed health conditions. Ask about their additional conditions that are commonly not raised (e.g., hearing, vision, incontinence) that should be considered in treatments.
- Medications. What medications do they currently take? Do they experience any side effects from the medications?
- Other musculoskeletal pain. Does the individual experience other musculoskeletal pain? Use of a body chart is helpful. How long has this pain been present; ask them to describe each painful area; how does any other musculoskeletal pain impact on their function and participation?
- Falls. Has the individual had any falls in the past 12 months? Details of any falls and injuries sustained as a result.
- Frailty. Using a combination of physical (e.g., walking speed; timed up and go test − see Physical assessment) and subjective findings (e.g., PRISMA 7 Questionnaire[7]; Tilburg Frailty Index[8]) to identify frailty is recommended.
- Impact on ability to undertake core treatments.

BOX 2.1 Common comorbidities that can present alongside osteoarthritis related symptoms, representing the whole person with osteoarthritis. The above box is missing. This needs to be added within this sub section on comorbidities.



Psychological factors

Psychological factors can have a significant impact on an individual's experience of osteoarthritis and must be considered carefully when designing a management plan.

People with osteoarthritis commonly report symptoms of anxiety and/or depression, and these conditions are often undiagnosed.[9] Assessing for mood disorders is important to consider in management, as an individual may require additional input or adaptions to treatments.

- Anxiety and depression.
  - Asking how the individual would describe their general mood, and whether they have experienced/currently experience symptoms of anxiety or depression is a good starting point.
  - Use of validated person-reported outcome measures is recommended to identify anxiety and/or depression. Measures such as the Center for Epidemiological Studies Depression Scale (CES-D),[10] Hospital Anxiety and Depression Score (HADS)[11] or the Patient Health Questionnaire-9 (PHQ)[12], and the Depression, Anxiety and Stress Scale (DASS-21)[13] are valid and reliable.
- Self-efficacy. A person's belief in their capacity to manage osteoarthritis has been associated with better treatment outcomes.[14] Asking "How confident are you that you can make this change?" rated on a scale of 0 (Not at all) to 10 (Essential) can give an indication. Longer person-reported outcomes can be used for a detailed assessment of self-efficacy.
- Coping. How an individual copes with pain can significantly impact on management. Use of a validated questionnaire such as the Coping Strategies Questionnaire (CSQ)[15] enables identification of coping responses. One coping response of particular importance is catastrophizing.
- Catastrophizing. Does the individual feel that they cannot stop thinking about their pain? Do they magnify their pain? Do they feel helpless about their pain? The Pain Catastrophizing Scale (PCS)[16] is a valid questionnaire to assess catastrophizing.
- Other stresses in current life. Asking about other causes of stress in the individual's current life, and how any stresses impact on their presenting condition can highlight barriers to engagement with treatment.

Sleep and fatigue

Osteoarthritis has been significantly associated with sleep disturbances, and these are commonly missed by health practitioners.[17] Poor sleep and fatigue issues are associated with worsening health, so identifying them during assessment is important to enable management to be tailored appropriately.

- Sleep conditions. Does the individual have any preexisting sleep conditions (e.g., insomnia or obstructive sleep apnea).
- Sleep pattern. What is the individual's usual sleep pattern? Has this been impacted by their presenting condition and how; how long has this been happening? Can they lie on the affected side? Disrupted sleep may be an indicator of severity and irritability of osteoarthritis, or may be preexisting or concomitant insomnia.
- Fatigue. Does the individual experience an overall feeling of tiredness or lack of energy? What has been their experience of this; how long has this been happening; how does it impact on daily life; do they notice exacerbating factors; how do they manage fatigue?
- Risk factors for obstructive sleep apnea. If the individual reports unexplained sleep disruption, do they have risk factors for obstructive sleep apnea: overweight, older age, hypertension, smoking, chronic nasal congestion, Type 2 diabetes.

Support network

Gaining insight to the individual's social network can be important in planning management and identifying barriers to engagement with best evidence care.

- Informal/formal care. Does the individual receive care, and what does this care include? Who provides the care? Is the care informal (unpaid) or formal (paid)?
- Isolation. Does the individual feel socially isolated? Asking about their social network and contacts, and whether they wish to be more socially connected can lead to treatment tailoring and goal identification.

Attitudes and beliefs

Attitudes, beliefs, and previous experiences may act as a driver or barrier to participation in management. Before setting a treatment plan and goals, it is important to understand the individual's status.

- Knowledge. What does the individual know and believe about their condition, prognosis, treatments?
- Previous experience. What treatments has the individual previously had? What was their experience of these treatments; what did they find helpful/not?
- Physical activity. What is the individual's current physical activity level? Has their physical activity been impacted by their condition? For how long?
- Barriers and facilitators. Asking about factors that may help or hinder participation in core treatments allows tailoring to maximize engagement and adherence.
- Willingness to change. Gauging an individual's willingness to change is important before starting management planning. Asking "How important is it to you to make this change?" rated on a scale of 0 (Not at all) to 10 (Essential) can give an indication.
- Treatment expectations. What are the individual's expectations of treatment (content)? What are they hoping and/or expecting to gain from treatment (outcomes)?

Screening for red flags

An essential component of history taking is screening for serious pathologies (known as red flags). Table 2.2 outlines indications for serious pathologies that should be ruled out when assessing an individual presenting with possible osteoarthritis.[18] Identification of suspected red flags must prompt further investigation as appropriate.

Use of recognized person reported outcome measures

Recognized person-reported outcome measures should be used in conjunction with the oral subjective history. Person-reported outcome measures provide important individual perspectives and are essential to gauge baseline levels and monitor treatment effectiveness.[19]

Outcome measures must be valid, reliable, and responsive and should be easy to administer, quick to complete, affordable and provide relevant information. Core sets of outcome measures have been recommended for use with individuals with osteoarthritis. Joint pain, function and health-related quality of life, and work status have been identified as

TABLE 2.2 Indications for serious pathologies.

Serious pathology	Examples	Indications
Infection	Septic arthritis Osteomyelitis	Redness, swelling, heat Fever, sweats, chills History of immunosuppression Difficulty weight-bearing.
Inflammatory	Rheumatoid arthritis Polymyalgia Rheumatica Crystal arthritis e.g., gout	Pain that worsens at rest Persistent joint swelling and tenderness Joint warmth and/or erythema Morning stiffness $\geq$30 min Unexplained weight loss
Fracture	Osteoporotic fracture Traumatic fracture	Sudden onset of pain Incidence of trauma History of osteoporotic fracture
Tumor	Bone tumor Soft-tissue sarcoma Metastases	Persistent, nonmechanical bone pain Pain that worsens at night or at rest History of cancer Unexplained weight loss Severe, unremitting nonmechanical pain Severe fatigue

TABLE 2.3 Examples of person-reported outcome measures for pain, function, and health-related quality of life.

Outcome domain	Examples of recognized person reported outcome measures	Tips for using the measures
Joint pain	Numerical rating scale (NRS)	* It is important to specify either the global or specific nature of the question (e.g., while walking, at rest, average, worst). * Clearly indicate the time period over which pain is being assessed (e.g., previous 48 h, past 1 week).
	Visual analogue scale (VAS)	
	Likert scale	
	Intermittent and constant pain score (ICOAP)[22]	
	Pain subscales within multidimensional health status instruments:	
	Western Ontario and McMaster (WOMAC)	
	Osteoarthritis Index[23]	
	Hip or Knee disability and osteoarthritis outcome score (HOOS/KOOS)[24,25]	
	Arthritis Impact measurement scales (AIMS)[26]	
	Lequesne index[27]	
Functional capacity	WOMAC osteoarthritis index[23]	* When interpreting functional measures consider whether the questions are asking if the respondent 'does do' an activity or whether they 'could do' the activity.
	Michigan hand outcomes questionnaire[28]	
	Hip or Knee disability and osteoarthritis outcome score (HOOS/KOOS)[24,25]	
	Lequesne index[27]	
Health-related quality of life	European health-related quality of life measures (EuroQol) (e.g., EQ-5D-5L)[29]	
	Short Form-36 health survey (SF-36)[30]	

the core domains that should be measured.[20,21] Table 2.3 outlines examples of outcome measures for each of these domains, and tips for applying these measures clinically.

Many outcome measures are protected by copyright and/or trademark, and this should be checked before use. The link below provides access to several recommended osteoarthritis measures:

https://oarsi.org/research/outcome-measures.

Goal setting

Information gathered during the holistic subjective assessment provides important insight for discussion with the individual about what they want to achieve and to set goals. Goal setting is well established as an effective way of changing behavior.[31]

Use of a structured framework for goal setting, such as SMART goals, ensures that the important aspects of each goal are considered. SMART stands for specific, measurable, achievable, relevant, and time-bound.[32]

Asking questions such as these are helpful to guide setting SMART goals:

- Specific: What do you want to achieve? Why is it important to you? When, where, and with whom?
- Measurable: How will you know when you have reached your goal?
- Achievable: Is your goal realistic, based on your presenting condition, and all other aspects of your life currently?
- Relevant: Is this important to you? Is this a good time for you to set this goal? Who do you want to support you in this goal?
- Time-bound: When do you want to reach your goal by?

Goal setting tips:

- For goals to be effective, they must be important to the individual.
- Set both short and longer-term goals. Larger long-term goals can often be broken down into smaller, shorter-term steps.
- Revisit goals regularly and change as appropriate.
- Encourage the individual to share their goals with family/friends and others involved in managing their health.

Key elements of documentation

An accurate record of medical history taking is important for several reasons:

- It forms an integral part of diagnosis and management.
- It contributes to the circulation of information among the different people involved in the individual's treatment or care.
- It is a legal requirement. Informed consent must be recorded, and each page of notes must be dated and signed.
- It provides proof of professional standards being met.

A systematic approach should be adopted to documentation to ensure all relevant information is recorded. Five key elements to keep in mind are:

- Accuracy. Notes should be completed during the consultation or as soon as possible afterward.
- Accessibility. The most clinically relevant information must be easy to find and immediately available. Handwritten notes must be legible.
- Completeness.
- Conciseness. Be brief and to the point.
- Consistency.

Use of a recording template that includes prompts, headings, and subheadings is recommended to organize information clearly. If a recording template is not used, subheadings in notes can help to ensure all relevant information is included. Box 2.2 outlines a case example of a comprehensive medical history recorded in a concise and clear template.

Summary

Comprehensive holistic history taking forms the foundation from which objective assessment can take place, an accurate diagnosis can be made, and a personalized management plan can be developed. Adopting the verbal and nonverbal communication techniques outlined in this section will enable clinicians to elicit accurate and rich information. Taking a systematic approach to subjective assessment and asking questions "beyond the joint" ensures information is a true reflection of the individual, and the impact that their presenting condition has on their life.

Physical assessment

Introduction

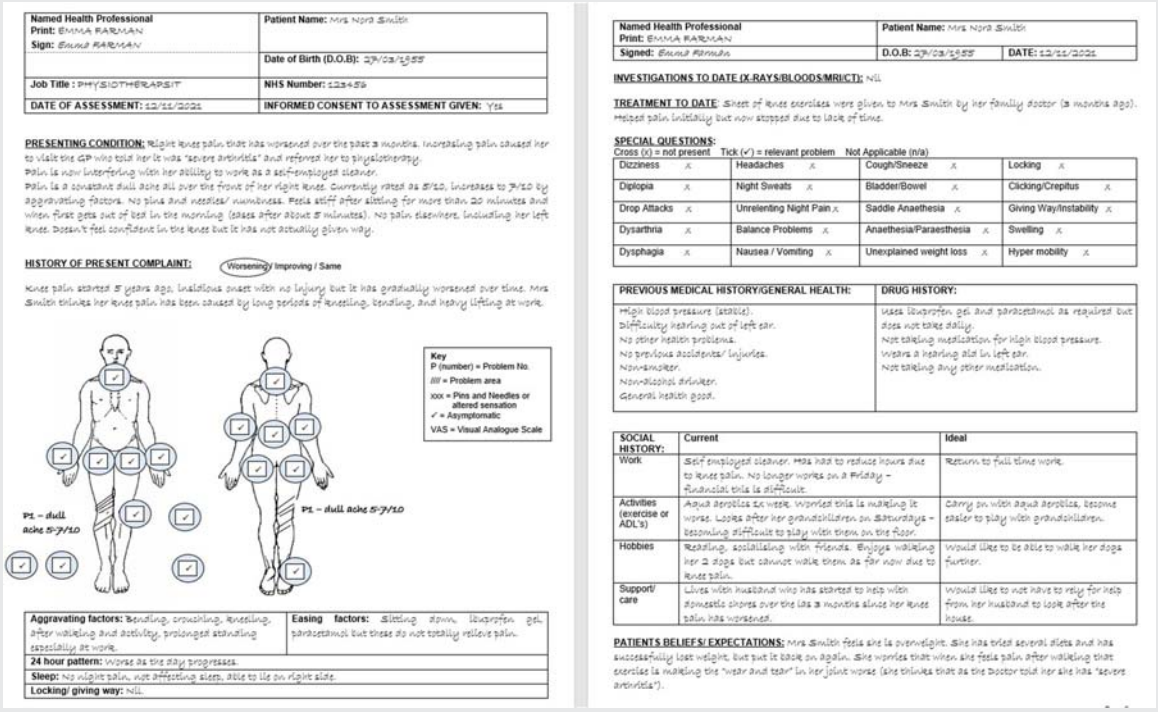
The physical assessment should be viewed as an extension of history taking to ensure accurate diagnosis (including ruling out serious pathology), problem identification, goal setting, and treatment planning. Clinical reasoning based on information from history taking and physical examination must be underpinned by solid knowledge of both anatomy and osteoarthritis. To ensure efficiency, consistency, and to determine the significance of an abnormal physical finding, a systematic approach should be adopted. In this section, how to prepare for and systematically undertake the physical assessment will be summarized. Suggested content of the physical examination for three joints commonly affected by osteoarthritis will be provided, namely the knee, hip, and hand.

Preparing for and undertaking the physical assessment

Before, and during, a physical assessment, the following steps are recommended[34,35]:

1. Gain verbal consent to complete the examination, and document this in the medical record.
2. Consider appropriate hand and plinth hygiene (before and after the assessment).
3. Explain to the individual what you are going to do and ask them to tell you if any aspect of the assessment causes pain, discomfort, or reproduces their symptoms.

BOX 2.2 Example of a comprehensive medical history recorded using a template.



Named Health Professional Print: EMMA FARMAN Sign: Emma Farman	Patient Name: Mrs Nora Smith
	Date of Birth (D.O.B): 29/03/1955
Job Title : PHYSIOTHERAPSIT	NHS Number: 123456
DATE OF ASSESSMENT: 12/11/2021	INFORMED CONSENT TO ASSESSMENT GIVEN: Yes

PRESENTING CONDITION: Right knee pain that has worsened over the past 3 months. Increasing pain caused her to visit the GP who told her it was "severe arthritis" and referred her to physiotherapy.
Pain is now interfering with her ability to work as a self-employed cleaner.
Pain is a constant dull ache all over the front of her right knee. Currently rated as 5/10, increases to 7/10 by aggravating factors. No pins and needles/ numbness. Feels stiff after sitting for more than 20 minutes and when first gets out of bed in the morning (eases after about 5 minutes). No pain elsewhere, including her left knee. Doesn't feel confident in the knee but it has not actually given way.

HISTORY OF PRESENT COMPLAINT: (Worsening) / Improving / Same

Knee pain started 5 years ago, insidious onset with no injury but it has gradually worsened over time. Mrs Smith thinks her knee pain has been caused by long periods of kneeling, bending, and heavy lifting at work.

Aggravating factors: Bending, crouching, kneeling, after walking and activity, prolonged standing especially at work.	Easing factors: Sitting down, ibuprofen gel, paracetamol but these do not totally relieve pain.
24 hour pattern: Worse as the day progresses.	
Sleep: No night pain, not affecting sleep, able to lie on right side.	
Locking/ giving way: Nil.	

Named Health Professional Print: EMMA FARMAN Signed: Emma Farman	Patient Name: Mrs Nora Smith D.O.B: 29/03/1955	DATE: 12/11/2021

INVESTIGATIONS TO DATE (X-RAYS/BLOODS/MRI/CT): Nil

TREATMENT TO DATE: Sheet of knee exercises were given to Mrs Smith by her family doctor (3 months ago). Helped pain initially but now stopped due to lack of time.

SPECIAL QUESTIONS:
Cross (x) = not present Tick (✓) = relevant problem Not Applicable (n/a)

Dizziness x	Headaches x	Cough/Sneeze x	Locking x
Diplopia x	Night Sweats x	Bladder/Bowel x	Clicking/Crepitus x
Drop Attacks x	Unrelenting Night Pain x	Saddle Anaethesia x	Giving Way/Instability x
Dysarthria x	Balance Problems x	Anaethesia/Paraesthesia x	Swelling x
Dysphagia x	Nausea / Vomiting x	Unexplained weight loss x	Hyper mobility x

PREVIOUS MEDICAL HISTORY/GENERAL HEALTH:	DRUG HISTORY:
High blood pressure (stable). Difficulty hearing out of left ear. No other health problems. No previous accidents/ injuries. Non-smoker. Non-alcohol drinker. General health good.	Uses ibuprofen gel and paracetamol as required but does not take daily. Not taking medication for high blood pressure. Wears a hearing aid in left ear. Not taking any other medication.

SOCIAL HISTORY:	Current	Ideal
Work	Self employed cleaner. Has had to reduce hours due to knee pain. No longer works on a Friday – financial this is difficult.	Return to full time work.
Activities (exercise or ADL's)	Aqua aerobics 1x week. Worried this is making it worse. Looks after her grandchildren on Saturdays – becoming difficult to play with them on the floor.	Carry on with aqua aerobics, become easier to play with grandchildren.
Hobbies	Reading, socialising with friends. Enjoys walking her 2 dogs but cannot walk them as far now due to knee pain.	Would like to be able to walk her dogs further.
Support/ care	Lives with husband who has started to help with domestic chores over the las 3 months since her knee pain has worsened.	Would like to not have to rely for help from her husband to look after the house.

PATIENTS BELIEFS/ EXPECTATIONS: Mrs Smith feels she is overweight. She has tried several diets and has successfully lost weight, but put it back on again. She worries that when she feels pain after walking that exercise is making the "wear and tear" in her joint worse (she thinks that as the Doctor told her she has "severe arthritis").

4. Ensure that the individual feels comfortable about being examined. This includes the clothing they wear and level of exposure. A good assessment relies on patient cooperation and their ability to relax their muscles, and the healthcare professional viewing and comparing joints and muscles.
5. Be aware and respectful of the individual's dignity, cultural/religious beliefs, and ability to cooperate. Adapt your assessment and instruction accordingly. This may include having a caregiver or interpreter present.
6. Consider the time you have available to perform the assessment. Appointment times can range between 10 and 60 min, focus your assessment accordingly.
7. As well as focusing on verbal information provided by the individual, also pay attention to nonverbal clues. Look for expressions of pain, which can include involuntary muscle movements about the eyes.
8. Use the individual's opposite (contralateral) side for comparisons: look for subtle differences and asymmetry.
9. Screen the joints above and below to rule out referred pain (e.g., assess the hip and ankle if an individual presents with knee pain).

Content of the physical examination

Irrespective of the joint being examined, the physical examination should include four broad components: **look** (general and local observation), **feel** (palpation), **move** (range of movement), and **measure** (range of movement assessment, muscle strength and length, function, neurological features, and special tests). These are described below.

Look

General observation

A brief general observation of the individual may show signs suggestive of their functional status and movements that cause pain:

- General body constitution (e.g., obesity or muscle wasting): observe for presence of risk factors for osteoarthritis development and progression.
- Ease of movement (e.g., walking into the department, sitting/standing, getting on/off bed)
- Posture while sitting, standing, and lying.
- Feet position in standing: flat feet or posterior tibial tendon dysfunction, excessive pronation or supination. Loot at shoe wear.
- Use of walking aids and technique of use. Canes should be held in the contralateral hand with the elbow slightly flexed. When starting to walk, the cane should be moved one stride in front of the individual, who can then step on the painful leg.

Joint specific observation

The joint specific examination starts by looking at the affected joint. Aspects that should be observed include:

- General muscle bulk and presence of muscle wasting
- Erythema and other skin rashes (e.g., vasculitic lesions)
- Swelling
- Scars
- Joint deformities such as bony enlargements, fixed flexion deformities, and hyperextension
- Joint alignment (e.g., valgus, varus, or neutral alignment of the lower limb)

Gait observation

Gait assessment should be performed with individuals presenting with problems in the lower limbs or lumbar spine. Particular attention should be noted to the following features:

- Gait cycle: presence of abnormalities in the swing and stance phases that may suggest pain, weakness, or asymmetries
- Range of motion: may be reduced in the presence of pain or advanced osteoarthritis
- Asymmetry and limping: may be due to leg length discrepancy, pain, or muscle weakness
- Muscle weakness: weakness of the hip abductors, particularly gluteus medius and minimus can be detected by observing contralateral pelvic drop during gait (Trendelenburg's gait[36])
- Dynamic joint alignment: check for varus thrust, which is the worsening or onset of varus during the stance phase of gait
- Footwear: shoe wear asymmetries may suggest abnormal walking mechanics such as overpronation and supination

Feel

Palpation

Palpation of the affected joint aims to:

- Localize points of tenderness in key structures, including the joint line and soft tissues surrounding the joint (e.g., tendons, bursae)
- Assess for inflammatory signs such as an increase in joint temperature and presence of joint effusions (see "Knee examination" below, section on "Special tests"). Temperature should be checked using the dorsum of the hand
- Identify joint deformities (e.g., bone enlargements)

Move

Range of motion assessment

- Active range of motion: the individual voluntarily moves the joint. Observe for movement limitations and signs of pain
- Passive range of motion: the joint is moved by the clinician. Note the joint range, ease of movement and joint end feel (normal, firm (limited by tendon or capsular involvement), soft (caused by tissue approximation), spongy block (possible loose body), empty (limited by pain)

TABLE 2.4 Normal range of movement for the knee, hip, wrist/hand.

Joint	Normal range of movement
Knee	Extension: 0 (neutral). Small levels of hyperextension (up to 5 degrees) may be normal.
	Flexion: 130
Hip	Flexion: 120
	Extension: 30
	Adduction: 20–30
	Abduction: 40–45
	Internal rotation: 20–30
	External rotation: 30–70
Hand	Flexion (ability to make a fist): MCP: 85–90, PIP: 100–115, DIP: 80–90, thumb CMC joint: 45-50
	Extension: MCP 30–45, PIP 0, DIP 20, thumb MCP 0, thumb IP 0-5
	Thumb abduction: 60–70
	Thumb adduction: 30
	Thumb opposition: ability to touch fingertips

CMC, carpometacarpal; *DIP*, distal interphalangeal; *IP*, interphalangeal; *MCP*, metacarpophalangeal; *PIP*, proximal interphalangeal.

If the active range of motion is normal, it is not necessary to perform the passive range of motion. However, passive range of motion is useful when there is impaired active range of motion due to a mechanical cause such as a torn ligament or tendon, severe pain, myopathy, or neurological causes.

Range of motion can be assessed using a goniometer. Normal values, in degrees, for the knee, hip, and hand joints are shown in Table 2.4.

Measure

Muscle strength and length/tightness

The strength of key muscle groups around the affected joint should be tested. The Medical Research Council (MRC) Scale for Muscle Strength (also known as the Oxford Scale) is commonly used to assess muscle strength from 0 to 5 [MRC 1943]:

- Grade 0: No visible contraction
- Grade 1: Visible contraction without movement of the limb
- Grade 2: Movement of the limb but not against gravity
- Grade 3: Movement against gravity but not resistance
- Grade 4: Movement against gravity and some resistance
- Grade 5: Movement against gravity and strong resistance

Length/tightness of large muscle groups surrounding the affect joint should also be assessed.

If muscle weakness is suspected, other performance-based tests can be used to assess joint function. The core recommended tests are the 30 s chair stand, 40 m fast-paced walk, and a stair climb test. Additional tests that may be used are the timed up and go test and the 6-min walk test.[37]

Neurological features

A basic neurological examination, including assessments of strength, sensitivity, and reflexes should be carried out when you suspect of neurologic involvement, such as with individuals with neuropathic type of pain. The cervical dermatomes should be tested in individuals with upper limb symptoms such as finger or thumb base pain, and the lumbosacral dermatomes should be tested in those with pain in the lower limb joints (Fig. 2.1).

Presence of central or peripheral pain sensitization is common in individuals with osteoarthritis and has been associated with a more constant type of pain.[38] The presence of the features below suggests pain sensitization:

- Hyperalgesia: exaggerated response to stimulus that usually cause pain
- Allodynia: experience of pain due to stimulus that usually does not cause pain such as gentle touch

Special tests

Special tests for specific joints can be performed to assess effusion, ligament integrity, and the presence of joint specific pathology (e.g., meniscal tears in the knee, carpel tunnel syndrome in the wrist/hand). Details about how to perform common special tests for the knee, hip, and wrist/hand can be found in the video links provided in the section below.

Specific content for physical examination of the knee, hip, and wrist/hand

The specific content for physical examination of the knee, hip and wrist/hand is briefly summarized below. Accompanying video links can be followed to view practical demonstrations of these joint assessments.

BOX 2.3 Valgus, varus, and neutral lower limb alignment[39]

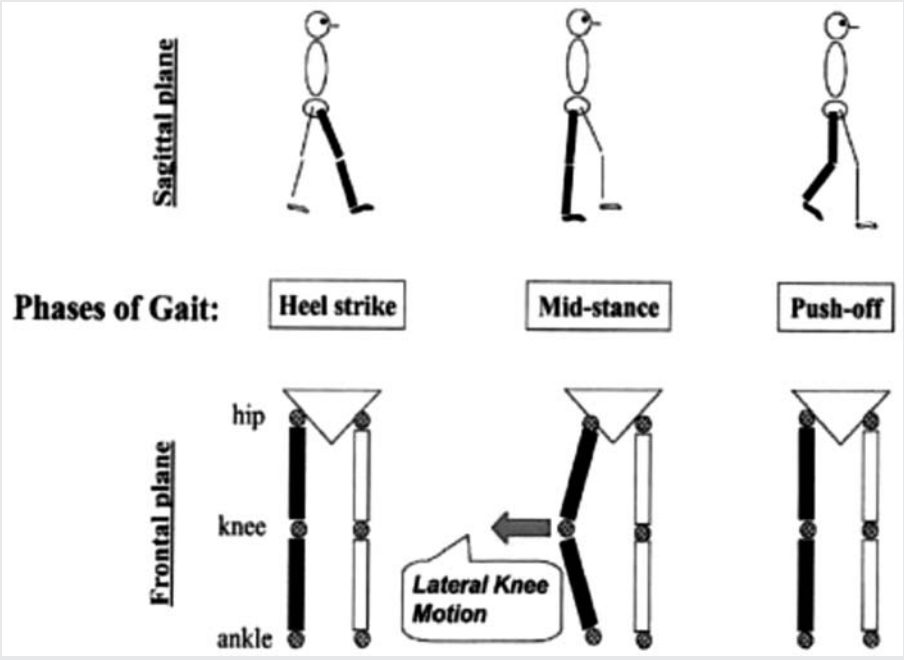
Full-length radiographs of both lower extremities showing neutral (left), varus (middle), and valgus (right) limb alignment. A line is drawn on each image from the center of the femoral head (representing the center of the hip joint) to the center of the ankle joint (talus).

Left. When the line transects the knee joint, as in the neutral alignment, the weight-bearing stresses are well distributed in the lower extremity.

Middle. When the line is medial to the center of the knee joint (varus alignment), there is an abnormal distribution of weight-bearing stresses on the medial (inner) aspect of the knee joint.

Right. Conversely, when the line is located lateral to the center of the knee joint (valgus alignment), the weight-bearing stresses are greater on the lateral aspect of the knee joint.

BOX 2.4 Trendelenburg's gait[40] (permission for reuse granted)
(A) Patient with a negative Trendelenburg sign. The pelvis remains level when the leg is lifted from the floor.
(B) Patient with a positive Trendelenburg sign indicative of a weak gluteus medius muscle on the left. Note the pelvic sag on the side of the lifted leg.

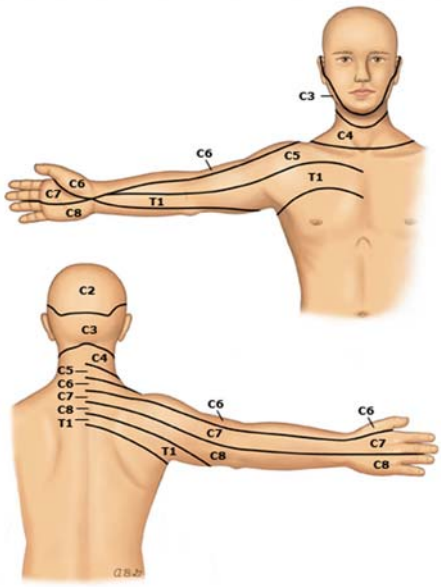


Knee examination

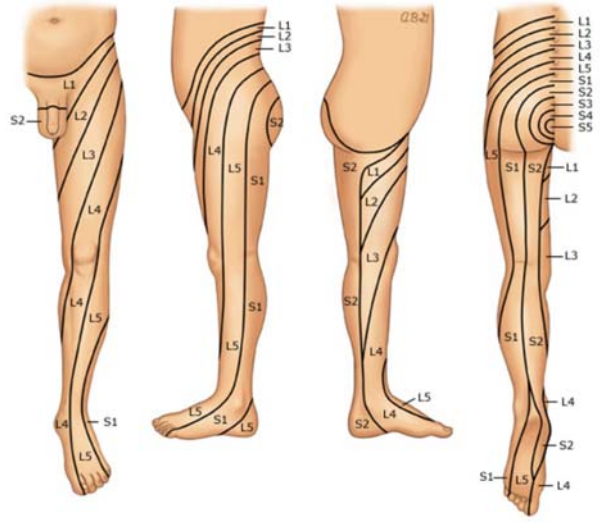
Video link: https://www.youtube.com/watch?v=rYkfiICDpdA.

Look	
General observation	General body constitution Ease of movement Posture Foot alignment in standing Leg length Use of walking aids
Joint observation	Knee alignment (varus, valgus, neutral (see Box 2.4) Knee deformity Muscle atrophy Patella alignment Erythema, scars Swelling (note: presence of popliteal swelling is suggestive of Baker's cyst)
Gait observation	Gait cycle Asymmetry and limping Muscle weakness (Trendelenburg's gait [Trendelenburg 1895] (see Box 2.5) Dynamic joint alignment (varus thrust (see Box 2.6) Footwear: Shoe wear
Feel	
Palpation	Skin temperature

BOX 2.5 Varus thrust during gait[41] (permission for reuse granted)

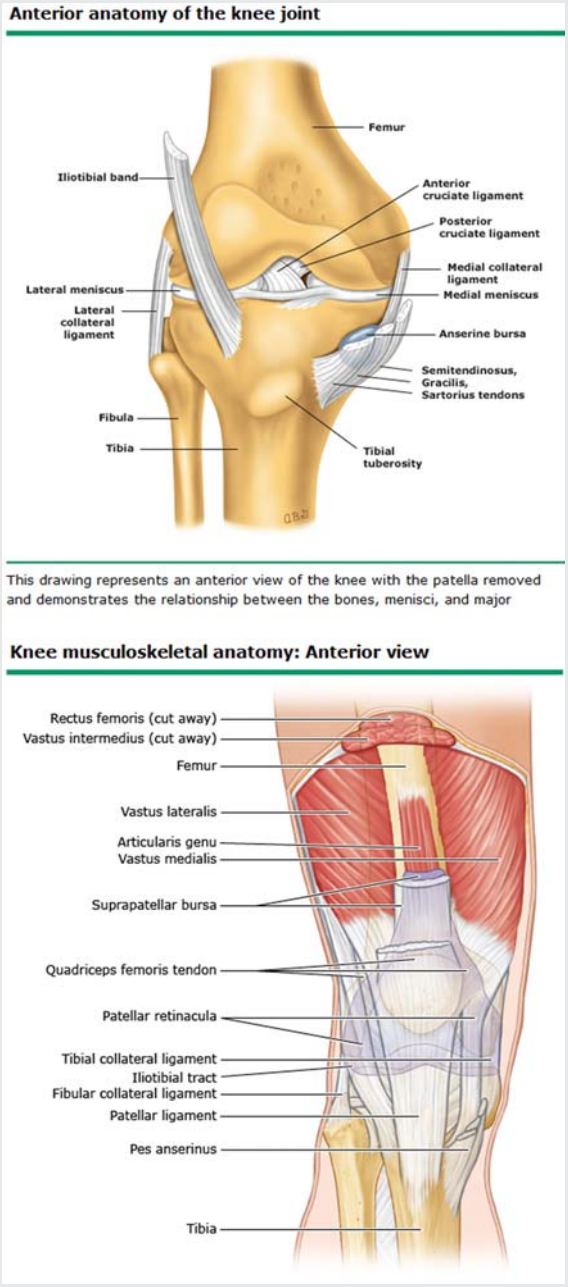


Schematic representation of the cervical and T1 dermatomes. There is no C1 dermatome. Patients with nerve root syndromes may have pain, paresthesias, and diminished sensation in the dermatome of the nerve that is involved.



Schematic representation of the lumbosacral dermatomes. Patients with sciatica may have pain, paresthesias, and diminished sensation in the dermatome of the nerve root that is involved.

BOX 2.6 Cervical and lumbosacral dermatomes[44,45] (permission for reuse granted)



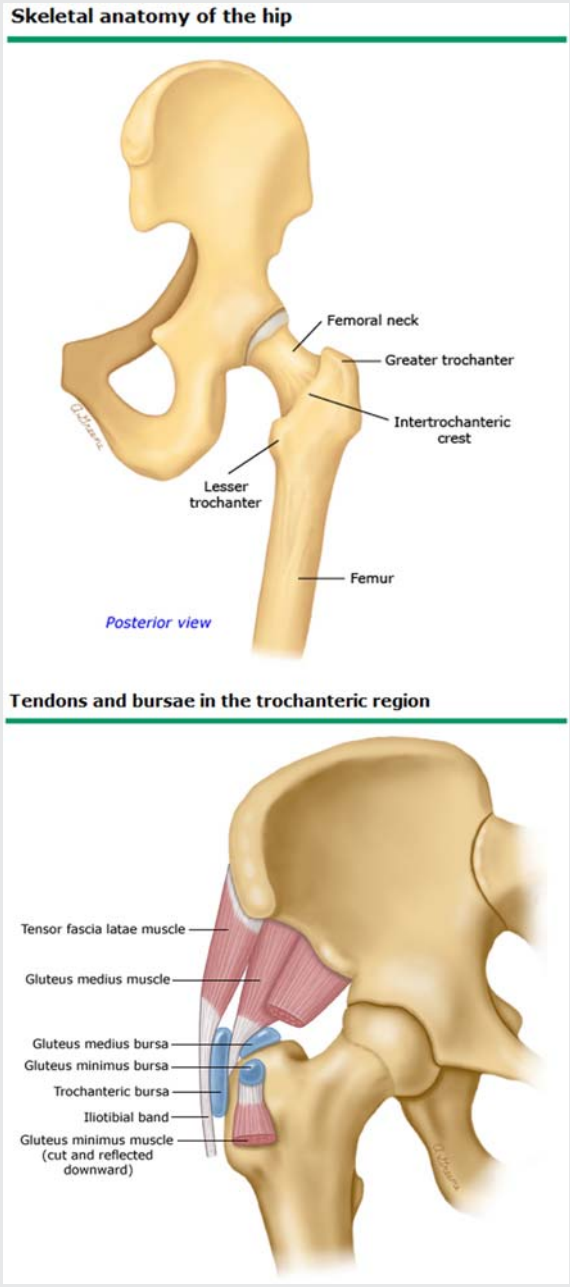
	Swelling: Effusion, bursae, Baker's cyst Joint line and soft tissue tenderness, including ilio-tibial band (ITB), pes anserine bursa, medial and lateral patellofemoral and tibio-femoral joints, collateral ligaments
Move Active and passive range of movement	Knee flexion/extension Crepitus (patellofemoral and tibiofemoral)
Measure Muscle strength and length/tightness	Quadriceps Hamstrings
Function	30 s chair stand test 40 m fast-paced walk test Stair-climb test
Neurological features	Lower limb dermatomes Patellar reflex Ankle jerk reflex Plantar reflex
Special tests For more detial on how to perform these tests, see table for special tests for the knee below.	Effusion (patella tap test, bulge sign or sweep test) Anterior cruciate ligament (anterior drawer test, Lachman's test) Posterior cruciate ligament (posterior drawer test) Collateral ligaments (varus and valgus stress test) Menisci (McMurray test) Patellofemoral joint (Clarke's test or patella grind test)

Box 2.7 Anterior anatomy of the knee[42] (accessed via Uptodate, permission for reuse granted)

Special tests for the knee

Test	Description
Effusion (patella test, bulge sign or sweep test)	*Patella test*: This test is used to detect moderate to large effusions. With the patient lying supine and the knee extended, stabilize the patella with one hand and press the patella down toward the femur with the fingers of the opposite hand. Presence of effusion will be felt as pressing ice downwards in a cup with water. *Bulge sign or sweep test*: This test is useful to detect small effusions when the patella tap test is negative. With the patient lying supine and the knee extended, slide your hand from the suprapatella space down to the lateral patella border to move any fluid from the suprapatella space to the lateral pouch. Then slide the hand down in the medial space to move fluid to the lateral pouch. Finally, do the same in the lateral space sliding your hand down to move all fluid to the medial pouch. In the presence of an effusion, a bulge can be seen on the medial side of the knee.
Anterior cruciate ligament (anterior drawer test, Lachman's test)	*Anterior drawer test*: This test is used to assess the integrity of the anterior cruciate ligament. With the patient lying supine and the knee flexed at 90 degrees, hold the proximal tibia with the thumbs over the tibial tuberosity. Pull the tibia anteriorly and observe for movement of the proximal tibia. Compare to the contralateral knee. If the ligament is intact, there will be minimal or no anterior movement while increased movement may indicate laxity of rupture of the anterior cruciate ligament. *Lachman's test*: This is an alternative test to the anterior drawer test for assessment of the anterior cruciate ligament. The patient is lying supine but now the knee is flexed at 30 degrees. Hold the lower leg with the thumbs over the tibial tuberosity and pull the tibia forward with your dominant hand, while the nondominant hand should hold the thigh to stabilize the femur. A positive test is when significant movement of the tibia anteriorly occurs.
Posterior cruciate ligament (posterior drawer test)	*Posterior drawer test*: The same technique described above should be used but the proximal tibia should be pushed posteriorly. Significant posterior movement of the proximal tibia may indicate laxity or rupture of the posterior cruciate ligament.
Collateral ligaments (varus and valgus stress test)	*Lateral collateral ligament (varus stress test)*: With the patient lying supine and the knee extended, hold the patient's lower leg with one hand close to the

BOX 2B.7 Patella maltracking. Clinical photograph showing the knee in flexion (A) and in extension (B). The dotted line delineates the inverted 'J' path the patella takes. (reproduced with permission from Hogan N et al 2018]. This box and image is also missing. It was included in the original document sent over



	ankle while the other hand holds the distal femur close to the knee joint. Apply a varus force which will cause an increase in the lateral joint space in case of laxity or rupture of the lateral collateral ligament. *Medial collateral ligament (valgus stress test)*: The same technique described above should be used but now a valgus force should be applied which will cause an increase in the medial joint space in case of laxity or rupture of the medial collateral ligament.
Meniscal integrity (McMurray test)	*McMurray test*: This test assesses the presence of a meniscal tear but does not rule out a tear if negative due to its low sensitivity. With the patient lying supine and the legs extended, hold the patient's heel with one hand and place the fingers of the other hand along the medial joint line to test the medial meniscus. Flex the patient's knee and internally rotate the tibia. With the tibia internally rotated, slowly extend the knee. Presence of a meniscal tear is suggested by pain in the medial joint line along with a click that can be felt or heard during extension. To test the lateral meniscus, used the same technique but place the fingers along the lateral joint line and rotate the tibia externally.
Patellofemoral joint (Clarke's test or patella grind test)	*Clarke's test or patella grind test*: This test assesses the patellofemoral (PF) compartment and is positive conditions such as PF OA, PF syndrome and chondromalacia. With the patient lying supine and the knee extended, press the patella into the trochlea and ask the patient to gently contract the quadriceps. Presence of anterior knee pain suggests the presence of PF compartment pathology.

Hip examination

Video link: https://www.youtube.com/watch?v=8vDcxW8xTG4.

Look	
General observation	General body constitution Ease of movement Posture Foot alignment in standing Leg length Use of walking aids
Joint observation	Muscle atrophy Deformity Alignment Scars Pelvic tilt: may indicate leg length discrepancy, weakness of the hip abductors or scoliosis
Gait observation	Gait cycle Asymmetry and limping Muscle weakness (Trendelenburg's gait [Trendelenburg 1895]). Dynamic joint alignment Footwear: Shoe wear
Feel	
Palpation	Skin temperature Swelling Tenderness: Anterior superior iliac spine, posterior superior iliac spine, greater trochanter, pubic symphysis, ischial tuberosity, sacroiliac joints
Move	
Active and passive range of movement	Hip: Flexion/extension, adduction/abduction, internal/external rotation
Measure	
Muscle strength and length/tightness	Hamstrings, quadriceps, hip flexors, abductors, adductors
Function	30 s chair stand test 40 m fast-paced walk test Stair-climb test
Neurological features	Lower limb dermatomes Patellar reflex Ankle jerk reflex Plantar reflex
Special tests for more information on how to perform these tests, please see table on special tests for the hands below	Trendelenburg test Iliotibial band (Ober's test)

	Hip provocation (patrick/FABER test) Flexion contracture: Thomas test True and apparent leg length discrepancy

Box 2.8 Anatomy of the hip joint[43] (accessed via uptodate, permission for reuse granted)

Special tests for the hip

Test	Description
Trendelenburg test	A positive test indicates weakness in the hip abductor muscles (gluteus medius and gluteus minimus). The patient stands on the affected leg which causes the pelvis to drops to the contralateral side.
Iliotibial band (Ober's test)	This test assesses tightness of the iliotibial band. The patient lies on the side that is not being tested. The lower leg stays flexed at the hip and knee for stability while the examiner holds the upper leg and passively abducts and slightly extends the leg. The examiner should fixate the pelvis with one hand and slowly lower the upper leg until it is as close to the table as possible. If the iliotibial band is tight the upper leg will encounter resistance and will not touch the table.
Hip provocation (patrick/FABER test)	This test assesses pathologies in the hip joint and sacroiliac joint. With the patient lying supine, the examiner passively flex, abduct and externally rotate the hip, leaving the ankle against the contralateral knee. The examiner shoulder fixate the contralateral pelvis and apply pressure at the ipsilateral knee toward the table. Posterior pain may indicate sacroiliac joint pathology while groin pain may indicate hip osteoarthritis.
Flexion contracture: Thomas test	This tests assesses tightness of the iliopsoas muscle and presence of hip pathology. The patient lies supine and hold the non-testing leg against his/her chest with the knee and hip flexed. A positive test is when the extended leg lifts off the table.
True and apparent leg length discrepancy	*True leg length:* The patient lies supine. The examiner measures the leg length from the anterior superior iliac spine to the medium malleolus. Discrepancies may occur in case of structural limb inequality (post-surgery, trauma, congenital abnormalities, etc). *Apparent leg length:* With the patient lying supine, the examiner measures the leg length from the umbilicus to the medial malleolus. Discrepancies may occur due to scoliosis, muscle weakness etc, without any shortening of the leg bones.

Wrist/hand examination

Video link: https://www.youtube.com/watch?v=65mjCLGrGTE.

Look	
General observation	General body constitution Ease of movement Posture
Joint observation	Alignment: Wrist, MCPs, PIPs, DIPs, thumb joints Deformities (e.g., squaring deformity of the thumb base (wasting of the thenar muscles, adduction of the first metacarpal and joint subluxation), heberden nodes in the DIPs, bouchard nodes in the PIPs) Muscle atrophy (dorsum, palm) Erythema, scars Skin, nails (e.g., signs of psoriasis) Swelling (dorsum, palm) Flexor tendons
Feel	
Palpation	Skin temperature Swelling and synovitis Joint tenderness: Wrist, MCPs, PIPs, DIPs, thumb joints Flexor tendons Extensor tendons Osteoarthritis nodes
Move	
Active and passive range of movement	Wrist: Flexion/extension, pronation/supination, abduction/adduction MCPs, PIPs, DIPs: Flexion/extension Thumb: Flexion/extension

	Fist
Measure	
Muscle strength and length/tightness	Opponens pollicis Flexor pollicis brevis Abductor pollicis brevis
Function	Jar top Key Button Writing Pinch grip Power grip
Neurological features	Cervical dermatomes Biceps reflex Triceps reflex Supinator reflexes
Special tests for more information on how to perform these tests, please see table on special tests for the hands below	Tinel's and Phalen's for presence of carpal tunnel syndrome

CMC, carpometacarpal joint; *DIPs,* distal interphalangeal joints; *MCPs,* metacarpophalangeal joints; *PIPs,* proximal interphalangeal joints.

Special tests for the hands

Test	Description
Tinel's and Phalen's for presence of carpal tunnel syndrome	*Tinel's test:* The patient is sitting with the forearm and hand resting on the examination table and the palm facing up. The examiner taps on the wrist at the location of the medial nerve which may elicit tingling in the thumb, second, third and medial half of the forth fingers (median nerve distribution) when carpal tunnel syndrome is present. *Phalen's test:* The patient flex both wrists, pressing the dorsal side of both hands against each other and holding in this position for 1 minute. This is cause tingling in the median nerve distribution.

Summary

Synthesis of findings from holistic subjective history taking and the physical examination is crucial for sound clinical decision-making, including accurate diagnosis of osteoarthritis, ruling out any serious underlying medical conditions and the need to refer on, problem identification, and tailoring of treatment according to mutually agreed goals. How to ensure accurate diagnosis of osteoarthritis is covered in detail in the next chapter Box 2.7.

Clinical practice points

- Comprehensive and accurate history taking and physical assessment provide the essential information to diagnose, manage, and engage with an individual presenting with possible osteoarthritis.
- A person-centered approach is key, with active, open communication.
- History taking should focus on the whole person, and the impact their joint pain has on all aspects of their life and participation.
- The physical assessment should be viewed as an extension of history taking.
- Physical assessment should focus on: look (general and local observation), feel (palpation), move (range of movement), and measure (range of movement assessment, muscle strength and length, function, neurological features, and special tests).

Concluding remarks

This chapter provides a detailed overview of history taking and physical assessment of the individual presenting with possible osteoarthritis. In addition to systematic guidance, communication tips are provided, clinical examples are given,

and links are provided to demonstrations. Using the approaches detailed in this chapter ensures the whole individual is considered and allows a solid foundation on which a personalized management plan can be built.

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Chapter 3

Diagnosis, risk factors for OA development and progression, OA prevention, and recognizing comorbidities

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Clinical practice points/evidence summary:

- Osteoarthritis is one of the most common forms of arthritis. Pain from osteoarthritis is a major clinical manifestation and important antecedent to functional disability
- The clinical diagnosis of osteoarthritis is made on the basis of symptoms and a physical examination.
- Overweight or obesity and joint injury are two key risk factors for osteoarthritis.
- To date, there is no cure for osteoarthritis. Measures of weight control and joint injury prevention should be taken to reduce the risk of osteoarthritis occurrence and its progression.
- Patients with osteoarthritis often have multiple comorbidities, including hypertension, back pain, depression, and peptic ulcer.

Introduction

Osteoarthritis (OA) is the most prevalent form of arthritis. The most common symptoms of OA include pain, stiffness, swelling, restriction of joint movement, and joint instability. To date, there is no cure for OA. The main goals of contemporary management of the disease continue to be control of pain and improvement in both function and health-related quality of life. In this chapter, we will describe the incidence and prevalence of OA, its impact on individual and on society, diagnosis methods, potential risk factors, preventive strategies, and common comorbidities.

OA incidence

OA is a condition involving movable joints characterized by cell stress and extracellular matrix degradation. The disease manifests first as a molecular derangement followed by anatomic and/or physiologic derangements (characterized by cartilage degradation, bone remodeling, osteophyte formation, joint inflammation, and loss of normal joint function) that can culminate in illness.[1] OA is a heterogeneous disease, and its prevalence and incidence vary greatly according to the definition of OA (i.e., structural lesions of joints based on plain radiographs vs. symptoms and findings from a physical examination),[2] the specific joint(s) under study (i.e., knee vs. hip vs. hand), and the characteristics of the study population (i.e., age, sex, race, geographic location).[3] In general, the knee is the most common joint affected by clinically diagnosed OA, followed by hand and hip. Pain from OA is a major clinical manifestation and a key factor leading people to seek medical care, and an important antecedent to functional disability.

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To date, there is a paucity of population-based data on the incidence of OA. Among the enrollees of Massachusetts Health Maintenance Organization, age- and sex-standardized incidence rates of knee, hand, and hip symptomatic OA were 240, 100, and 88 per 100,000 person-years, respectively.[4] A similar pattern of incident symptomatic OA was also observed 20 years later in Spain; however, the corresponding incidence rates of symptomatic OA (knee: 650, hand: 240, hip: 210 per 100,000 person-years, respectively) were higher than that reported in Massachusetts.[5]

Impact of OA

The World Health Organization estimated that 18% of women and 9.6% of men aged >60 years have symptomatic OA; of them, 80% have some limitation in mobility and 25% are unable to perform their major daily activities.[6] In 2019, OA was the 15th highest cause of years lived with disability (YLDs) worldwide and accounted for 2% of the total global YLDs.[7] OA consumes a substantial amount of healthcare resources. For example, among individuals with OA, the average lifetime risk was 30% for knee replacement and 14% for hip replacement in Spain, respectively.[8] Symptomatic OA is one of the most common and expensive medical conditions treated in US hospitals, accounting for 10% of all hospitalizations and 2% of all ambulatory visits, with a cost of approximately $138.4 billion in total expenditure for national inpatient care.[9] Symptomatic knee or hip OA is associated with an increased risk of all-cause mortality.[10–12] Although tremendous effort has been made to control for OA over the past decades; to date, there is no known cure. With aging populations and the obesity epidemic globally, OA will become a great burden on society.

OA diagnosis

Structural features of OA can be assessed on plain radiographs. The common X-ray findings of OA include narrowing of the joint space between adjacent bones (indicating loss of cartilage) and osteophyte formation at the joint margins. However, mild forms of these features are very common with increasing age, and only a minority of the people with such mild features report joint complaints. Therefore, more emphasis on a clinical diagnosis of OA should be considered.

Clinical diagnosis

The clinical diagnosis of OA is made on the basis of symptoms and a physical examination. The American College of Rheumatology classification criteria for OA[13–15] have for many years been used as diagnostic criteria. However, these classification criteria were developed for use in research, ensuring that the people in the study really have OA. That means that such criteria ought to have a high specificity (rule out the people without the disease). The European League Against Rheumatism presented criteria for the diagnosis of knee OA[16] and presented higher probabilities of OA along with more symptoms or signs present. The National Institute for healthcare and excellence (NICE) guideline[17] from the United Kingdom proposed very inclusive (to rule in everyone with the disease) diagnostic criteria for hip and knee OA. These NICE diagnostic criteria are based on symptoms only, while the other sets of criteria are based on both symptoms and physical examination (Table 3.1).

Early-stage OA

The need for early-stage OA criteria has been stressed for many years to enable key treatment (maintaining muscle strength around the joint, staying active, and maintaining a healthy weight) from the earliest symptoms. Pain symptoms such as pain during stair use in combination with crepitus or joint line tenderness, yet with limited functional limitations have been suggested, but these criteria need further validation.[18] Also, morning stiffness and *problems* with rising from a chair might already are present at an early stage.[19]

Use of additional diagnostics by imaging or laboratory tests

Plain radiographs are not needed for diagnosis in people with a typical presentation of OA (middle-aged or older, usage-related pain, and short-duration morning stiffness). In atypical presentations, radiography might help confirm the diagnosis of OA and/or make alternative or additional diagnoses.[20] However, one has to realize that at first presentation with OA symptoms that the vast majority of people do not have any plain radiographic features, or they are as yet very subtle.[21] Laboratory tests might be indicated when the presentation is atypical and differential diagnoses such as gout and other forms of arthritis are suspected.[20]

TABLE 3.1 Clinical criteria for OA of the knee.

NICE guideline	European league against rheumatism	American college of rheumatology
Diagnostic criteria	**Diagnostic criteria**	**Classification criteria**
Activity related knee pain + Age >45 years + No morning stiffness or of short duration (<30 min)	- Knee pain - No morning stiffness or of short duration (<30 min) - Crepitus - Functional disability - Limited range of motion - Bony swelling Probability of knee OA increases with more criteria present (up to 99% when all six are present)	Knee pain + at least three of the following: - Age >50 years - Morning stiffness <30 min - Crepitus - Joint line tenderness - Bony swelling - No warm knee

Holistic approach

Initial assessment should include a complete history and physical examination, but it also should ascertain the effect the presenting symptoms have on function, quality of life, mood, social participation and relationships, occupation, leisure activities, and sleep.[17] Such a holistic assessment facilitates shared decision-making and should improve outcomes.[22]

Risk factors

OA is a heterogeneous disease and has a multifactorial etiology (Fig. 3.1).[23] The relative importance of risk factors may vary for different subtypes of OA. Potential risk factors (at the systemic and or local level) act together to cause OA occurrence and progression. Systemic risk factors often affect all relevant joints, such as age, sex, whereas local-level factors may be unique to a particular joint, such as injury. However, some risk factors, such as overweight/obesity, may have both systemic and local impacts on OA occurrence. Understanding and recognizing the potential risk factors for each subtype of OA help develop the effective and targeted preventive and treatment strategies.

Age

The risk of radiographic OA for all joints increases with age[23]; however, risk of symptomatic OA does not increase monotonically with age, rising rapidly after age 50, and leveling off around age 70.[4,5,24] The biological mechanisms linking age to OA are not fully understood. Age may be a proxy for the cumulative exposure to many other risk factors for OA, and it could also be degenerative indicator for physiological changes over time, such as cartilage thinning, weak muscle strength, and poor proprioception.[25]

Sex

Women are at higher risk of developing OA and tend to have more severe disease (i.e., structural lesions and clinical symptoms) than men.[26] Estrogen has been postulated to play a role in the development of OA; however, results from both observational studies and clinical trials have been inconclusive.[27–30] Women had nearly threefold higher risk of development of lateral tibiofemoral radiographic OA than men; however no such sex difference was observed for medial tibiofemoral radiographic OA.[31] In general, women have a wider pelvis,[32,33] larger Q-angle,[34,35] and greater knee valgus[36,37] than men, which places increased loading of the lateral knee compartment, resulting in a high risk of lateral tibiofemoral disease.

Race/ethnicity

The prevalence of OA and patterns of joints affected by OA vary greatly among racial and ethnic groups. Studies suggest that the prevalence of hand OA in Chinese people was lower than that in Caucasian people.[38] Hip OA was also less

common in Chinese and Japanese people than that in Caucasian people.[3,39] However, prevalence of knee OA in Chinese people was similar to, if not higher than, that in Caucasian people.[40] Clinical manifestations and joint involvement patterns of OA also differ between racial and ethnic groups. Heberden's nodes (i.e., small bony growths that appear on the joint closest to the tip of finger) were more common in Caucasian than in Black[41] and Japanese people,[42] whereas lateral tibiofemoral knee OA was less frequent in Caucasian than in Chinese people.[43] Genetic and environmental factors among racial/ethnic groups are likely to contribute to the difference in OA occurrence and joint involvement pattern.

Overweight/obesity

Overweight/obesity is a strong risk factor for OA.[23] Overweight/obesity puts more stress on weight-bearing joints (e.g., knee and hip) and may also contribute to metabolic-like inflammation that increases the risk of symptomatic OA.[44] A weight loss of approximately 10 pounds (or 4.5 kg) was associated with 50% reduction in the risk of symptomatic knee OA in women, and the effect was even stronger in those with high baseline BMI.[45] Results from a randomized clinical trial showed that subjects who already had a clinical diagnosis of OA assigned to the intensive diet and exercise (average weight loss: 10.6 kg or 23Lbs) intervention arm had significant improvement in knee pain and function when compared with those assigned to a single intervention arm of either diet (weight loss: 8.9 kg or 19.6Lbs) or exercise (weight loss: 1.8 kg or 4Lbs).[46]

Joint injury, habitual and occupational physical activities

Knee injury is one of the strongest risk factors for OA,[23] conferring approximately fourfold increased risk of developing knee OA.[47,48] Severe knee injuries resulting in meniscal tears, anterior cruciate ligament injury, or articular cartilage damage, are associated with an increased risk of radiographic OA, pain development, and subsequent joint replacement surgery. Surgical reconstruction of anterior cruciate ligament tears does not seem to show any protective effect on the occurrence of OA. Individuals with partial meniscectomy had 2.5-fold higher risk of developing radiographic OA and 4.5-fold higher risk of worsening cartilage damage than those without partial meniscectomy,[49] suggesting that primary prevention of joint injury is more important than clinical treatment after injury.

Repetitive joint use is an important risk factor for OA. Occupational activities that involve frequent kneeling or squatting, carrying, or lifting heavy objects,[50,51] prolonged standing,[52] are associated with an increased risk of lower limb OA. Individuals who squatted >2 h per day had twofold higher prevalence of knee OA than those who squatted <1/2 h per day.[53] Repeated pincer grip is associated with increased risk of hand OA,[54,55]

In general, low-impact moderate-intensity physical activities, such as swimming or cycling, could strengthen periarticular muscles, stabilize the joint, and reduce the risk of OA, whereas high-impact physical activity may potentially increase the risk of knee or hip OA owing to their undue load on the joint.[56,57] A meta-analysis that included 11 cohort studies and four case-control studies evaluated the association between running and knee OA, the results are contradictory and inconclusive,[58] suggesting that more evidence from well-designed prospective cohort studies is needed to clarify the contradictions. An increased risk of knee OA from physical activities appears to be modified by either activity-related joint injury, or by greater BMI, or by joint posture, such as squatting among weightlifters.[59] Interestingly, one study reported participants who engaged in long-term low-to-moderate physical activities had a lower, albeit nonstatistically significant,

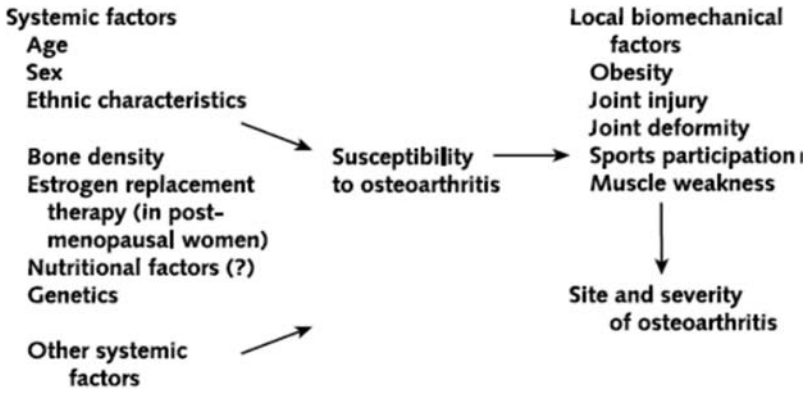


FIGURE 3.1 Pathogenesis of osteoarthritis with putative risk factors. *Reproduced from Felson DT, et al. Osteoarthritis: new insights. Part 1: the disease and its risk factors.* Ann Intern Med. *2000;133(8):635–646.*

risk of incident knee radiographic OA than those who undertook no physical activities,[60] suggesting that adults may be benefited from their engaging in light-to-moderate physical activities.

Nutritional factors

Nutritional factors are the subject of considerable interest in OA because of their potentially modifiable nature. Although many observational studies have been conducted to assess various nutritional factors, results have been inconclusive.

Vitamin D

Although vitamin D plays an important role in bone health,[61] findings from epidemiologic studies of either dietary intake or serum levels of vitamin D in relation to the risk of OA are conflicting.[62–66] Two randomized clinical trials that assessed the effects of Vitamin D supplements in people with OA did not show any beneficial effect on either reducing the cartilage volume loss or improving pain[67,68].

Vitamin K

Vitamin K plays a role in cartilage calcification; thus, low levels of vitamin K may increase the risk of OA.[69,70] Several observational studies found that high vitamin K intake or high plasma vitamin K levels were associated with a lower prevalence, incidence, and progression of OA,[70–73] whereas low levels of plasma vitamin K were associated with a high risk of radiographic knee OA, cartilage lesions, and meniscus damage.[72,73] Users of acenocoumarol, one vitamin K antagonist, had 2.5 times higher risk of knee or hip radiographic OA than nonusers[74]; whereas use of warfarin, another vitamin K antagonist, was associated with a 1.6-fold increased risk of knee or hip replacement compared with nonuse.[75]

Selenium

Kashin–Beck osteoarthropathy is an endemic OA occurring in southeast Siberia of Russia, northern region of North Korea, and long narrow zone from northeastern to southwestern China. Joint deformation and limited joint mobility are common signs and symptoms, which usually become evident between the age of 5 and 15 years. Although selenium deficiency has been linked to Kashin–Beck osteoarthropathy,[76] others have failed to confirm this.[77] In addition, there is paucity of evidence that selenium levels are associated with the risk of nonendemic OA.

Dietary fiber

Diet with a low intake of fiber was associated with an increased risk of knee OA, and such an effect was mainly mediated through its effect on BMI.[78,79]

Bone mineral density

Systemic high bone mineral density (BMD) increases the risk of knee, hip, and hand OA.[23] In addition, high regional subchondral BMD was associated with a high prevalence of joint space narrowing, osteophytes, sclerosis, bone marrow lesions, and meniscal damage.[80–82] Although biological mechanisms linking BMD to OA are not fully understood, high systematic or local BMD may reflect long-term loading on bone, leading to an increased risk of OA. Paradoxically, several studies have reported that high systemic BMD was associated with a lower risk of OA progression. These findings, however, may be susceptible to potential selection bias.[83] In fact, results from a large randomized clinical trial of bisphosphonates showed that BMD increase neither improves symptoms nor alters the progression of OA.

Joint shape and alignment

The shape of a joint may affect the distribution of mechanical load on that joint and contribute to the occurrence of OA. Studies have shown that acetabular dysplasia (Fig. 3.2), which decreases contact area and increases shear force at the acetabular rim, leading to excessive and eccentric loading of the anterosuperior acetabular rim complex,[84] was associated with an increased risk of hip OA.[85,86] The morphometry of impingement and sphericity were more common in the hips of Caucasian women than that in Chinese women, predisposing them to femoroacetabular impingement and subsequent risk of hip OA.[87] Abnormal bone shape also increases the risk of both hip and knee OA.[88]

Many studies have demonstrated that varus knee (i.e., Fig. 3.3, Middle panel: bowlegged joint causes knees to turn outward) is a strong predictor for progression of medial tibiofemoral OA, whereas valgus knee (i.e., Fig. 3.3, Right panel:

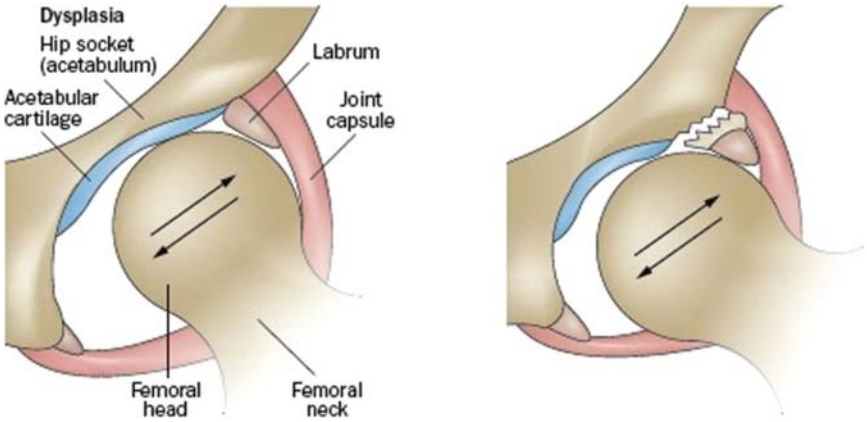


FIGURE 3.2 Hip dysplasia pathophysiology. Left panel: hip has a shallower, more vertical acetabulum and a greater radius of curvature than normal hip; Right panel: The radius of curvature and alignment of the joint are normal, but acetabulum has a "short roof" and does not cover the femoral head sufficiently. *Reproduced from Sandell LJ. Etiology of osteoarthritis: genetics and synovial joint development.* Nat Rev Rheumatol. *2012;8(2):77–89.*

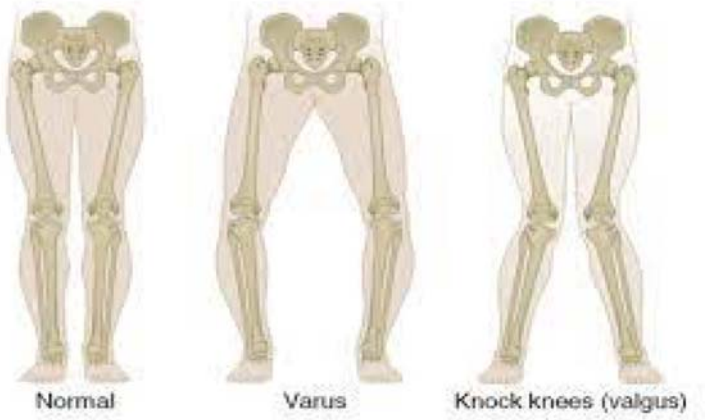
knock-kneed joint causes knee inward) is a predictor for progression of lateral tibiofemoral OA.[89] However, its relation to the risk of incident knee OA is inconclusive.[89–91] These findings imply that knee malalignment can be both cause and result of OA. In studies of knee OA progression, knee malalignment may be one component of the structural changes in OA, i.e., joint space narrowing, and bony contour alterations lead to joint malalignment, malalignment then changes the loading distribution on knee joint, and accelerates the disease progression.[90] To date, no study has demonstrated that correction of joint malalignment halts OA progression.

Many studies have examined the relation of patellofemoral alignment (i.e., patellofemoral index and patella displacement) and trochlea morphology (i.e., sulcus angle) to patellofemoral knee OA. Several studies found that lateral displacement and patella tilt are associated with radiographic patellofemoral OA,[92–97] and such an association is stronger for radiographic lateral patellofemoral OA when compared with radiographic medial patellofemoral OA.[92,93,97] Studies also demonstrated that a higher sulcus angle was associated with cartilage damage and worse bone marrow lesions.[92,98]

Muscle strength

While the reduction or avoidance of physical activity from OA symptoms leads to muscle weakness, the relationship between muscle strength and the risk of OA is not clear. A few studies reported that weak quadriceps muscle was associated with an increased risk of radiographic knee OA,[99,100] and individuals with low knee extensor strength were more likely to develop symptomatic knee OA.[101] Recent studies, however, found that higher total extensor cross-sectional area was associated with an increased risk of patellofemoral cartilage loss,[102] and higher knee extensor strength in adolescent men experienced an increased risk of knee OA in the middle age.[103] Individuals with greater grip strength also had a higher risk of development of radiographic hand OA.[104]

FIGURE 3.3 Knee alignment.



Genetics

Individuals with a family history of OA are more likely to develop OA than those without such a history.[105] Twin and family studies have shown that genetic influence for hand and hip OA was greater than that for knee OA,[106–108] and individuals with genetic defects in joint cartilage tend to develop OA at a younger age.[84] To date, 90 OA susceptibility loci have been identified.[109] Although the mechanisms linking genetic factors to OA are not fully understood, it is likely that the interaction between genetic and environmental factors plays a critical role in disease occurrence and progression, and individuals who have both genetic susceptibility loci and environment risk factors are likely to have much higher risk of development of early or severe OA.

Risk factors for symptomatic OA

Pain from OA is a major factor for seeking medical care and an important antecedent to disability; however, the number of studies of risk factors for pain is much lower than those studies of risk factors for structural lesions of OA, partly owing to challenges in studies of pain. Pain is a subjective experience. Many factors, such as genetic predisposition, prior experience of pain, personnel perception, expectation, and social environmental factors, play roles in a subject's response to painful stimuli.[110] To date, only a few environmental risk factors have been identified, such as overweight/obesity, joint injury, or strenuous physical activity, and occupational activities requiring kneeling, knee bending, squatting, prolonged standing, or weight lifting.[111] Nevertheless, considering the severity of joint structural lesions is strongly associated with the presence of joint pain and pain severity,[112,113] and changes of these structural lesions also preceded fluctuation of joint pain and its severity,[110] it is reasonable to speculate that any risk factors that strongly associated with joint structural lesions are likely to be the potential risk factors for joint pain. Several studies have also found that psychological factors were also associated with pain[114–116]. Changes in psychological factors correlated with pain fluctuation,[116,117] suggesting an important link between the pain experience and psychological state.

Two studies reported that gut microbiota may play a role in pain from OA. One study reported that abundance of gut streptococcus species was associated with higher knee pain[118], and another study showed that individuals with symptomatic hand OA had a low relative abundance of *Roseburia* but high relative abundance of *bilophila* and *Desulfovibrio* at the genus level compared with those without hand OA.[119] These findings may shed light on our understanding of the etiology of pain from OA and guide the development of new preventive and treatment strategies for OA.

OA prevention

Although OA is becoming the most frequent chronic disease in Western societies,[120] a main cause of living with pain and disability,[121] and with subsequent increased risk for other morbidity such as cardiovascular disease,[122,123] the development of effective strategies for the prevention of this disease is still in its infancy.[124]

Primary prevention

Primary prevention aims to prevent OA before it occurs. It aims to diminish the influence of modifiable risk factors for the development of OA or increase resistance to the development of OA once the risk factor already has occurred or is not modifiable. Risk factors such as local muscle weakness, traumatic joint injury, overweight or obesity, altered joint-shape or malalignment, and repeated high impact joint loads can be prevented or are modifiable, while female sex, older age, and genetic predisposition are not.[125].

- Target populations for primary prevention

Several issues play a role in defining a target population for primary prevention. The strength of the risk factor is important, as well as how easy it is to identify the population with that specific risk factor, and whether there is an intervention available. The prevalence of the risk factor together with the strength of the risk and the effectiveness of the intervention, defines how much of the OA in total can be prevented. Important target populations for primary prevention are those who are overweight or obese. In developed countries, 24%–30% of the knee OA cases can be attributed to being overweight.[126] The odds of developing knee OA is about three times that in people who are not overweight or obese and is a risk factor of moderate strength, but because this risk factor is so prevalent the contribution of this risk factor on population level ratio is very high.

Another important target population is the population with, or at risk for, knee joint injury. This risk factor is less prevalent than being overweight or obese, but the strength of the risk factor is much higher; anterior cruciate ligament

injuries, intraarticular fractures, and meniscal damage all carry a more than seven times hazard for knee OA compared to absence of these injuries.[127] Among patients with ankle OA, prior joint trauma is the most common cause, accounting for 70% of the ankle OA cases.[128] The risk for joint trauma is particularly present among sporting populations.

Severe hip dysplasia is strongly associated with the development of hip OA at a young age.[129] Milder hip dysplasia increases the risk for hip OA at middle age.[86] A similar increased risk for hip OA at middle age is also seen for cam deformity.[86].

- Potential interventions reducing weight

The evidence for the preventive effect of weight reduction is mainly based on observational studies. For example, in the Framingham cohort, it was estimated that a reduction from obesity to overweight and a reduction from overweight to normal weight would reduce the incidence of knee OA by 21% in men and 33% in women.[130] So far only one randomized controlled trial has been published that focused on the prevention of OA. This study evaluated a diet and exercise program aimed at weight reduction among middle-aged, overweight women, and was unable to show a preventive effect of the intervention on knee OA development after 2.5 year of follow-up.[131] However, promising post-hoc analysis showed that a 5 kg or 5% weight loss during the first year resulted in a 3.0 times reduction in clinical knee OA after 6 years, and a 2.5 times reduction in radiographic knee OA development.[132]

Preventing knee injury

High-quality randomized controlled trials have shown that a neuromuscular training program in high-injury sports can reduce knee injuries by 45%−83%.[133] Similarly, the specifically for soccer players designed the FIFA 11+ program reduced lower limb injuries by 30%. Despite this evidence, widespread implementation of such programs remains challenging.

Interventions after knee injury

For reducing the risk of subsequent knee OA after knee injury, there is not yet any evidence based on randomized controlled trials.[125] For exercise therapy, a systematic review based on small moderate-quality nonrandomized studies showed conflicting evidence.[134] Higher-quality studies are needed to better understand the role of exercise and physical activity after knee injury in preventing the OA, as these activities may prevent many other additional risk factors such as muscle weakness, weight gain, and re-injury.[125]

Evidence for whether surgery for meniscal damage or anterior cruciate ligament injury prevents subsequent knee OA is also lacking. Early surgery for anterior cruciate ligament injury has been tested against exercise therapy, with a post-exercise option for delayed surgery, in two randomized trials, with two to 5 years of follow-up.[135−137] They both showed equivalent patient reported outcomes in both groups, but as yet we have no long-term outcomes available that indicate a protective effect of surgery on the development of OA. A recent meta-analysis of observational studies showed increased severity of OA after 10 years of follow-up for inpatients that had surgery.[138] Also, evidence for the effectiveness of (antiinflammatory) medications, intraarticular injections, assistive devices (e.g., braces, and crutches), and weight reduction in reducing the risk for OA after injury is unknown.[125]

Interventions for hip dysplasia

Many healthcare systems have screening programs to detect developmental dysplasia of the hip (DDH) in newborns. When diagnosed early, DDH can often be successfully managed with nonsurgical measures, usually with abduction orthoses. Patients with more severe dysplasia, completely dislocated hips, or a higher age at treatment initiation are at risk of nonsurgical treatment failure.[139] Surgery (open reduction, pelvic or femoral osteotomies) during childhood or adolescence might then be needed. However, when a normal morphology is not achieved, or the dysplasia is undetected, it can contribute to hip OA in early adulthood. Recent studies showed that some hip dysplasia, especially mild forms, may not appear until childhood.[140,141]

Interventions for cam deformity or FAIS

Cam deformity of the hip develops mainly when the growth plate is open and is suggested to be a bony adaptation resulting from stimulating the growth plate by sporting activities.[142] Whether changing or diminishing sporting activities during this

age will prevent the cam development and thereby diminish the risk for later hip OA is not known. Cam deformity can contribute to femoroacetabular impingement syndrome (FAIS). In patients with FAIS, arthroscopic hip surgery (reshaping the hip and repair of cartilage and labral damage) has been compared to physiotherapy-led care in several randomized controlled trials. Meta-analyses show no difference in symptoms at 2-year of follow-up.[143,144] A recent randomized controlled trial comparing hip arthroscopy to sham surgery neither found a difference for pain at 1-year.[145] It is unclear whether surgery or nonsurgical treatment will prevent OA in the longer term.

Secondary prevention

Secondary prevention aims to reduce the impact of a disease that has already occurred. Detecting and treating the disease as soon as possible to halt or slow its progress should do this. In other diseases, this is done by screening (for instance, breast cancer screening programs) for the disease before the people present with symptoms. To the best of our knowledge, there have not yet been intervention studies where people were screened for very early signs or symptoms of OA before they presented to any healthcare provider. As early-stage OA criteria already have been proposed for knee OA, such studies will likely appear in the near future. Screening for such early-stage OA could be done in high-risk populations that are easy to identify. Interventions that should be considered are those that are harmless and effective in established OA (for instance, weight loss and exercise).

OA and comorbidities

People with OA frequently have multiple comorbidities. The coexistence of the comorbidities and OA could be due to their shared risk factors, or OA may have a pathological role in the occurrence of some of these comorbidities. Results from a systematic review and meta-analysis reported that the pooled prevalence of any chronic condition among individuals with OA was 66% (95% confidence intervals (CI): 58−74). Of them, 29% had one, 25% had two, and 24% had three or more

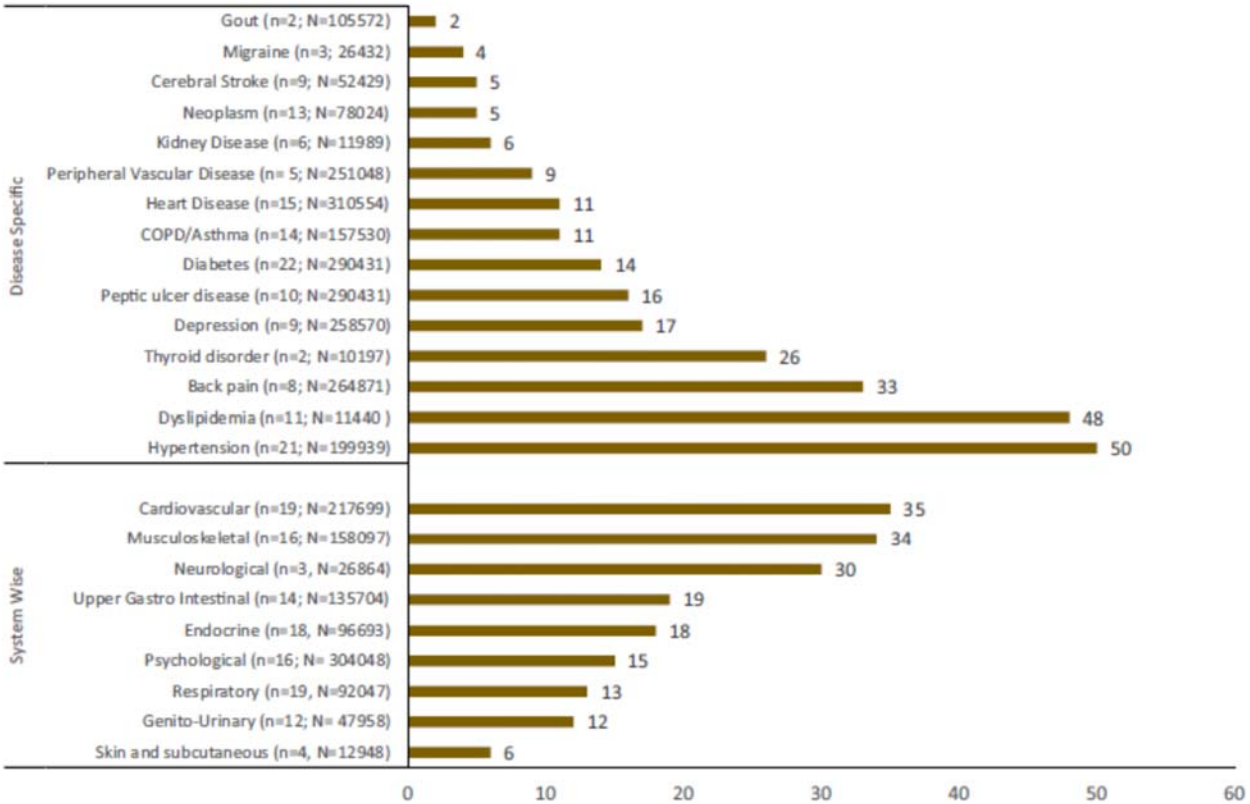


FIGURE 3.4 Prevalence (%) of comorbidities in individuals with OA (disease and system specific). n = number of studies; N = number of participants; COPD = chronic obstructive pulmonary disease. *Reproduced from Swain S, et al. Comorbidities in osteoarthritis: a systematic review and meta-analysis of observational studies.* Arthritis Care Res. *2020;72(7):991−1000.*

comorbidities.[146] As shown in Fig. 3.4, approximately half of people with OA had hypertension (prevalence: 50%, 95% CI: 36%−57%) or dyslipidemia (prevalence: 48%, 95% CI:14%−66%); one-third had back pain (prevalence: 33%, 95% CI:11%−37%), one quartile had thyroid disorder (prevalence: 26%, 95% CI: 6%−68%), and slightly less than one-fifth had depression (prevalence: 17%, 95% CI: 12%−22%) or peptic ulcer diseases (prevalence: 16%, 95% CI: 8%−23%). Comorbidities were more likely involved in cardiovascular (35%), musculoskeletal (34%), neurologic (30%), and upper gastrointestinal (19%) systems.[146] Other studies also reported that subjects with OA were at an increased risk of cardiovascular diseases,[123] gastrointestinal bleeding,[147] venous thromboembolism,[148] and depression.[149,150]

The pathological mechanisms linking OA to the comorbidities may be partly due to their shared risk factors (e.g., old age, overweight/obesity).[123] In addition, chronic pain, pain-induced immobility, low-grade inflammation, frequent use of pain-relief medication (i.e., nonsteroidal antiinflammatory drugs) from OA may also affect the occurrence of comorbidities or aggravate the severity of these comorbidities. Recognition of comorbidities of OA and their coexistent pattern with OA not only helps shed light on our understanding the etiology of OA and its comorbidities, but also guides the development of targeted preventive and treatment strategies for these diseases. For example, weight loss among people with obesity and overweight, coupled with regular participation in physical exercise, will benefit both OA and many other comorbidities, such as cardiovascular disease. These strategies may also mitigate the risk of toxic effects by avoiding long-term use of nonsteroidal antiinflammatory drugs on the gastrointestinal and cardiovascular systems.[151,152]

In summary, OA is the most common joint disorder, characterized by pain, impaired function, and reduced quality of life. Female sex, old age, overweight/obesity, and joint injury are most important risk factors for OA. Many people with OA also have comorbidities. With the aging of the population and the obesity epidemic globally, OA will become a great burden on society. Strategies aiming at maintaining normal weight, avoiding overuse and injury of joints, and minimizing toxic effects of long-term use of pain medications should be promoted to reduce the burden of OA and its comorbidities.

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Chapter 4

Core components of best evidence OA care: management planning, education, supporting self-management and behavior change

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Clinical practice points/evidence summary

- Core components of OA care include self-management support and education, exercise, and weight management.
- Information sharing and education alone are insufficient to improve clinical outcomes and motivate behavior change.
- Comprehensive management is best achieved when it is person-centered and goal-driven; utilizing a bio-psychosocial approach.
- For best results, management plans should be based on a behavioral framework such as Social Cognitive Theory and integrate behavior change techniques into practice.

Introduction to core components of best evidence OA care

There is consensus among international guidelines that the core treatments for osteoarthritis (OA) are arthritis education and support for self-management, as well as lifestyle interventions, such as exercise and weight management.[1–5] (Fig. 4.1). In this chapter, we aim to describe key components of an evidence-based OA management program (OAMP) and briefly summarize the evidence that supports the core treatment strategies of OA care. This chapter will also describe a comprehensive approach to OA management, explain why education and self-management support are essential for care, and identify key elements of behavior change. At the end of this chapter, there will be a case study that will show how these strategies can be implemented into an OA care plan. Further details of strategies to implement lifestyle interventions will be described in depth in Chapters 5 and 6.

Key components of best evidence OA care

The Joint Effort Initiative (JEI) is a collaboration between international researchers and clinicians with the aim of successful implementation of OAMPs.[6] In their recent publication of a consensus exercise to determine the priorities for the effective implements of OAMPs, they defined the key components of an evidence-based, nonsurgical OAMP:

- Care that is tailored, personalized, and person-centered;
- Includes longitudinal reassessment and progression;

Osteoarthritis Health Professional Training Manual. https://doi.org/10.1016/B978-0-323-99269-5.00004-9

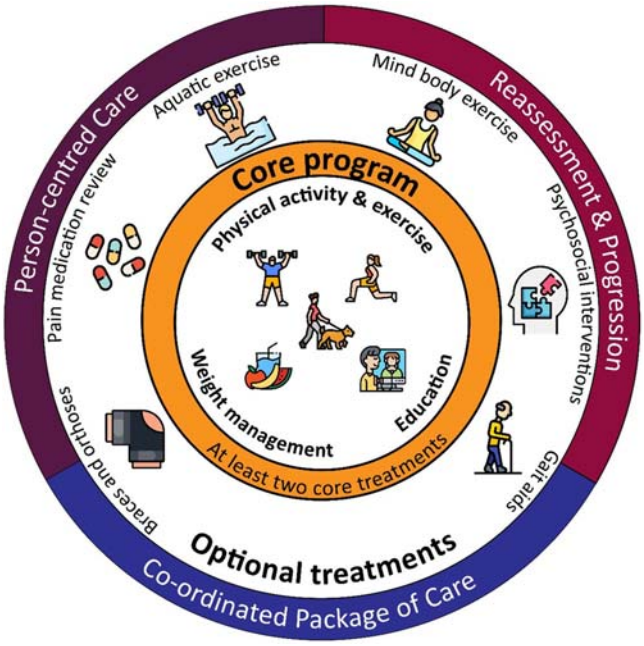

FIGURE 4.1 Core aspects of OA Management Programs. *Permission granted for reuse Kobayashi et al. (2021) Clin Geriat Med.*

- Comprises at least two of the core high-value treatments for OA: education and self-management, exercise, and weight loss/management; and
- May also include optional evidence-based adjunctive treatments (Chapter 7), as required.

Person-centered care is at the crux of best evidence OA care. Considering comorbidities, as well as social and personal situations of a person with OA, is important in deciding their pathway of care. This is especially important in implementing exercise and weight management lifestyle interventions that are at the core of best evidence OAMPs, as they are difficult to implement and sustain.[7] Strategies for long-term behavior change that are regularly reassessed and progressed and that encourage self-management should be considered when managing care for people with OA.

Brief summary of evidence supporting core components of best evidence OA care

Education and support for self-management

OA education is considered the first step in an OA treatment plan.[7] Despite a lack of strong evidence on its positive effects on pain and function, education about the condition, its progression, and strategies for self-management are considered essential to delivering care for people with knee and hip OA.[1] OA education and support for self-management can be delivered individually during clinical consultations, online or in a group as part of a self-management program. Self-management programs are primarily education-based[8] and are designed to:

- Encourage people with OA to be active in managing their own condition;
- Improve pain and function by supporting people with OA; and
- Modify behavior.

People with OA who engage with self-management education programs may develop skills such as problem-solving, shared decision-making with healthcare professionals, and finding and using helpful resources. These skills empower people with OA to self-manage their own symptoms in a way that works best for them and avoids relying on medical treatments (such as pharmacological and surgical interventions).[7]

Increasing physical activity and exercise

All international guidelines for OA management recommend therapeutic exercise and physical activity as core treatments for everyone living with OA.[7] Exercise and physical activity are safe for people with all severities of OA, as well as any comorbid health condition.[1] Therapeutic exercise has been shown to reduce knee pain and improve function in people with knee OA, with sustained benefits for at least 2–6 months following cessation of treatment.[9] There is, however, a lack of high-quality evidence to demonstrate the positive effects of exercise in people with hip and hand OA. Despite this,

undertaking therapeutic exercise or managing physical activity goals is still important in maintaining strength and function for people with OA. Although there is stronger evidence for land-based exercises, water-based exercises such as aqua aerobics, hydrotherapy, and swimming can be used as low-risk and low-impact alternatives to land-based exercises and are conditionally recommended for people with hip and knee OA, particularly for those who have increased pain as a result of weight-bearing.

Weight management

Weight loss is strongly recommended by international guidelines for people with OA who are overweight or obese.[1,3] Being obese or overweight is associated with the incidence of knee and hip OA, as well as the progression of knee OA. It is also correlated with increased pain levels. Weight loss of more than 5% reduces pain and improves function in people with OA who are overweight or obese. More weight loss (e.g., $\geq$10%) further reduces pain and improves function.[10] Guidelines recommend that people with OA achieve this weight reduction through a combination of diet and exercise that is most appropriate for them. The Royal Australian College of General Practitioners recommends that a strength training exercise program should be undertaken alongside a weight loss program to reduce potential loss of muscle mass and bone mineral density as a result of a change in diet. When managing people with OA with comorbidities, a referral to a dietician should be considered so that weight loss is managed safely.

Evidence-based guidelines and recommendations for the management of osteoarthritis are published and updated regularly by leading organizations (e.g., American College of Rheumatology, Arthritis Foundation); however, these guidelines often lack practical implementation guidance, which will be the focus of the remainder of this chapter.

A comprehensive approach to osteoarthritis management

Given that OA affects multiple domains of an individual's life, a comprehensive approach to OA management is necessary. A comprehensive management program is personalized and person-centered—guided by a patient's goals and preferences, based on the patient's unique needs and readiness to make changes, and weighs risks and benefits of treatment options.[11] To assist patients in developing the capacity to manage their condition and choose courses of action that lead to better health outcomes, comprehensive management programs should incorporate educational, behavioral, psychosocial, and physical interventions.[3] Which intervention is chosen first and their order will vary among patients.

Utilizes a biopsychosocial approach and perspective

Comprehensive management programs are holistic and address both the physical and psychosocial health needs of a patient. Individuals with OA often have complex needs, which are best addressed with a biopsychosocial approach and perspective.[12] Fig. 4.2 can be used as an aid when developing a comprehensive management plan. While not every topic or suggestion of individual importance is covered, this is a great starting point and provides an overview of needs that might be addressed in the development of a comprehensive management plan utilizing a biopsychosocial approach.

Interdisciplinary coordinated care

A comprehensive management program involves multiple disciplines and may require the enlistment of or referral to specialists in addition to the primary clinician to effectively care for individuals with OA (discussed in Chapter 10). Regardless of the healthcare system structure, a coordinated approach is needed as care is typically provided by a range of clinicians (e.g., doctors, nurses, physiotherapists, mental health specialists, social workers, dietitians, exercise physiologists, and other allied health professionals) and from one or more organizations (e.g., hospital groups, advocacy and support groups, community activity, and education programs). Interdisciplinary care promotes coordinated and coherent comprehensive management where team members work together to improve the experience and outcomes for the patient with consistent messages across the team.[13]

Success of any plan or program is determined by the individual's willingness and abilities to adopt medical and lifestyle recommendations. Any program will need to be tailored to the individual as they are fully responsible for their own decisions and self-care behaviors, which largely take place outside the purview of the healthcare establishment. Nevertheless, encounters with clinicians play a powerful role in shaping the beliefs and behavior of individuals with OA. During medical encounters, clinicians have the opportunity to create supportive and positive experiences, boost realistic therapeutic expectations, and influence a patient's decision-making processes.[14–16]

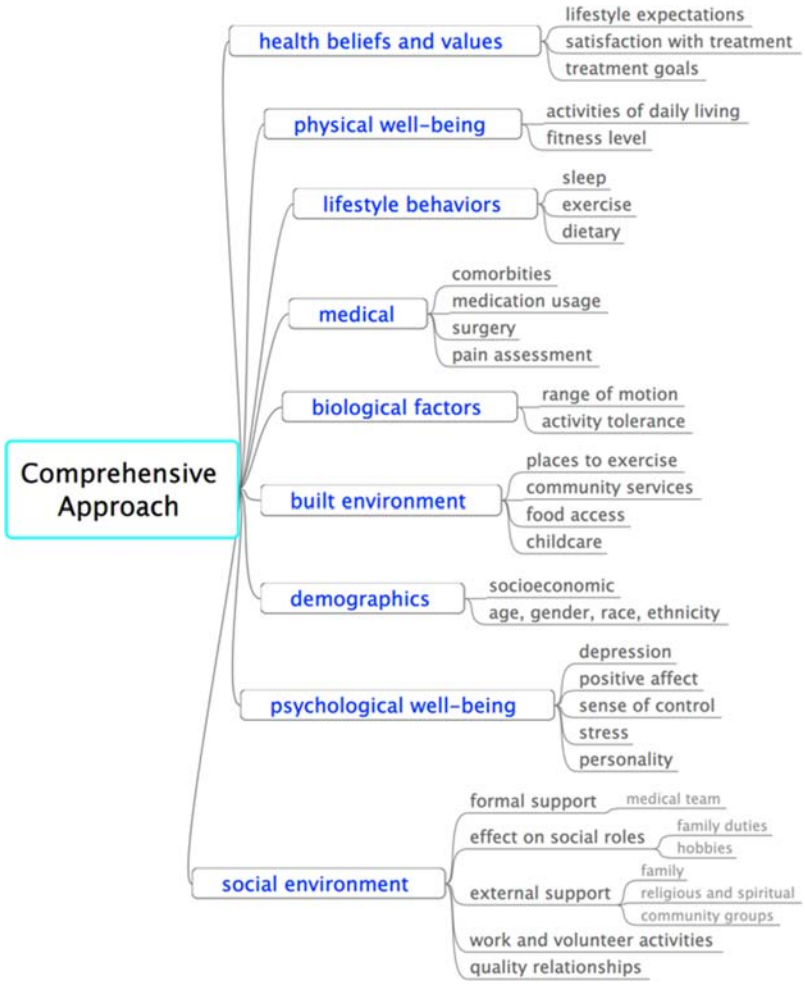

FIGURE 4.2 Topics to consider when developing a comprehensive management plan for individuals with osteoarthritis. *Figure format adapted from National Institute for Health and Care Excellence [NICE], 2014.*

Key elements: self-efficacy, goals, strengths and available resources, and behavior change techniques

Comprehensive management plans are developed with a focus on the patient's current life context and capacity for self-management. With this understanding, at minimum, plans should direct efforts at increasing and maintaining self-efficacy for self-management behaviors by incorporating patient goals, considering individual strengths and available resources, and using a variety of behavior change techniques.

Self-efficacy

Comprehensive management programs achieve better results when efforts are directed at increasing an individual's self-efficacy for self-management tasks. Self-efficacy is an individual's belief in one's capabilities to effectively perform the tasks needed to attain a valued goal or outcome.[17] Clinicians engage individuals in a goal-setting process that considers an individual's strengths and available resources needed for attainment.

Goal-driven

Comprehensive management explores the risks, benefits, and consequences of treatment options and discusses the individual's beliefs, values and treatment expectations in the context of their experiences and goals. This goal-driven process is central to successful self-management and serves to motivate individuals to alter behavior, remove barriers, and achieve desired goals.[18] It is important to note that goals are hierarchical and must be valued by the patient. Linking goals with

values provides activities, which otherwise seem unimportant, with meaning and purpose. For example, a goal, such as exercising 3 days a week, is often viewed as not important by the patient, but when exercise is linked to the ability to spend more time with grandchildren or participate in an enjoyable hobby, the goal is then valued.

With established goals, along with provider feedback and monitoring, individuals are more likely to engage in self-regulation—systematic efforts to direct thoughts, feelings, and actions toward the attainment of one's goals.[19] Clinicians should engage individuals in the goal-setting process, help establish measurable and achievable goals based on ability and perceived self-efficacy, and continually assess, monitor, provide feedback, and as needed, assist in revising goals. After the establishment of appropriate goals, most individuals will need further assistance in interpreting symptoms and emotional states, subsequent effects of changing symptoms, and how to use this feedback to make appropriate decisions about daily self-management behavior. When individuals struggle with goal achievement, clinicians can use the opportunity to reframe the struggle as a problem to be solved by offering positive affirmation of progress and effort and by exploring solutions to barriers. When individuals are successful at mastering goals, this serves as a primary source of information for increasing self-efficacy for the task at hand.

Considers individual strengths and available resources

As individuals adopt behaviors and orient actions toward goal achievement, strengths and resources of various types will be needed as obstacles and barriers arise. Common obstacles and barriers cited by patients with OA include lack of time, pain beliefs, fear, limited resources, lack of support, and unrealistic expectations.[20,21] Often patients and clinicians utilize a deficit-based approach to problem-solving—describing individuals and diseases in negative terms; focusing on behavioral failings, what is wrong or what needs to be fixed.[22] On the other hand, when clinicians understand that patients have internal and external strengths and resources to influence outcomes, they are utilizing a strength-based approach—"*the repertoire of potentials — internal and external strength qualities in the individual's possession, both innate and acquired — that mobilize positive health behaviors and optimal health/wellness outcomes*".[23]

To increase motivation, it is imperative to know that internal strengths and resources are at the heart of behavior change. Individual well-being comes from within, beginning with strengths, values, and beliefs, which lead to sustained behavior change.[24] The holistic approach starts at the personal level, promoting a sense of energized calm that draws on inner strengths and understanding more so than reacting to external stressors and influences.[25] This inside-out perspective builds greater self-regulatory capacity for engaging in healthful behaviors and when faced with barriers, individuals will assess if they have the individual strengths and available resources to overcome problems.[26] Motivation originates from within, at the personal level, and informs how one interacts at the interpersonal and community levels. An exploration of potential strengths and resources that an individual can draw upon is displayed in Fig. 4.3.

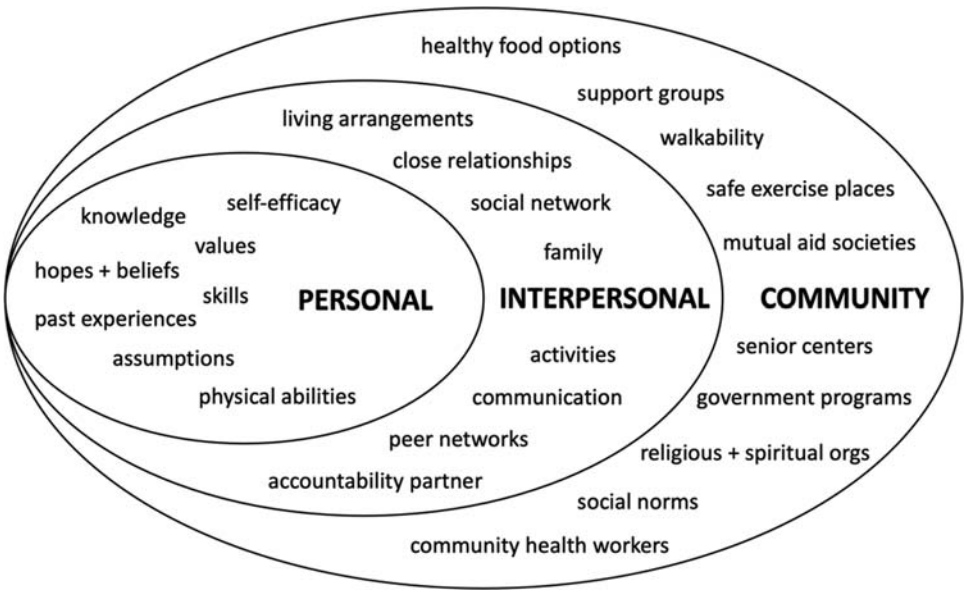

FIGURE 4.3 Support and resources available to individuals with osteoarthritis.

Incorporates a range of behavior change techniques

An understanding of behavior change techniques is essential to support behavior change (covered in next section). Behavior change techniques (BCTs) are the smallest active components of interventions.[27] Clinicians need a number of BCT to draw upon as effectiveness is largely determined by factors outside of the clinician's control (i.e., individual characteristics, core beliefs, personality, social environment, etc.). Some of the BCTs shown to be effective in the treatment of osteoarthritis can be found in Table 4.1. The following sections will take an expanded look at two BCTs widely used in practice: monitoring and education support.

Approaches to monitoring treatment progress and adjusting management plans

The success of any management plan relies on the ability to measure and monitor a patient's symptoms, function, and psychosocial well-being over time. Lack of social support and psychological states, such as depression, may affect pain perceptions, functional outcomes, and adherence. As a patient's condition and needs evolve, the comprehensive management plan will need to be adjusted and optimized. Monitoring is a tool that can be used to gauge treatment effectiveness and aide in identifying barriers and adverse effects, identify treatment limitations, and bolster self-monitoring behaviors.[30,31]

Regular monitoring

Regularly conducting monitoring facilitates communication about treatment goals, mastery and accomplishments, progress, and adjustment of previously set goals. Furthermore, monitoring demonstrates the provider's interest in the patient's well-being, serving as a source of motivation and support. Table 4.2 lists some benefits associated with monitoring.[30,32] To assist healthcare practitioners in optimizing treatment, well-being, and quality of life of individuals with osteoarthritis,

TABLE 4.1 Behavior change techniques used in osteoarthritis.

Behavior change technique	Definition
Goal setting	Set or agree on a goal defined in terms of the behavior to be achieved.
Goal review	Review of previously set goals and modify goal or behavior change strategy in light of achievement.
Problem solving	Prompt the person to analyze factors influencing the behavior and generate or select strategies that include overcoming barriers and/or increasing facilitators.
Action planning	Prompt detailed planning of performance of the behavior.
Behavioral contract	Create a written specification of the behavior to be performed, agreed on by the person, and witnessed by another.
Feedback and monitoring	Monitor and provide informative or evaluative feedback on performance of the behavior.
Role playing (demonstration and practice)	Provide opportunities for client to perform behavior in simulated situation.
Social support	Advise on, arrange or provide social support (e.g., from friends, relatives, colleagues,' buddies' or staff) or noncontingent praise or reward for performance of the behavior.
Adding objects to the environment	Add objects to the environment in order to facilitate performance of the behavior.
Shared decision making	Generate alternative courses of action, and weighs the pros and cons of each.

Adapted from Michie S, Richardson M, Johnston M, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. Ann Behav Med 2013;46(1):81–95. https://doi.org/10.1007/s12160-013-9486-6; Eisele A, Schagg D, Krämer LV, Bengel J, Göhner W. Behaviour change techniques applied in interventions to enhance physical activity adherence in patients with chronic musculoskeletal conditions: a systematic review and meta-analysis. Patient Educ Counsel 2019;102(1), 25–36. https://doi.org/10.1016/j.pec.2018.09.018; Willett M, Duda J, Fenton S, Gautrey C, Greig C, Rushton A. Effectiveness of behaviour change techniques in physiotherapy interventions to promote physical activity adherence in lower limb osteoarthritis patients: a systematic review. PLoS One, 2019;14(7):e0219482. https://doi.org/10.1371/journal.pone.0219482

TABLE 4.2 Potential benefits associated with monitoring.
Increased self-efficacy
Goal attainment
Motivation
Reduced depression, anxiety, and perceived stress
Enhanced psychological well-being
Reduced strain on social networks

effective monitoring should be conducted at regular intervals using validated assessment tools. This information can then be used in the revision and adjustment of self-management plans.

Use validated psychosocial tools to aid in assessment and to support monitoring

Along with history taking and physical assessment (covered in Chapter 2), it is important to initially and continually assess psychosocial factors that may affect the patient's quality of life and their ability to carry out their usual activities. Validated measures can be either generic or disease-specific. Depending on the key areas identified in consultation with the patient, selected measures will vary from patient to patient. See Table 4.3, for examples of validated psychosocial tools used to support monitoring.[33] It is important to note that osteoarthritis affects many areas of an individual's life and clinicians will need to select measures that adequately capture domains of functioning and well-being most relevant to the individual.[34]

Regularly review plan and adjust

Frequent review and adjustment of the comprehensive management plan are key in supporting individuals to self-manage and developing the abilities to self-monitor and self-adjust lifestyle behaviors. A regular review of the plan with each

TABLE 4.3 Osteoarthritis-specific and generic psychosocial measures used in monitoring osteoarthritis.
Osteoarthritis specific psychosocial measures
Western Ontario and McMaster Osteoarthritis Index (WOMAC)
Knee Injury and Osteoarthritis Outcome Score (KOOS)
Western Ontario Osteoarthritis of the Shoulder index (WOOS)
Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH)
Hip Disability and Osteoarthritis Outcome Score (HOOS)
Australian/Canadian Hand Osteoarthritis index (AUSCAN)
Generic psychosocial measures
36-item Short Form Health Survey (SF-36)
European Quality of Life-5 Dimensions questionnaire (EQ-5D)
Arthritis Self-Efficacy Scale (ASES)
Pepper Assessment Tool for Disability (PAT-D)
Montreal Cognitive Assessment (MoCA)
Pain Catastrophizing Scale (PCS)
Intermittent and Constant Assessment of Pain (ICOAP)

Adapted from Peat G, Porcheret M, Bedson J, Ward AM. Monitoring in osteoarthritis. In Evidence-based Medical Monitoring. Blackwell Publishing Ltd; 2008: 335–336. https://doi.org/10.1002/9780470696323.ch24; Busija L, Osborne RH, Roberts C, Buchbinder R. Systematic review showed measures of individual burden of osteoarthritis poorly capture the patient experience. J Clin Epidemiol 2013;66(8):826–837. https://doi.org/10.1016/j.jclinepi.2013.03.011; Emery CA, Whittaker JL, Mahmoudian A, et al. Establishing outcome measures in early knee osteoarthritis. Nat Rev Rheumatol 2019;15(7):438–448. https://doi.org/10.1038/s41584-019-0237-3.

patient will help identify key barriers and determine whether recommendations have been implemented.[35] Based on this feedback, adjustments to management programs might include the use of simpler treatment regimens, more thorough patient instructions, patient counseling, provision of information, education, reminders, and close follow-up of patients.[32]

Purpose and importance of education and support for self-management

To effectively manage their condition and participate in usual life activities, individuals with OA will need ongoing self-management support and education. The key terms—self-management and self-management support and education—are defined in Table 4.4.

Self-management education increases arthritis related self-efficacy, promotes autonomy, and lessens dependence on the healthcare system. Formal education programs serve as a foundation for an individual's self-management practices and provide an opportunity for trained educators to correct inaccurate or faulty beliefs. Where available and if patients are willing, healthcare professionals may refer patients to community-based arthritis self-management education programs[38]; however, there remains a role for education and support in the clinical setting as maintenance of self-management strategies diminish over time.[39]

Even though contact between clinicians and patients is limited, clinicians play a key role in educating, supporting, and guiding patients. Self-management support includes activities such as information provision and education, support for lifestyle modifications, providing skills training, and assisting with the emotional impact of OA.[40,41] Healthcare practitioners can expand their portfolio of support techniques through continuing education and formalized training. Understanding the self-management education process, developing the skills needed to help people make changes, and integrating these skills into clinical practice will allow clinicians to form a partnership with patients and facilitate continued support for self-management.[42] Table 4.5 includes several elements of person-centered self-management support.

Self-management support strategies

There are many ways to provide support in clinical practice ranging on a continuum from passive information sharing approaches, soliciting patient input through consultation and collaboration, and fully engaging patients in partnership as

TABLE 4.4 Key definitions.

self-management refers to the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences, and lifestyle changes inherent in living with osteoarthritis.
Self-management support and education is defined as the systematic provision of education and supportive interventions by health care staff to increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem-solving support.

From Barlow J. How to use education as an intervention in osteoarthritis. Best Pract Res Clin Rheumatol 2001;15(4):545–558. https://doi.org/10.1053/berh.2001.0172; Institute of Medicine (US). Patient self-management support. In: Adams K, Greiner A, Corrigan J. eds. The 1st Annual Crossing the Quality Chasm Summit: A Focus on Communities. National Academies Press (US); 2004: 57–66. https://doi.org/10.17226/11085.

TABLE 4.5 Person-centered self-management support.

Use active learning approaches. Education is an active process and provides clinicians an opportunity to identify and correct faulty or inaccurate perceptions or beliefs.
Recognize and extend current self-management practices and beliefs. When providing support, discuss preexisting strategies and work with the patient to thoughtfully examine what has worked and what has not.
Identify stressors, barriers, and coping strategies. Identifying existing and possible stressors, while emphasizing that stress is a perception. Identify coping strategies and help develop adaptive-positive coping strategies.
Avoid doing too much at one time. Tackling many adjustments at one time can be overwhelming and quickly lead to poor adherence.

they take ownership over their health and health-related outcomes.[43–46] Each type of support along this continuum is important for the encouragement of self-management, but information sharing alone is unlikely to be sufficient to improve clinical outcomes and motivate behavior change. Furthermore, chosen strategies must match the individual's ability, willingness, and motivation to engage in self-management. More active behavioral change interventions are unlikely to have an effect if an individual is not ready to adjust their lifestyle.

A useful framework to guide clinicians in matching appropriate support strategies with an individual's motivational level is the transtheoretical model of behavioral change, commonly referred to as stages of change.[47]

1. Precontemplation (no intention of changing behaviors)
2. Contemplation (ambivalent about behavior change)
3. Preparation (starting the process of changing behavior)
4. Action (behaviors have been adopted)
5. Maintenance (adherence to behavior change over time)

Clinicians will need to employ a range of strategies, some of which are highlighted in Table 4.6 to help an individual move from precontemplation and contemplation through to preparation, action, and then to maintenance.[48]

TABLE 4.6 Support of self-management in clinical practice.

Information sharing: *patient receives information*	
Written information	Information about the diagnosis, available treatment options, and what to expect.
Patient education	Strategies or experiences designed to help individuals understand and improve their health by increasing their knowledge or influencing their attitudes.
Access to health Records	Enabling individuals to access their paper or electronic medical records, health information or electronically communicate with their clinicians.
Consultation and collaboration: *patient consulted on perceptions and engages in decision-making*	
Decision support tools	Informational resources about the benefits and consequences of treatment options.
Goal setting and follow-up	The process of setting realistic and achievable goals, also known as SMART goals (specific, measurable, achievable, realistic, and timely).
Shared decision making	Patients and clinicians work together to weigh possible options, choices, and preferences.
Agenda setting	Asking the patient's perspective and goals for the consultation at the beginning of the visit.
Closing the loop	Following up with a patient after answering a question or providing information by asking the patient to restate (teach back) the shared information.
Ask-tell-ask	Providing information that the patient is interested in by (1) Asking patients what they know and what they want to know; (2) Tells patients what they want to know; and (3) ask again, to find out whether patients understand what was said and what else they want to know.
Partnership: *engaged patients where providers accompany patient in development of self-management capabilities*	
Motivational interviewing	A systematic method clinicians use to determine readiness to change, motivations, strengths, and experiences.
Brief action planning	A formalized process that uses specific questions and discussion prompts to develop courses of actions that lead to goal attainment.
Problem-solving	Process usually involves problem identification; brainstorming of possible solutions; formulating a plan, solution implementation, and the evaluation of results
5 As model	The 5 As are: assess, advise, agree, assist, and arrange.

Adapted from Carman KL, Dardess P, Maurer M, et al. Patient and family engagement: a framework for understanding the elements and developing interventions and policies. Health Aff 2013;32(2):223–231. https://doi.org/10.1377/hlthaff.2012.1133; Grande SW, Faber MJ, Durand MA, Thompson R, Elwyn G. A classification model of patient engagement methods and assessment of their feasibility in real-world settings. Patient Educ Counsel 2014;95(2), 281–287. https://doi.org/10.1016/j.pec.2014.01.016; McGowan PT. Self-management education and support in chronic disease management. Prim Care, 2012;39(2):307–325. https://doi.org/10.1016/j.pop.2012.03.005; Pomey M-P, Flora L, Karazivan P, et al. The Montreal model: the challenges of a partnership relationship between patients and healthcare professionals. Sante Publique 2015;27(1 Suppl):S41–S50. https://doi.org/10.3917/SPUB.150.0041.

TABLE 4.7 Responding to emotions.

Naming or labeling the emotion: "That seems sad for you."
Legitimation: "It's only natural to feel that …. "
Understandability: "I can imagine that must have been quite upsetting."
Validation: "Yes, this is a very anxiety-provoking time for you."
Respect: "You've really dealt remarkably well with this."
Empathy: "I understand how this might make you anxious. Would like to discuss this."
Tangible help: "Here are some ways I can help …. "
Partnership: "Together, I think we can get on top of this."
Support: "I am here to help you …. "

Epstein RM, Street Jr, RL. Patient-centered communication in cancer care: promoting healing and reducing suffering. Communication 2007;222. https://doi.org/10.1037/e481972008-001; Smith RC, Hoppe RB. The patient's story: integrating the patient- and physician-centered approaches to interviewing. Ann Intern Med 1991;115(6):470–477. https://doi.org/10.7326/0003-4819-115-6-470.

Responding to emotions

Living with OA elicits a range of emotions that are in constant flux as individuals respond to, interpret, and cope with daily symptoms. An individual's emotional state can impact quality of life, the ability to self-manage, interpretation of pain, and responses to treatment. Being present, available, and focused on the patient within the consultation provides an opportunity for individuals to share emotional concerns, such as: uncertainty about disease progression; anxiety caused by the fear of pain and flare-ups; and depression resulting from loss of ability. Effective responses that provide acknowledgment and validation to help individuals process their emotions are demonstrated in Table 4.7. Furthermore, emotional care can be provided through the exercise of communication skills, such as: active listening, making eye contact, observing of body language, allowing silence, stopping distracting behaviors (e.g., computer use), and self-monitoring of your own reactions, feelings, and perspectives.[51]

Soliciting and responding to emotional dimensions of health provide clinicians an opportunity to assist patients in reinterpreting physiological states and developing effective coping strategies. Drivers of pain and disability are often based on faulty beliefs and assumptions. For example, individuals may avoid exercise, believing that exercise will cause further pain and "wear and tear." Clinicians can also assist individuals in exploring the cyclic relationship between physical and emotional symptoms. Individuals with OA often get stuck in a cycle where symptoms (e.g., pain) lead to emotional stress, and then emotional stress makes the perception of symptoms worse (e.g., pain catastrophizing). As pain increases an individual might avoid exercise, which can lead to depression and fatigue, causing worsening symptoms. When individuals are given the opportunity to reinterpret their symptoms and related beliefs in a new light, they begin to view their disease differently, providing them with an opportunity to increase self-efficacy to exercise greater control over how osteoarthritis affects their day-to-day experiences.[52]

For an individual to adapt, to overcome obstacles and barriers, which impede progress toward one's goals, they must have the resources to cope, monitor, and adjust day-to-day activities and lead productive healthy lives. Individuals will avoid activities and situations if they believe they possess deficient coping capabilities. Some effective coping strategies are listed in Table 4.8*: Adaptive Coping Strategies*.

Need for a framework

This chapter, thus far, has discussed many aspects of productive clinical encounters: development of a self-management plan, aspects of education and support, responding to emotions, and helping patients cope. Collectively these actions strengthen the therapeutic alliance by fostering a collaborative, emphatic, and supportive environment that positively influences an individual's ability to self-manage.[53] Acknowledging the need to adapt and uniquely approach each patient, clinicians need knowledge of frameworks that help organize their thoughts in a time-constrained environment. As a guide to crafting and designing effective interventions, the next section will introduce theoretical frameworks of behavior change as a much-needed instrument of clinical practice.

TABLE 4.8 Adaptive coping strategies.

Relaxation Techniques: breathing, progressive muscle relaxation
Positive self-talk: negative thoughts or images are replaced with positive self-statements
Distraction: Talking with an exercise partner, listening to music
Cognitive restructuring: Countering irrational thoughts with more positive and realistic coping thoughts
Seeking social support: Joining a support group or community walking program
Positive reappraisal: Instead of dwelling on what they cannot do, they work at being successful at what they can do
Activity pacing: Identify activities one tends to overdo and break the tasks into periods of activity and rest

Gonzalez VM, Goeppinger J, Lorig K. Four psychosocial theories and their application to patient education and clinical practice. Arthritis Care Res 1990;3(3):132–143. https://doi.org/10.1002/ART.1790030305.

Behavior change: why should we use a theoretical framework?

Using a theoretical framework for behavior change in clinical practice to guide discussions with patients assists clinicians in building rapport and selecting the most effective approach to address factors of health and well-being relevant to the individual patient. Frameworks consistently describe, organize, and articulate relationships among various factors involved in the dynamics of behavior and the process of changing behavior. Simply raising awareness of behavior with a patient is generally insufficient to promote behavior change. Likewise, targeting one element of behavior change (e.g., ability) without simultaneously considering other influences of behavior (e.g., emotion) often leads to ineffective treatment. In this section, common elements of behavior change will be defined, self-efficacy will be highlighted as a central element in the behavior change process, and a case study will be used to illustrate the use of a theoretical framework in practice.

Common elements of behavior change theory

In the field of health promotion and behavioral science, there is an overwhelming number of theories and frameworks, often using different names for similarly defined elements.[54] Yet, a growing body of evidence demonstrates that predicting and understanding behavior can be accomplished by targeting a small number of elements or determinants of behavior. Comprehensive management plans and behavioral interventions should be designed to target, at a minimum, the elements listed in Table 4.9.

TABLE 4.9 Common elements of behavior change theories from the Committee on Communication for Behavior Change in the 21st Century.

(1) Self-efficacy	The person perceives that he or she has the capability to perform the behavior under a number of different circumstances.
(2) Goal intention	The person has formed a strong positive intention (or made a commitment) to perform the behavior.
3) Outcome expectations	Person believes that performing the behavior will lead to a certain outcome; advantages of performing the behavior outweigh the disadvantages.
(4) Barriers	Obstacles to overcome.
(5) Skills and abilities	The person has the skills necessary to perform the behavior.
(6) Social norms	The person perceives more social pressure to perform the behavior than not to do so.
(7) Personal norms	The person perceives that performing the behavior is more consistent than inconsistent with his or her own self-image, personal standards or self-standards.

Institute of Medicine (U.S.). Committee on Communication for Behavior Change in the 21st Century: Improving the Health of Diverse Populations. Speaking of Health. National Academies Press; 2002. https://doi.org/10.17226/10018; Bartholomew Eldredge LK, Markham CM, Ruiter RAC, Fernández ME, Kok G, Parcel GS. Planning Health Promotion Programs : An Intervention Mapping Approach. John Wiley & Sons, Incorporated; 2016. http://ebookcentral.proquest.com/lib/wfu/detail.action?docID=4312654; Fishbein M, Triandis HC, Kanfer FH, Becker M, Middlestadt SE, Eichler A. Factors influencing behavior and behavior change. In: Baum AS, Revenson TA, J. E. Singer JE, eds. Handbook of Health Psychology. Psychology Press;2001:3–18. https://doi.org/10.4324/9781410600073.

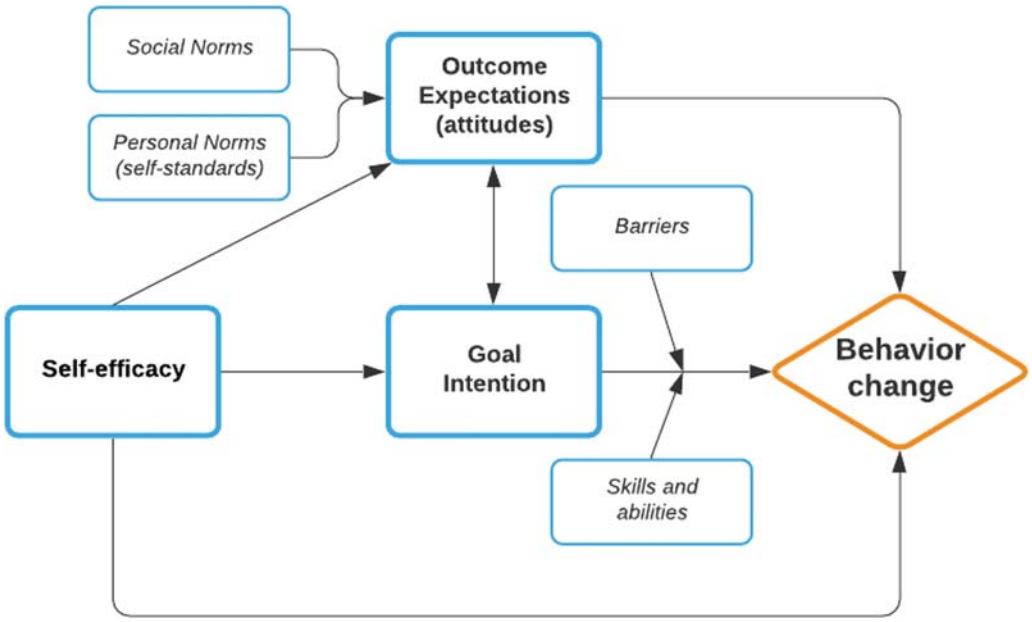

FIGURE 4.4 Social cognitive framework of behavior change.

A social cognitive framework: social cognitive theory

One way to organize the common elements is in a framework based on social cognitive theory (Fig. 4.4). According to Social Cognitive Theory,[17,55] the key elements that influence health behavior change are: (1) *self-efficacy*, (2) *goal intention*, and (3) *outcome expectancies*. For an individual to engage in the behavior change process, they must:

(1) Believe they can perform the desired behavior (*self-efficacy*).
(2) Commit or propose to perform the behavior (*goal intention*).
(3) Believe performing the behavior will lead to a valued outcome (*outcome expectancies*).

Secondary elements that do not directly determine behavior change are (4) *barriers*, (5) *skills and abilities*, (6) *social norms*, and (7) *personal norms*. When an individual moves from *intention* to action, the strength of their intention is influenced by *barriers* and/or *skill and abilities*. The individual might discover that the *barriers*, the obstacles to overcome, are insurmountable; and/or the individual might realize that the actual *skills and abilities* required to execute the behavior are lacking. When forming beliefs about *outcome expectations*, an individual will often consider if the outcome of the behavior will conform to *social norms*. Also of concern is the alignment of the behavior with the individual's self-identity or *personal norms* (self-evaluative costs and benefits for different health habits).

Promoting self-efficacy: the central element

Self-efficacy, the confidence in one's ability to carry out actions necessary to perform the desired behavior change, is the central element of most behavioral frameworks.[17] Self-management education and support provide a solid foundation for the development of one's self-efficacy. Clinicians can further enhance and aid in the development of an individual's self-efficacy by targeting four specific sources of self-efficacy: mastery experiences (e.g., experiencing success, facilitation of task mastery), vicarious experience (e.g., exposure to someone similar having positive experiences and acting successfully), verbal persuasion (e.g., encouragement from others), and interpretation of physiologic/emotional states (e.g., perception of sensations from body, enjoyment, positive mood states) (see Fig. 4.5 and Table 4.10).

These sources of self-efficacy work best in tandem with each other.[58,59] An individual developing confidence in his or her ability to walk as a form of exercise will develop greater self-efficacy judgments through successful completion of walking at greater distances while being able to positively interpret physiological and emotional states that arise while walking (i.e., pain, stiffness, fear of falling). Table 4.10 includes sources of self-efficacy along with cognitive and behavioral strategies that clinicians can use to enhance self-efficacy.

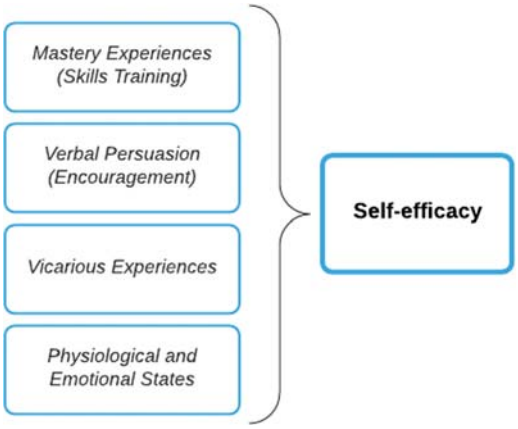

FIGURE 4.5 Sources of self-efficacy.

TABLE 4.10 Sources of self-efficacy and behavioral strategies to enhance self-efficacy.

Sources	Description	Examples of behavioral strategies to enhance self-efficacy
Mastery experiences	Have successful experience with participating in the targeted behavior	Set valued goals that can be reached; goals should be set primarily by the patient.
		Break long-term goals into attainable short-term goals that are at first easy to attain and become more challenging over time.
		Demonstrate skills, giving proper instruction and then guide patients as they attempt to perform the activity.
Vicarious experiences	Exposure to someone of a similar background acting successfully	Refer individuals to community arthritis programs, support groups and other programs experienced in providing support services to individuals with osteoarthritis.
		Provide videos of exercise tasks that reflect relatable adult successfully completing tasks.
		Discuss and provide success stories of individuals with similar background and characteristics.
Verbal persuasion	Have others provide encouragement that he/she can be successful	Give frequent feedback and express confidence in the patient's abilities to perform recommended behaviors.
		Involve family and close relationships in the planning and execution of care.
		Solicit social support and encouragement.
Physiological and emotional states	Aide in the interpretation of symptoms associated with osteoarthritis and behavior change.	Provide education about symptoms associated with having osteoarthritis.
		Provide education that aides in interpretation of pain and emotional states.
		Discuss how exercise and weight management may impact the way the individual feels, both physically and emotionally.

Feedback loops: relationship among past behavior, self-efficacy, and performance

Individuals' beliefs and actions are often mutually reinforcing. Even minor accomplishments can build into major behavior changes. Successful attainment of incremental goals increases self-efficacy beliefs, which in turn increase the likelihood of future engagement with the behavior.[60] Conversely, behavior change attempts viewed as a failure can diminish self-

efficacy, decreasing the likelihood of future behavior change attempts. Although a strong predictor of future behavior is past behavior, when faced with new obstacles individuals rely on perceptions of ability. During setbacks, healthcare practitioners critically influence the way in which individuals self-reflect, evaluate performance, and consider future courses of action. At this critical juncture individuals rely on their self-efficacy, opting to either give up on adopting a behavior, or adjust and retry. Clinicians can encourage individuals to reframe failures as learning experiences and engage together in problem-solving through which goals are reassessed, new resources gathered, and strategies are discussed to positively impact self-efficacy and ultimately future attempts at behavior change.

By organizing these common elements into a framework for behavior change, clinicians can use Social Cognitive Theory to help individuals develop the capacity to self-manage. The following case study will use the many components of comprehensive management to illustrate the use of a social cognitive framework in clinical practice.

Case study

Background information

Six months ago, Helen, a 67-year-old female, was diagnosed with moderate bilateral knee osteoarthritis. At the initial consultation, the rheumatologist explained the diagnosis, disease progression, provided her with an informative handout, and encouraged her to attend a self-management education program. Helen was overwhelmed with the diagnosis and hoped the educational program would answer her questions and reduce her anxiety.

Helen now presents to the rheumatologist for the first time after attending the self-management education program.

Relationship building and assessment

In the previous encounter with Helen, the clinician shared information needed by Helen to make informed decisions about her health. During the current encounter, the clinician should engage Helen in decision-making through consultation and collaboration. To initiate the process, the clinician invites Helen to set the agenda and determine the course of this appointment (i.e., What would you like to focus on during our time together?). Using open-ended questions and active listening, the clinician investigates Helen's concerns, emotions, and main purpose of the clinical encounter.

Helen shares that she was pretty shaken up by her diagnosis. While the self-management education program provided her with useful information and ways to self-manage, Helen feels overwhelmed processing what she has learned. She has contemplated starting to walk more often in her neighborhood and the park close by. But Helen states she is afraid of causing more pain and damage to her knee and is confused as to how exercise might help her pain and functioning.

Helen is married, retired, and has two adult children, one of which lives in the same neighborhood. She cares for her grandchildren, ages 5 and 9, several times a week, and she enjoys hosting family dinners on Sundays. Helen is concerned that her knee osteoarthritis will prevent her from enjoying time with her family. She has experienced unexplained flare-ups, is fearful of exacerbating her symptoms and now avoids some playtime activities with her grandchildren. Helen is concerned that if she is not careful her knee osteoarthritis will prevent her from being involved with her family, especially her grandchildren.

Before soliciting Helen's main concern, it is important to acknowledge and recognize Helen's emotional experience. Validating and legitimizing Helen's emotions and her experience provide an opportunity to show empathy (e.g., "Seems that this is a very anxiety-provoking time for you."; "It's only natural to feel overwhelmed with this new diagnosis.") and to discuss how emotions can be used as a guide to our thinking (e.g., "When we are feeling overwhelmed or perceiving stress it is easy to get caught up in negative thinking; wait for those thoughts to clear before making any decisions about your exercise program or when to play with your grandchildren."). Patients often need increased emotional support while adjusting to a new diagnosis.

Soliciting the main concern

After pausing to provide emotional support, the clinician will have the opportunity to summarize Helen's statements and suggest a discussion related to Helen's main concerns (e.g., "Based on what you have told me, you seem interested in walking regularly to remain physically active. Yet, you are afraid that moving more will make your pain worse. Would you like to focus today's meeting on how to incorporate walking into your daily routine and cope with the pain that might occur?").

Helen concurs with the doctor's assessment. She would like to walk more often, but fears causing pain and is unsure she can adequately manage her pain. Helen is certain that the best way to avoid pain is to scale back her activities. She remains skeptical, but would feel more comfortable exercising if she knew more about dealing with the pain.

Now that the agenda is set, the clinician uses a social cognitive framework and selects appropriate behavior change techniques and coping strategies to help Helen start a walking program and maintain the activity over time.

Using a social cognitive framework – intervention

This behavior change process should begin with what is known about Helen's current intentions, self-management routine and coping practices. Specifically, the clinician should work to understand how Helen copes with pain ("When a flare-up or pain occurs, what steps do you take to alleviate the pain?"). The clinician also checks to see if Helen's exercise goals, intentions, and expected outcomes are realistic and appropriate ("How often and for how long would you like to walk in a given week?" and "If you walk regularly, what outcomes are you hoping for?").

Helen shares that in terms of exercise, she would like to be able to walk for an hour three times a week. Currently, she avoids activities that she believes might cause pain and thinks that once her pain levels increase, she will be unable to control them. When pain and flare-ups occur, Helen explains that she tends to rest in a recliner while trying to figure out how her actions contributed to her pain.

A variety of behavioral change techniques and pain coping strategies might help Helen successfully adopt an exercise program and maintain engagement with her family and grandchildren. However, the clinician's approach should be tailored to Helen's level of readiness for change. In this instance, Helen's readiness to change exercise habits is currently in the action planning stage (preparation), meaning she is seeking to develop strategies that will help her move past barriers, namely pain catastrophizing and lack of confidence in her ability to manage pain.

Pain catastrophizing is an emotional state of fear that the actual or anticipated pain will never be controlled, will get worse, and will never end. Helping Helen develop pain management coping skills might interrupt the fear–avoidance cycle. To cope with pain, Helen avoids activities and when pain does occur, she tends to ruminate and blame herself for causing the pain. Offering alternatives to Helen's maladaptive coping strategies, the clinician can suggest coping strategies such as taking more frequent breaks during physical activities. During moments of rest, Helen can engage in relaxation practices to calm her thoughts (e.g., meditation, stretching) or enjoyable distractions (e.g., reading, calling a loved one, listening to music) instead of ruminating about what she might have done to cause her pain.

Helen explains that she often gets caught up in activities or tasks and prioritizes getting the task done over breaking up the task by incorporating relaxing breaks. She plans to set a timer on her phone to remind her to take a break and plans to experiment with varying break frequencies to find one that works for her.

The clinician agrees that setting a timer is an excellent idea. Recognizing the limited time left during the appointment, the clinician asks if Helen would like to brainstorm ideas and set a goal for Helen's desired walking program.

Helen agrees to discuss the walking program and the clinician offers to write down the ideas they come up with.

Options considered during the brainstorming session can be found in Table 4.11. The clinician focused on suggestions that were likely to increase self-efficacy with the aim of targeting each of the four sources of self-efficacy. In the end, Helen decided that she would exercise in the park, which has a walking path on level terrain and offers benches for rest if she feels that

TABLE 4.11 Options considered during Helen's encounter with the clinician.

Environmental considerations - Location: gym, park, neighborhood - Time of day
Social supports - Community walking program - Exercise partner
Time and duration goals - Building up to 30 min a session - Number of steps, distance walked - Days and minutes
Coping strategies - Listening to music - Walking and talking - Choosing a scenic environment - Taking breaks

she needs a break. Helen and the clinician agree that it would be best to walk for 10 min the first session, adding 5 min a session until she can walk comfortably for 30 min at a time (mastery experiences). The clinician explained to Helen that individuals with knee osteoarthritis often experience a temporary increase in pain at the beginning of a walking session. Often the pain decreases, and Helen should notice that she is in less pain at the end of the session than before. Pain that increases after a session might indicate that Helen overexerted herself, should rest and plan to decrease the speed or distance next time she walks (positively interpret physiological and emotional state).

Helen and the clinician discussed the option of walking with a friend (verbal persuasion) or joining a hospital-sponsored walking program to provide encouragement (vicarious experiences). Helen seemed open to the idea but wanted to have flexibility in when she walked. The clinician provided Helen a list of community exercise programs and encouraged Helen to call the clinic if she had any questions about her walking program or became concerned about her pain levels (verbal persuasion).

In closing, the clinician decides to close the loop and asks Helen to restate the plan they just discussed with regard to Helen's walking program. (e.g., "So, I know we talked about a lot, and I want to ensure we covered everything important to you. Can you explain the plan we decided upon?")

Helen explains the plan to the clinician, adding that she feels less anxious about starting a walking program than earlier in their appointment.

Follow-up and evaluation

In the previous encounter with Helen, the clinician utilized Social Cognitive Theory to frame their discussion and to build strategies into her program to gradually increase Helen's self-efficacy over time. By negotiating and eliciting outcomes that Helen finds valuable, the intervention was tailored to her goals and interests. When Helen returns for her follow-up appointment a few months later, she brings the walking log that she has used to keep track of her time spent walking.

Helen has had some success with meeting her walking goals but expresses concern about those weeks when she didn't hit her target number of minutes walking.

The clinician congratulates Helen on her success and points out how helpful it is that she has monitored her progress with the walking program each week in her log. They then talk about setbacks and how it is important to recognize that everyone has barriers that are difficult to overcome and that they can continue to work together to brainstorm strategies for persevering when faced with challenges, including soliciting support from Helen's family and friends. The clinician points out that it is just as important to forgive oneself for those days when our emotions and thoughts get the best of us, leading to a decision not to walk or meet the walking goal as it is to build in rewards for those weeks when we successfully navigate the many challenges faced in reaching the goals set in the management plan.

Working together, the clinician and the patient have the tools to develop a comprehensive management plan that is flexible and holistic, and that can lead to sustainable behavior change over the long term. This person-centered approach shaped within a biopsychosocial framework, guided by theory and well-tested behavior change techniques is at the heart of meaningful clinical encounters and plays a powerful role in the behavior of individuals with osteoarthritis.

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Chapter 5

Physical activity, exercise, and therapeutic exercise

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Clinical practice points:

- Adults with knee OA typically spend two-thirds of their daily time in sedentary behavior.
- For lower limb OA, a goal of 45 min of moderate-vigorous physical activity per week may improve or sustain high levels of physical function over time.
- For knee OA, walking >6000 steps/day may protect against functional decline over time.
- For lower limb OA, strength training should target the major lower limb muscle groups appropriate for the affected joint, according to individual impairments.
- Where walking function is a problem, strengthening exercises that target both the hip musculature and the quadriceps muscles result in superior outcomes to programs only focused on quadriceps strengthening.
- Exercise programs focusing on quadriceps strength appear to be more beneficial in reducing OA pain and disability than programs aimed at improving general lower limb strength.
- Inclusion of balance exercises in a therapeutic exercise program may be warranted in people with OA when an increased falls risk is identified.
- Of all types of therapeutic exercise, mind-body exercise is the most effective for improving self-reported physical function and is one of the two most effective forms of exercise (alongside aerobic exercise) for reducing joint pain, at least in the short term.
- Evidence suggests that up to 10,000 steps per day of activity do not accelerate OA progression in individuals with pre-existing knee OA.
- Even in people with end-stage knee OA, walking can be performed safely, without exacerbating joint pain.

Physical activity and exercise are first-line, core components of evidence-based management for people with OA, irrespective of patient age, joint involved, radiographic disease severity, pain intensity, functional levels, and comorbidities.[1] This chapter will outline the role of physical activity and exercise in the management of OA. Although OA in general will be covered, knee OA will be a primary focus given that this is the most common lower limb joint affected and that the majority of OA exercise research involves the knee.

What is physical activity, sedentary behavior, exercise, and therapeutic exercise?

Physical activity is "any bodily movement produced by skeletal muscles that results in energy expenditure."[2] Physical activity, therefore, refers to all planned and incidental movement, including during activities of daily living, leisure, sport, for transport, or as part of a person's work. Sedentary behavior is any waking behavior characterized by an energy expenditure $\leq$1.5 metabolic equivalents while in a sitting, reclining, or lying posture,[3] while physical inactivity is an insufficient physical activity level to meet current physical activity recommendations. Exercise is "a subset of physical activity that is planned, structured and repetitive" with the objective of improving or maintaining physical fitness.[2] Therapeutic exercise is prescribed exercise that aims to relieve symptoms, improve function or improve, retain, or slow deterioration of health.[4]

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Recommendations for physical activity in OA

World Health Organization physical activity guidelines[5] for adults and older adults **recommend at least 150–300 min of moderate intensity (e.g. brisk walking, doubles tennis) aerobic physical activity per week, or at least 75–150 min of vigorous intensity (e.g. running, soccer match) activity per week**, along with muscle strengthening on at least 2 days for additional health benefits. Older adults aged 65 years and over are also advised to include varied multicomponent physical activity that emphasizes functional balance and strength training on 3 or more days, to enhance functional capacity and to prevent falls. The World Health Organization also recommends that adults and older adults limit the amount of time spent being sedentary, by replacing sedentary time with physical activity of any intensity.

Doing some physical activity is better than none and there are health benefits with some physical activity, even if recommendations are not met. This is true in OA, where research on people with or at risk of knee OA has shown that, for people with lower extremity joint symptoms, undertaking at least 1 hour of moderate-vigorous activity per week may prevent the development of disability over 4 years.[6] Of particular relevance to people with OA is advice that adults start by doing small amounts of physical activity and gradually increase the frequency, intensity, and duration over time.[5] Adults aged 65 years and over with OA should be as physically active as their functional ability allows and adjust their level of effort for physical activity relative to their level of fitness.[5] In adults with lower extremity symptoms of joint pain/aching/stiffness, a minimum threshold of 45 min of moderate-vigorous physical activity per week predicts improved or sustained high physical function over 2 years[7] and thus can serve as a useful intermediate goal toward achieving public health guideline recommendations for people with lower limb OA.

Recognizing that physical activity recommendations are relevant for people with OA, but may be challenging to achieve given the associated symptoms and impairments, the European League Against Rheumatism has developed 10 recommendations for physical activity and exercise in people with inflammatory arthritis and OA (Table 5.1).[8] The four overarching principles are:

- Physical activity is part of a general concept to optimize health-related quality of life.
- Physical activity has health benefits for people with hip and knee OA.
- General physical activity recommendations, including the four domains (cardiorespiratory fitness, muscle strength, flexibility, and neuromotor performance), are applicable (feasible and safe) in people with OA.
- Planning of physical activity requires a shared decision between healthcare providers and people with hip and knee OA, considering an individual's preferences, capabilities, and resources.

TABLE 5.1 EULAR physical activity recommendations[8] for people with osteoarthritis (OA).

Recommendations
1. Promoting physical activity, consistent with general physical activity recommendations, should be an integral part of standard care throughout the course of disease in people with hip and knee OA.
2. All healthcare providers involved in the management of people with hip and knee OA should take responsibility for promoting physical activity and should cooperate, including making necessary referrals, to ensure that people with hip and knee OA receive appropriate physical activity interventions.
3. Physical activity interventions should be delivered by healthcare providers competent in their delivery to people with hip and knee OA.
4. Healthcare providers should evaluate the type, intensity, frequency and duration of an individual's actual physical activity by means of standardized methods to identify which of the four domains of general physical activity recommendations can be targeted for improvement.
5. General and disease-specific contraindications for physical activity should be identified and taken into account in the promotion of physical activity.
6. Physical activity interventions should have clear personalized aims, which should be evaluated over time, preferably with a combination of subjective and objective measures (including self-monitoring when appropriate).
7. General and disease-specific barriers and facilitators related to performing physical activity, including knowledge, social support, symptom control and self-regulation should be identified and addressed.
8. Where individual adaptations to general physical activity recommendations are needed, these should be based on a comprehensive assessment of physical, social and psychological factors including fatigue, pain, depression and disease activity.
9. Healthcare providers should plan and deliver physical activity interventions that include the behavioral change techniques of self-monitoring, goal setting, action planning, feedback, and problem-solving.
10. Healthcare providers should consider different modes of delivery of physical activity (e.g., supervised/not-supervised, individual/group, face-to-face/online, booster strategies) in line with people's preferences.

The 10 specific recommendations emphasize that promoting general physical activity consistent with public health recommendations is an integral part of care throughout the OA disease course and the responsibility of all healthcare providers. Indeed, adults with arthritis who receive healthcare providers' recommendations for physical activity are more likely to adhere to physical activity guidelines than those who do not.[9]

With the increasing popularity of accessible and inexpensive wearable devices, steps per day are a common and easy measure used by both clinicians and patients to assess and monitor physical activity. For adults and older adults, at least 7000−8000 steps/day are suggested to meet minimal recommended amounts of moderate-vigorous physical activity.[10] In people with or at risk of knee OA, walking >6000 steps/day seems to protect against functional decline over 2 years[11] and each additional 1000 steps/day is associated with 16%−18% less risk of developing functional limitation. These data are helpful for clinicians to consider when developing physical activity goals with their patients with OA.

Consequences of physical inactivity and sedentary behavior in OA

Many people with OA are physically inactive. A systematic review showed that only 13%−41% of people with knee and hip OA achieve the recommended amount of ≥150 min of moderate-vigorous physical activity per week, and only 48% achieve ≥7000 steps per day.[12] Similar findings have emerged from the Osteoarthritis Initiative, where more than 50% of men and nearly 80% of women with or at risk of knee OA do not achieve at least 150 weekly minutes of moderate-vigorous physical activity.[13] Alarmingly, **adults with knee OA typically spend two-thirds of their daily time in sedentary behavior**.[14] There are many complex reasons why people with OA are physically inactive, including activity-related joint pain, fatigue, reduced self-efficacy for exercise, and fear of movement, and these will be explored later in this chapter. Fig. 5.1 depicts the "vicious cycle" of physical inactivity in people with OA, the negative consequences of which will be discussed further in this section.

Physical inactivity is often associated with loss of muscle strength and deconditioning, which in turn can adversely impact OA symptoms and capacity for physical function. In knee OA, evidence suggests that knee extensor weakness is associated with an increased risk of worsening of knee pain and deterioration in physical functioning,[15,16] although findings do differ somewhat across systematic reviews. Although there is evidence that knee extensor weakness is

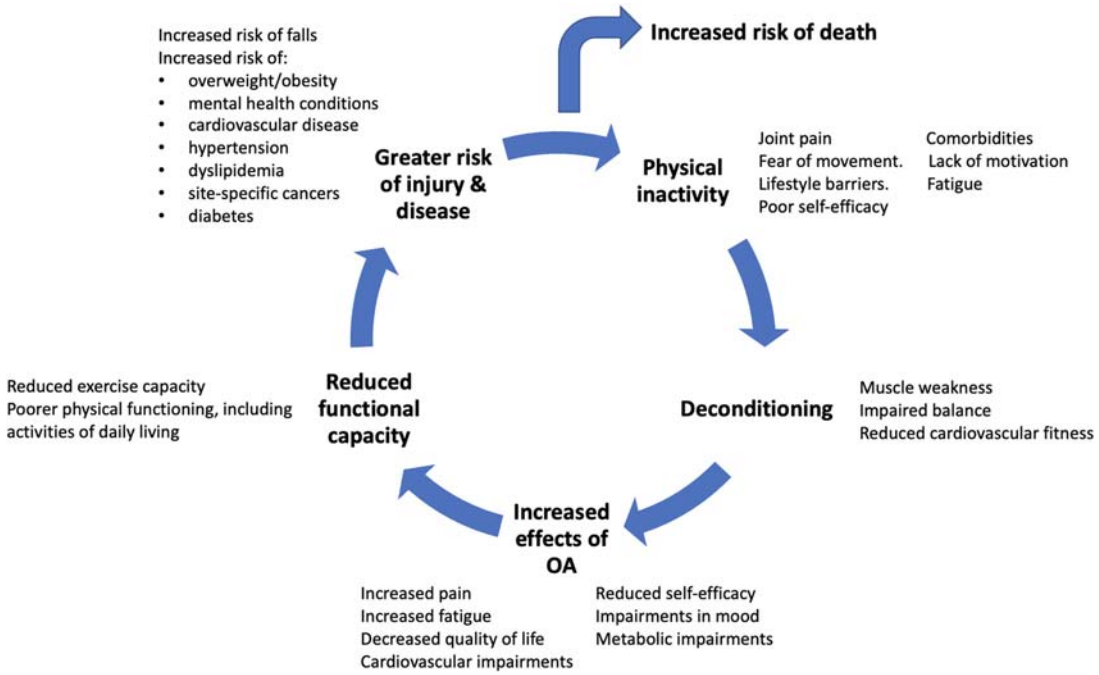

FIGURE 5.1 Vicious cycle of physical inactivity in people with osteoarthritis (OA).

associated with an increased risk of developing knee OA,[17] it does not increase the risk of radiographic knee OA progression, over time.[16,18] In people with hip OA, limited research means links between physical inactivity, muscle weakness, and symptomatic and structural OA deterioration are less clear. Systematic reviews[19,20] describe weak and conflicting evidence that hip abduction muscle weakness, knee extensor weakness, physical inactivity, and no participation in supervised exercise may predict the deterioration of physical function and/or worsening of hip pain over time. Limited research suggests that weaker hand strength is associated with poorer hand function in older adults with hand pain due to OA,[21] and weaker grip strength in people with hand OA is associated with clinically meaningful functional decline over 12−18 months.[22] Although the evidence is limited, grip strength and pinch power do not appear to be prognostic for radiographic interphalangeal joint OA.[23]

Physical inactivity increases the risk of many adverse health conditions, including hypertension, type 2 diabetes, some cancers, anxiety, and depression, as well as shortens life expectancy.[5] Two out of three people with OA suffer from at least one other chronic comorbid medical condition,[24] with the most common including hypertension, dyslipidaemia, back pain, thyroid conditions, and depression. Multimorbidity is frequent, with around a quarter of people with OA having three or more comorbidities.[24] It is therefore not surprising that people with OA are at increased risk of death due to cardiovascular disease,[25] and there is increasing evidence that people with knee symptomatic or radiographic OA are at increased risk of death from any cause.[26] Modeling suggests that, in the United States, if even 20% of the inactive knee OA population was instead active, 95,920 cases of cancer, 222,413 of cardiovascular disease, and 214,725 of diabetes mellitus could potentially be averted.[27] Increasing evidence shows that OA is associated with chronic low-grade inflammation,[28] and physical inactivity can exacerbate this. A physically inactive lifestyle can lead to the accumulation of visceral fat, which, when combined with comorbidities, can exacerbate the systemic inflammation associated with OA and activate a network of inflammatory pathways that can promote metabolic disorders, atherosclerosis, and increase the risk of developing chronic diseases (Fig. 5.2).[29] The development of comorbidities in patients with OA is believed to contribute to a positive feedback loop that further exacerbates systemic inflammation, contributing to a worsening of OA symptoms.

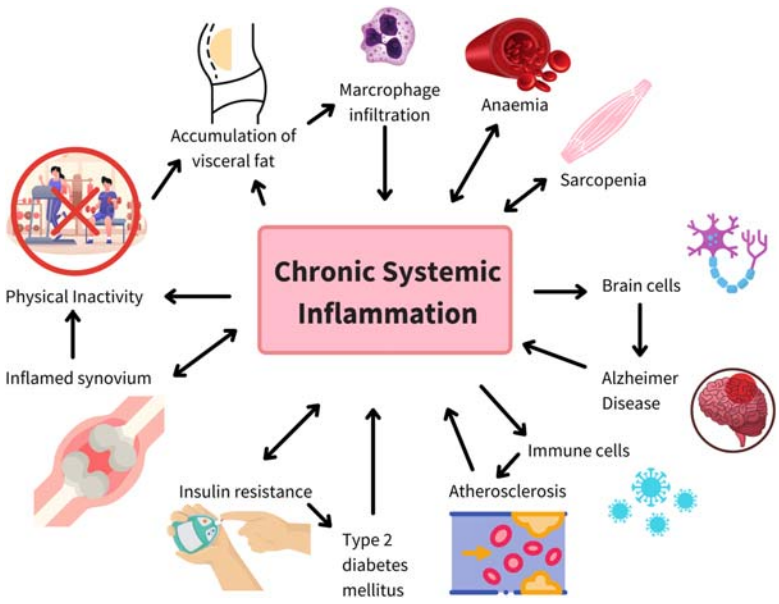

FIGURE 5.2 Relationship of physical inactivity, chronic inflammation, and comorbidities in people with rheumatic diseases.[29]

Physical inactivity and a sedentary lifestyle can contribute to an increased risk of falling and sustaining falls-related injuries in individuals with lower limb OA, particularly among people with knee OA.[30] Compared with people without symptomatic knee or hip OA, the odds of falling increases with an increasing number of lower limb symptomatic OA joints, where people with one OA joint have 53% higher odds, those with two OA joints have 74% higher odds, and those with three to four OA joints have 85% higher odds.[31] Risk factors for falls among people with knee OA[32] include impaired balance, muscle weakness, presence of comorbidities, and increasing number of symptomatic joints, all of which can be linked to physical inactivity.

Types of exercises that are beneficial for people with OA

As of 2002, sufficient research evidence had accumulated to show the significant benefits of exercise interventions compared to no exercise for people with lower limb OA.[33] However, most evidence relates to studies of people with knee OA as there have been far fewer trials in people with hip OA. Nonetheless, a Cochrane review of land-based exercise for hip OA reported improvements in pain and physical function immediately after intervention and 3–6 months later.[34] The evidence is less convincing for hand OA, with only limited low-quality evidence showing small beneficial effects of exercise on hand pain, function, and finger joint stiffness,[35] with benefits of uncertain clinical relevance.

A wide variety of different types of therapeutic exercises can bring health benefits to people with lower limb OA. Although effects vary according to type of exercise, benefits may include improvements in joint pain, physical function, and health-related quality of life,[36] lasting up to 6 months following cessation of a defined program.[37] To date, there are no systematic reviews addressing the benefits of physical activity on comorbid conditions in OA.[37] Exercise therapy can reduce the need for joint replacement by 44% at 6 years in people with hip OA[38] and by 68% at 2 years in knee OA.[39] **Although the size of treatment effects with exercise is only considered small to moderate, the benefits observed are similar in magnitude to those of common pain-relieving drugs used for OA**.[40,41] Land-based exercise appears to be as efficacious as water-based exercise for people with lower limb OA.[37] Water-based exercise (or hydrotherapy) has the additional benefit of buoyancy and decreased joint impact and may be preferable for some, such as those with more advanced disease or when land-based exercise is too painful.[42]

Cardiovascular (aerobic) fitness

Aerobic exercise aims to improve cardiovascular fitness and includes activities such as walking, running, cycling, and swimming. Low-impact aerobic exercise that is gentle and places less stress on the joint, such as walking, cycling, or swimming, may be optimal for people with OA rather than high-impact activity (such as running or jumping) that often involves both feet off the ground at the same time and can increase stress on joints when the foot impacts the ground. Most research evaluating the efficacy of aerobic exercise for people with knee and hip OA has focused on walking. Walking is a popular choice of aerobic exercise, given its accessibility and the variety of surfaces (treadmill, indoors, outdoors), structures (independent vs. supervised group programs), and types of walking available (e.g., Nordic walking).[43] Meta-analyses confirm that aerobic exercise is beneficial for improving cardiovascular fitness in people with OA and inflammatory arthritis[44] and for improving both pain and physical function in people with lower limb OA.[33,45] For knee OA, the effect of aerobic exercise on pain relief may be increased with an increased number of supervised exercise sessions—for every additional 10 supervised sessions, the effect size for pain was increased by more than 0.2.[45] A recent network meta-analysis suggests that, of all types of therapeutic exercises, aerobic exercise may be the most beneficial for improving objective physical performance (e.g., walking) and, along with mind-body exercise, is the most effective form of exercise for reducing joint pain (Fig. 5.3), at least in the short term.[36]

Resistance (strength) training

Strengthening exercises are exercises that apply resistance (for example, via body weight, exercise/elastic bands, free weights, resistance machines) in order to increase force of muscle contraction. Strengthening exercises can be facility-based (e.g., independently in a gym or as part of group classes) or performed independently at home. Strength training is recommended to combat age-related loss of muscle mass (sarcopenia)[46] and is a useful strategy to combat OA-associated muscle weakness. For lower limb OA, strength training should target the major lower limb muscle groups appropriate for the affected joint, according to individual impairments (e.g., hip flexors, extensors, abductors, adductors, and rotators; knee flexors and extensors; calf muscles).[43] Meta-analyses confirm that strengthening exercise improves muscle strength[44] and is beneficial for improving both pain and physical function in people with lower limb OA.[33,45] A network meta-analysis

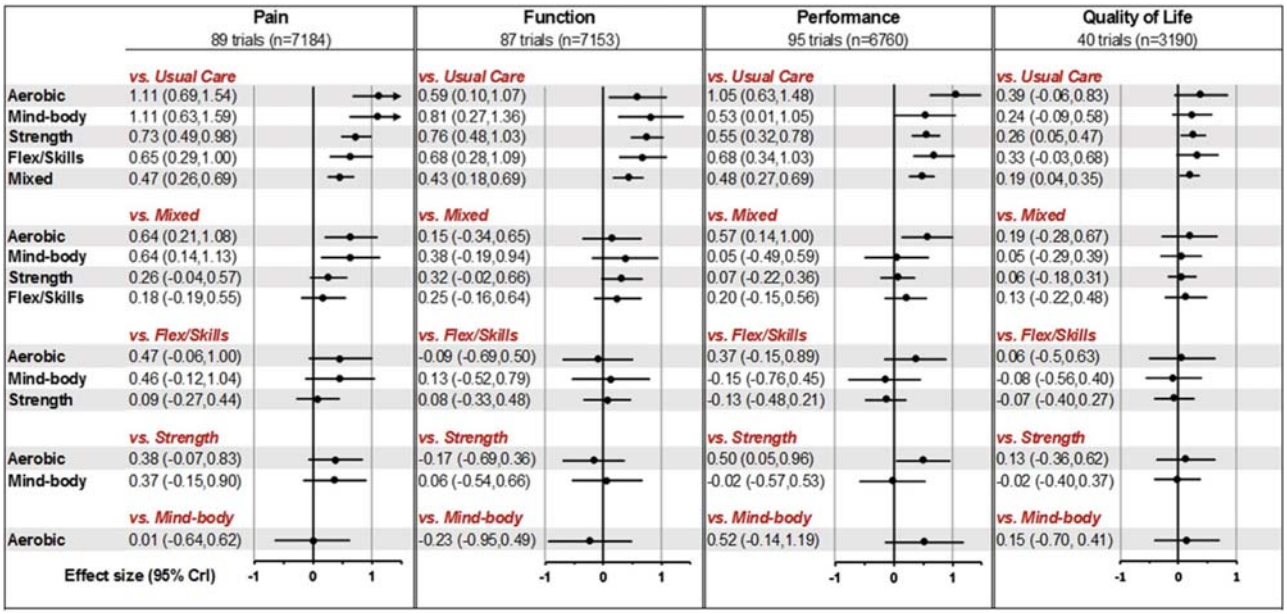

FIGURE 5.3 Effect size of different exercise types versus different comparators (presented as standardized means difference (95% credibility interval).[36] Note that "Flex/Skills" refers to flexibility and skills exercises.

suggests that strengthening exercise moderately improves multiple outcomes concurrently, including pain, function, objective performance, and quality of life (Fig. 5.3), at least in the short term.[36] For people with knee OA where walking function is a problem, strengthening exercises that target both the hip musculature and the quadriceps muscle result in superior outcomes to programs only focused on quadriceps strengthening.[47] However, the available low quality evidence does not support the addition of hip exercises to a quadriceps exercise program for improving self-reported pain, function, or QoL. Exercise programs focusing on quadriceps strength appear to be more beneficial in reducing OA pain and disability than programs aimed at improving general lower limb strength.[45]

Flexibility (stretching) exercise

Flexibility exercises aim to improve joint range of motion and muscle pliability. Examples of flexibility exercises may include joint range of motion exercises and muscle stretching. The benefits of flexibility exercises, in isolation from other types of therapeutic exercise, are unknown due to a lack of research in people with OA. Although flexibility exercises are most commonly included as part of a combined exercise program, evidence suggests that stretching combined with strength or aerobic exercises does not change flexibility in people with hip/knee OA.[44] In the short term, programs that address both flexibility and neuromotor skills training can moderately improve multiple outcomes concurrently, including pain, function, and objective performance (Fig. 5.3).[36]

Neuromotor (neuromuscular) exercise

Neuromotor exercise is therapeutic exercise that incorporates motor skills such as balance, coordination, gait, agility, and proprioceptive training. Unfortunately, research evaluating the effects of neuromotor exercise in OA is scarce compared to other types of therapeutic exercise, and it is not clear if neuromotor performance can be improved with therapeutic exercise.[44] Given that balance exercises can reduce the rate of falls in older adults by 23%,[48] inclusion of balance exercises in a therapeutic exercise program may be warranted in people with OA when an increased falls risk is identified. It is important to note that yoga and Tai Chi incorporate elements of neuromotor exercise and are reviewed below.

Mind-body exercise

Mind-body exercise is exercise that combines body movement, mental focus, and controlled breathing to improve strength, balance, flexibility, and overall health. Examples include yoga and Tai Chi. Meta-analyses have shown that Tai Chi has

significant moderate effects on pain, physical function, and stiffness in people with OA;[49–51] however, there is only very low-quality evidence that yoga improves pain, physical function, and stiffness compared to exercise and nonexercise controls.[52] A network meta-analysis suggests that, of all types of therapeutic exercises, mind-body exercise is the most effective for improving self-reported physical function (effect size of 0.81 compared to usual care) and is one of the two most effective forms of exercise (alongside aerobic exercise, both with an effect size of 1.11, compared to effect sizes of 0.47−0.73 for other forms of exercise compared to usual care) for reducing joint pain (Fig. 5.3), at least in the short term.[36]

Counselling-based physical activity promotion

Being more sedentary is related to poorer physical function in adults with knee OA,[14] independent of time engaged in moderate-vigorous physical activity. To improve physical function, clinicians should encourage adults with knee OA to decrease time spent in sedentary behavior, as well as assist in the development of patient-centered strategies to increase weekly participation in moderate-vigorous physical activity. This may include tips for undertaking planned as well as incidental physical activity (Table 5.2). Counselling-based physical activity promotion interventions based on public health recommendations can lead to small improvements in physical activity behavior in people with OA and inflammatory arthritis,[44] although subgroup analyses in OA participants alone did not quite reach statistical significance.

Mechanisms of exercise benefits

The working mechanisms explaining the beneficial effects of therapeutic exercise on OA-associated pain and physical dysfunction are poorly understood, and it is likely that numerous factors play a role (Fig. 5.4).[54] In knee OA, it has been suggested that an increase in upper leg strength, a decrease in knee extension impairments, and improvement in proprioception may possibly explain the positive association between therapeutic exercise and OA symptoms.[55] Although there is limited causal mediation research to unpack exercise mechanisms, there is evidence to suggest that an increase in knee extensor strength leads to improved physical function in people with knee OA.[56,57] Increasing evidence suggests that systemic anti-inflammatory effects of exercise may also be an explanatory factor.[29,58] Analysis of an 18-month diet and exercise intervention suggested that changes in inflammatory factors accounted for 15% of the total effect on pain and 29% of the effect on function, independent of the change in body mass index.[59] Increased self-efficacy (confidence to self-manage) also partially explains improvements in pain and function observed with a combined diet and exercise intervention.[60] Other research suggests that weight loss and increased cardiovascular fitness explain improved pain and function in people with obesity and knee pain following an intensive lifestyle intervention of moderate-vigorous intensity physical activity.[61] Positive effects of exercise on mood and psychological parameters may be attributed to the distracting effects of exercise participation, improvements in fatigue with exercise, and/or release of endorphins.[62] It is likely that contextual effects of therapeutic exercise (e.g., clinician characteristics, patient expectations, and the clinician−patient relationship[63]) also explain the improvement in OA symptoms, given that very low-quality evidence suggests that exercise training is no more effective than placebo in the treatment of chronic pain.[64]

Safety of physical activity and therapeutic exercise

Long-term low-impact therapeutic exercise (lasting 3−30 months) is safe for most older adults with knee pain and/or OA.[65] No research study has reported any serious adverse events related to exercise. Moderate adverse events (e.g., inguinal hernia, fall, dropped weight on foot, knee inflammation) are rare and reported in only 0%−6% of exercise intervention participants.[65] Mild adverse events occur in 0%−22% of exercise participants (within individual studies) and usually involve muscle soreness and temporary or mild increases in joint pain.[65] Contrary to common beliefs that physical activity may hasten OA disease progression, the evidence suggests that up to 10,000 steps per day of activity do not accelerate OA progression in individuals with preexisting knee OA,[37] although there may be an increased risk of structural progression associated with performing $\geq$10,000 steps/day. Even in people with end-stage knee OA, walking can be performed safely, without exacerbating joint pain.[66] The evidence is uncertain regarding the safety of high-impact exercise such as running,[37] although a recent large cohort study showed that self-selected running was associated with improved knee pain without worsening of structural disease progression over 48 months in people aged over 50 years with knee OA.[67]

An increasing body of research has explored the effects of exercise on knee articular cartilage and molecular biomarkers, given that mechanical loading generated from exercise, combined with cell biology and inflammatory factors, may alter the function of articular cartilage. In people with, or at increased risk of knee OA, knee joint loading exercise

TABLE 5.2 Tips for people with osteoarthritis to increase and monitor planned and incidental physical activity, adapted from.[53]

To increase amount	To increase intensity	To monitor
Use more active transport options Walk to the shops instead of driving Commence a new activity, sport, or exercise class Do a workout/exercise class at home via video, on the internet or via a mobile app Join a club that involves physical activity (e.g., hiking) or join a walking group Walk the dog (or the neighbor's) Play outside with the kids or grandkids Take up gardening or growing vegetables Wash the car by hand or clean the exterior windows Take the stairs instead of the elevator or escalator Stand up in meetings rather than sitting Have "walking meetings" at work rather than sitting Get off the bus or subway one stop early Park the car further away from a destination to neccessitate walking a bit Stand up while talking on the phone Get up and walk around during commercial breaks when watching TV Take a 10–15 min walk in the morning and/or evening	Walk at a faster rate than normal Walk up or down hills rather than flat ground Walk on more challenging surfaces, such as a soft sandy beach or an unpaved nature trail with steps Wear a weighted backpack while walking Perform cleaning and other household tasks more vigorously Substitute walking for dancing, swimming or cycling Cycle faster or cycle up hills rather than flat ground Take a spin (cycling) class Take a water aerobics or other exercise class Play doubles tennis (or singles to make it even harder)	Heart rate monitor (often found in smart watches or other wearable devices) Wearable activity tracker to monitor steps per day, energy expenditure, sedentary behavior and/or time spent in moderate-vigorous physical activity Calendar to record the days that planned physical activity has been undertaken Exercise diary or physical activity log book to record and track exercise/activity sessions Mobile application to set physical activity goals and record and track exercise/activity sessions (e.g., My exercise messages) Set an alarm on a computer or phone as a reminder to stand up every hour Borg rating of perceived exertion scale to monitor intensity of exercise- aim for within 3–7 for moderate intensity Pain numerical rating scale to monitor pain levels during physical activity "Talk test" to monitor intensity- being able to comfortably talk but not sing during exercise indicates moderate intensity activity.

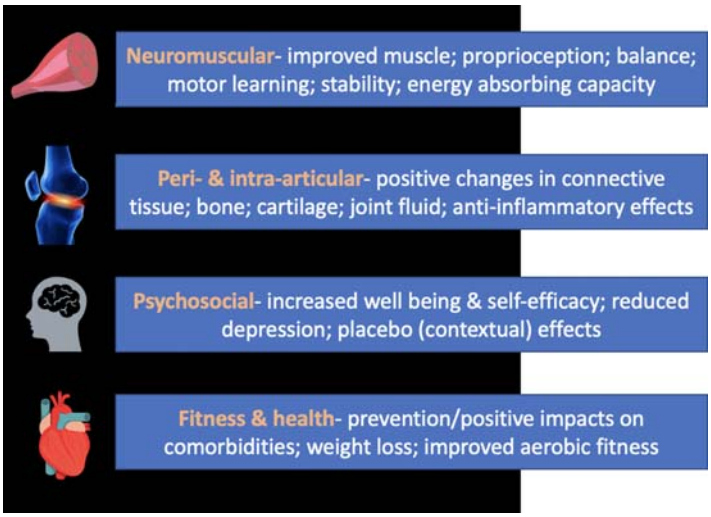

FIGURE 5.4 Potential factors that may explain beneficial effects of exercise in people with knee osteoarthritis.

does not seem to be harmful for articular cartilage on magnetic resonance imaging.[68] Exercise therapy also does not seem to increase the concentration of molecular biomarkers related to cartilage turnover and inflammation, associated with cartilage breakdown.[69] A recent systematic review evaluated the effects of a single running bout or repeated exposure to running on lower limb cartilage morphology and composition measured via magnetic resonance imaging.[70] Although running appeared to have some immediate effects on knee cartilage, the effects were transient (probably reflecting natural fluid dynamics), and evidence suggests that running does not lead to the formation of new lesions. Repeated running exposure did not cause changes to foot and ankle cartilage thickness or composition. Collectively, it appears that exercise, including running, is not harmful for articular cartilage.

In order to identify individuals at risk for adverse exercise-related cardiovascular events, clinicians should screen participants prior to prescribing an exercise program.[71] People identified at risk should receive medical clearance before undertaking moderate-vigorous intensity exercise or increasing the intensity of their current program. Some individuals may not be able to safely participate in exercise until the relevant medical condition has stabilized. Useful tools to assist clinicians in screening include the Exercise and Sports Science Australia Adult Pre-Exercise Screening System[72] and the American College of Sports Medicine (ACSM) Preparticipation Screening Algorithm.[71]

Principles of exercise prescription and progression for OA

The optimal dosage, including intensity, of therapeutic exercise needed for clinical benefits in people with OA is largely unknown. Although clinical benefits can be derived from both lower and higher-intensity therapeutic exercise,[73] benefits may be larger when appropriate physiological doses of exercise are undertaken. For example, strength gains are greatest when therapeutic exercise for people with knee OA is prescribed according to ACSM recommendations for strength training.[71] This research also suggests that an increase of less than 30% in knee extensor strength is not likely to be clinically beneficial in terms of changes in pain and disability. Another meta-analysis[74] showed that land-based supervised therapeutic exercise only reduced pain in patients with hip OA when exercise doses met the ACSM recommendations for cardiorespiratory fitness, muscular strength, and flexibility. Collectively, research suggests that clinicians should consider physiological principles when prescribing therapeutic exercise for people with OA in order to maximize the clinical benefits of exercise participation.

The ACSM recommends the "FITT-VP" exercise prescription principles, which highlight the various aspects that clinicians should consider when developing an exercise training plan.[75,76] The FITT-VP principles incorporate: Frequency (how often exercise is done), Intensity (how hard to exercise), Time (how long is the exercise duration), Type (mode of exercise), Volume (total amount of exercise), and Progression (advancement of exercise program). Table 5.3 summarizes

the FITT-VP principles for prescribing cardiovascular, resistance, flexibility, and neuromotor exercise in healthy adults. Unfortunately, much research investigating exercise interventions in people with OA does not meet ACSM-recommended dose, and it is likely this reflects clinical practice more broadly. For example, approximately 39% of studies evaluating resistance training in knee OA[71] and 58% of studies evaluating supervised land-based exercise for hip OA[74] followed ACSM guidelines. Only 16% of studies that evaluated aerobic exercise interventions in patients with knee OA met all or most FITT guidelines.[77]

It is normal for people with OA to experience some joint discomfort while exercising, particularly with weight-bearing exercise. It is important that levels of pain remain within tolerable levels for the person with OA and that any increases from normal pain levels with exercise return to normal levels (or lower) within 24 h.[78] Monitoring pain levels during exercise with a simple scale, such as a numerical rating scale or visual analog scale (e.g., where 0 = no pain and 10 = worst pain possible), can be helpful. Clinical trials of therapeutic exercise for people with OA often lack information about how the intensity of exercise programs is tailored and progressed, which makes replication in the clinical setting challenging.[79] For strengthening exercise, the ACSM recommends serial testing of maximal muscle strength (e.g., % of one repetition maximum) to progress the intensity of resistance training.[75,76] An alternate approach for progression is to select the resistance that makes the last repetition in a set difficult to complete (e.g., eight out of 10 difficulty, where 0 = no effort and 10 = hardest effort you can give).[43] For aerobic exercise, target heart rates (based on individual capacity) can be measured during exercise bouts to determine intensity of exercise and guide progression.[75,76] However, a more simple clinical approach involves the use of subjective reports of perceived exertion,[43] such as the Borg Rating of Perceived Exertion Scale[80] (Table 5.4). A "talk test" can be simple method for measuring moderate and vigorous-intensity exercise. Moderate intensity is when a person can comfortably talk but can't sing while exercising, while vigorous-intensity exercise is when a person can't say any more than a few words while exercising without having to pause to breathe. Wearable devices to track physical activity, including daily step count, can also be useful to monitor and progress cardiovascular (aerobic) exercise.

Overcoming barriers to physical activity and exercise participation

People with OA experience a vast array of challenges to participating in physical activity and therapeutic exercise and the clinical benefits following a therapeutic exercise program typically decline over time, most likely due to lack of adherence. To implement targeted strategies to facilitate exercise participation and ongoing adherence, it is important for clinicians to explore with their patients the unique individual barriers to exercise experienced. Research shows that, in people with hip and knee OA, **barriers to physical activity[81] include pain and physical limitations; nonpositive physical activity experiences, beliefs, and information; OA-related distress; a resigned attitude; and lack of motivation, behavioral regulation, professional support, and negative social comparison with coexercisers**. Conversely, **facilitators of physical activity[81] include aiming for symptom relief and mobility; positive exercise experiences and beliefs; knowledge; a 'keep going' attitude; adjusting and prioritizing physical activity; and having healthcare professionals' and social support**. Behavior change theory has been used to understand factors that influence physical activity participation in people with OA,[82] highlighting a complex interplay of barriers and facilitators that span physical, personal, social, and environmental factors (Table 5.5). The greatest number of unique barriers and facilitators appear related to environmental context and resources (such as costs associated with exercise, accessibility, adverse weather, equipment requirements).[82] Additionally, many barriers are related to individual "beliefs about the consequences" of exercise, highlighting the importance of education about OA and the benefits of exercise. This is reinforced by research showing that common misconceptions about knee OA influence patients' acceptance of nonsurgical, evidence-based treatments such as exercise.[83] People who have been "diagnosed" with "bone-on-bone" changes often disregard exercise-based interventions because they believe it may be harmful.

Table 5.6 outlines a range of strategies that may assist people with OA to overcome some of the more common barriers encountered with exercise participation. Behavior change techniques are the smallest active components of interventions, which are designed to optimise patient health behaviors. A systematic review[85] of behavior change techniques showed that "behavioral contract," "nonspecific reward," "patient-led goal setting" (regarding the behavior), "self-monitoring of behavior," and "social support" appear to be most effective at promoting physical activity adherence in people with lower limb OA. Other research in people with persistent musculoskeletal pain[86,87] has shown that goal setting, social support, instruction in exercise performance, demonstration of exercise, practice/rehearsal, and feedback and monitoring can positively impact exercise adherence in older adults.

Support from health professionals is particularly important to assisting people with OA to participate and adhere to physical activity and therapeutic exercise. Physiotherapists appear to have a significant positive influence on exercise

TABLE 5.3 FITT-VP principles of exercise prescription recommended by the American College of Sports Medicine.[74,75]

	Cardiorespiratory (aerobic) exercise	Resistance (strengthening) exercise	Flexibility (stretching) exercise	Neuromotor (neuromuscular) exercise
Frequency	≥3 days/week Spreading exercise sessions across 3–5 days/week may be optimal for achieving recommended amounts.	Novices: At least 2 days/week Experienced exercisers: Frequency is secondary to training volume; choose frequency based on personal preference	≥2–3 days/week (daily for greater gains in joint range)	≥2–3 days/week
Intensity	Moderate (40%–59% HRR) and/or vigorous (60%–89% HRR).	Novices: 60%–70% of 1-RM (moderate to hard) for strength Experienced exercisers: ≥80% of 1-RM (hard to very hard) for strength Older, beginning exercisers: 40%–50% of 1-RM (very light to light) for strength Sedentary beginner exercisers: 40%–50% of 1-RM (very light to light) for strength ≤50% of 1-RM (light to moderate) for muscular endurance 20%–50% of 1-RM in older people to improve power	Stretch to point of feeling tightness or slight discomfort.	Effective intensity has not been determined.
Time	30–60 min/day (at least 150 min/week) of moderate intensity or 20–60 min/day (at least 75 min/week) of vigorous intensity or combination of both Performed in one (continuous) session per day or in multiple bouts of at least 10 min to accumulate the desired duration.	No specific duration	Hold static stretch for 10–30 s. In older people, holding for 30–60 s may confer greater benefit.	≥20–30 min/day
Type	Regular, purposeful exercise involving major muscle groups and performed in a continuous or intermittent in nature. Activities with low joint stress (e.g., walking, cycling, swimming, aquatic exercise) may be most suitable for people with OA.	Multi-joint exercises affecting more than one muscle group and targeting agonist and antagonist muscle groups. Single-joint and core exercises may also be included. Variety of exercise equipment and/or body weight can be used.	Flexibility exercises for each of the major muscle–tendon units Static flexibility, dynamic flexibility, ballistic flexibility and proprioceptive neuromuscular facilitation are effective	Exercises involving motor skills (e.g., balance, agility, coordination and gait), proprioceptive training and multifaceted activities (e.g., tai Chi and yoga) are recommended for older people to improve/maintain physical function and reduce falls risk.
Volume	≥500–1000 MET/min/week. Increasing step counts by ≥ 2000 steps/day to reach a daily step count ≥7000 steps per day is beneficial.	1-3 sets, each with 8–12 repetitions, to improve strength and power. Single set of 10–15 repetitions in older, novice exercisers may be effective for strength. ≤2 sets of 15–20 repetitions for muscular endurance.	Total of 90 s of discontinuous flexibility exercise per joint.	Optimal volume is not known.
Progression	Gradual progression of volume by adjusting duration, frequency and/or intensity until the desired exercise goal (maintenance) is attained.	Gradual progression of greater resistance and/or more repetitions/set and/or increasing frequency.	Methods for optimal progression are unknown.	Methods for optimal progression are unknown.

1-RM, one-repetition maximum; *HRR*, heart rate reserve; *MET*, metabolic equivalents; *OA*, osteoarthritis.

TABLE 5.4 Borg rating of perceived exertion scale.[80]

Rating	Descriptor
0	Nothing at all
0.5	Very, very weak (just noticeable)
1	Very weak
2	Weak (light)
3	Moderate
4	Somewhat strong
5	Strong (heavy)
6	
7	Very strong
8	
9	
10	Very, very strong (maximal)

behavior[81] and advice to exercise by doctors is also an important facilitator, whereas ambiguous, no or conflicting information from doctors about physical activity is a barrier to participation.[81] People with OA value exercise instructions, education, and encouragement from health professionals, as well as supervision of exercise performance to ensure correct exercise technique and remain motivated. A strong and positive therapeutic alliance with the clinician has been shown to improve pain outcomes from treatments, including physical activity and therapeutic exercise in people with chronic musculoskeletal pain.[88] Agreement on goals and tasks, clear communication, a sense of connectedness, positive feedback, genuine interest, individualized care plans, trust in the clinician, and feeling empowered appear particularly relevant for promoting exercise adherence.[89] Unfortunately, not all clinicians feel equipped to provide evidence-based exercise care of people with OA. Clinicians have reported being "underprepared" to manage OA, lacking knowledge about recommended practice and/or how to implement recommendations into routine care, in particular the skills to support patients to make lifestyle changes, including exercise.[90–92]

Services and supports to facilitate engagement in physical activity and exercise for people with OA

A variety of modes can be used to deliver exercise programs, including individual, group-based, home-based, or a combination, with benefits for pain and function appearing to be similar across these different delivery modes.[42] Referral to an exercise specialist such as a physiotherapist or exercise physiologist may be appropriate for patients who are starting exercise so that the clinician can prescribe an individualized program and adjust the level and type of exercise according to response and performance. Furthermore, evidence suggests that a greater number of supervised sessions may enhance pain-relieving effects of exercise in knee OA, at least for aerobic exercise.[45] Supervised group exercise programs have the advantages of being less costly to deliver than individualized care and incorporating social interaction, which may facilitate exercise adherence. A number of formal evidence-based hip and knee OA management programs include education and group exercise programs and are offered in different countries. These include ESCAPE-pain,[93] Better Management of Patients with Osteoarthritis (BOA),[94] Good Life with osteoArthritis:Denmark (GLA:D),[95] and Active with OsteoArthritis (AktivA).[96] Exercise can also be delivered remotely by clinicians, which can improve access, especially for those living in rural areas. For example, a clinical trial evaluating videoconferencing consultations with a physiotherapist for exercise therapy for knee OA showed they were effective in improving pain and function, safe, and well accepted.[97,98]

It is helpful for clinicians to be aware of the different services and supports that are available within their local setting to help people with OA engage in physical activity and exercise. Community-based exercise and physical activity programs delivered by nonhealth care professionals, including walking groups, classes at gymnasiums/leisure centers, and personal

TABLE 5.5 Examples[43] of barriers and facilitators to exercise participation, demonstrated by qualitative evidence synthesis and mapped to the theoretical domains framework.[82]

Domain	Example barrier	Example facilitator
1. Knowledge	Lack of disease knowledge/education	Having undertaken OA education class
2. Skills		Higher level of physical fitness
3. Social/Professional Identity	Self-perception of being 'inactive'	Feeling of contributing to the study which will benefit others long-term
4. Beliefs about Capabilities	Beliefs about limitations due to disability	Low level of self-reported physical limitations
5. Optimism	Fatalism regarding knee OA	Positive exercise attitude
6. Beliefs about consequences	Beliefs about disease	Perceived benefits of exercising
7. Reinforcement	Lack of improvement with exercises	Previous positive personal experience of exercise
8. Intentions	Lack of motivation	Loyalty to physical therapist
9. Goals	Short-term goal setting only	Long-term and short-term goals
10. Memory, attention and decision processes	Forgetfulness	Good quality sleep
11. Environmental context and resources	Use of a walking aid	Online program
12. Social influences	Family commitments	Low social strain
13. Emotion	Anxiety	Improved depression with exercise
14. Behavioral regulation		Performing exercise at own pace in own time

TABLE 5.6 Strategies that may be useful in overcoming barriers to therapeutic exercise in people with osteoarthritis (OA).[84]

Barrier	Strategies to consider
Insufficient time	Identify available time slots in the individual's weekly routine. Try to identify 3 × 30 min slots over the week, or alternatively, more frequent slots of shorter duration. Book time for exercise into the daily calendar.
	Encourage incorporation of exercise into daily routines. For example, walking to work or the shops, taking the stairs instead of the elevator, walk the dog, exercising while watching the news on TV, etc.
	Recommend exercises that are time-efficient and do not require complicated set up of equipment. Aim for home—or work-based exercise programs rather than those that require additional travel to get to a gym or scheduled class.
Lack of motivation	Encourage the individual to plan exercise sessions for the week ahead, and to make "appointments" for exercise in their weekly schedule. Write the "exercise appointments" in a diary or on a calendar.
	Discuss the benefits of exercise and set short- and long-term person-centered goals that are meaningful for the individual.
	Encourage the individual to discuss the importance of exercise with friends and/or family members. Encourage exercise participation with friends and/or family.
	Recommend participation in an exercise group or class. Provide referrals to appropriate group classes in the community.
Limited access to exercise facilities, transportation	Recommend exercises that do not require travel to specialized facilities or to allow exercise participation. Consider home-based exercises that can make use of body weight for resistance or prescribe aerobic exercises such as walking programs.
	Identify inexpensive and convenient facilities available in the local community (such as arthritis exercise groups, walking groups, local swimming pools). Provide information and contact details for accessing these services.
Adverse weather conditions	For outdoor exercise, anticipate and plan ahead with the individual about how the exercise program may be modified or rescheduled in case of hot/cold/wet weather.
	Provide a range of exercise options that are possible irrespective of the weather conditions (e.g., indoor cycling, water aerobics, indoor swimming, home based strength training).
Perception exercise is ineffective or will worsen OA	Education regarding the benefits of exercise, using scientific evidence delivered in a language that lay people can easily understand.
	Provide educational support materials (websites, written handouts, online videos) that describe the benefits of exercise for OA. Encourage use of information provided by trusted sources, such as national arthritis advocacy and/or exercise organisations.
	Provide tailored exercise advice with specific individualized exercise instructions and dosage, rather than generic exercise recommendations.
	Consider referral to commence exercise under the supervision of a health professional (such as a physiotherapist or exercise physiologist).
Lack of enjoyment	Discuss preferred exercise options and previous experiences with exercise. Tailor the exercise program to personal preferences and according to past exercise strategies that have been successful.
	Regularly change the exercise program to minimize boredom. Advise the individual on principles of exercise progression and empower them to change the program independently where possible.
	Listen to music, a podcast or audio-book, or watch television, while exercising.
	Discuss reward systems, where an individual rewards themselves at regular intervals for ongoing exercise participation and/or for achieving predetermined exercise goals.

TABLE 5.6 Strategies that may be useful in overcoming barriers to therapeutic exercise in people with osteoarthritis (OA).[84]—cont'd

Barrier	Strategies to consider
Other health problems	Tailor the exercise program to consider the impact of other comorbid conditions, rather than use generic exercise recommendations.
	Ensure other medical conditions are being adequately and appropriately managed.
	Consider if medical review by another health professional (e.g., general practitioner) may be required before exercise participation can be commenced safely or if exercise should be commenced initially under supervision of an exercise specialist (e.g., physiotherapist or exercise physiologist).
Forgetfulness	Discuss strategies to help remember to exercise. For example, cue cards around the house; scheduling exercise appointments into the calendar or diary; setting reminders via email alerts or alarms on smart phones/computers; or placing exercise instructions in visible locations.
Insufficient energy	Discuss how regular exercise will increase energy over the longer-term. While an individual might feel tired initially, continued exercise will usually increase energy levels. Discuss about the vicious cycle of feeling tired, leading to less physical activity, leading to feeling more tired.
	Sleep quality can also influence feelings of fatigue and energy levels, so improved sleeping will also result in reduced tiredness. Consider providing tips for "sleep hygiene," to increase the chances of a good night's sleep.
Exercise aggravates joint pain	Conduct a comprehensive physical assessment to determine the body positions, movements and activities that aggravate pain and use this information to tailor the exercise program.
	Consider supervised exercise sessions initially, with regular monitoring by both the individual and clinician regarding changes in pain. Consider using a simple pain scale to monitor pain during exercise and to ensure pain does not increase to intolerable or unsafe levels.
	Reassurance that pain is often felt when people with OA exercise and that this is normal and safe. Explain that pain does not mean that exercise is harming the joint.
	Modify exercise program in a timely manner to remove any exercises that excessively increase pain or to modify the dosage. Teach the individual how to modify the exercise program in case of flare-ups.
	Smaller durations of exercise with greater frequency may be appropriate.
	Consider exercise in aquatic environments rather than land-based.
Lack of confidence in exercise ability	Consider referral to an exercise specialist (e.g., physical therapist or exercise physiologist) in the early stages of exercise.
	Supervised exercise sessions, either individually or group classes, rather than unsupervised exercise.
	Provide clear exercise instructions. These may in the form of be printed exercise handouts with diagrams/photos, video clips, mobile apps with exercise instructions, or photos/videos captured on a smartphone of the individual themselves performing the exercise.
	Ensure sufficient time demonstrating the exercises and watching the individual perform the exercises themselves to ensure correct technique and to provide feedback.
	More regular monitoring may be required, especially when the exercise programs are being progressed or the dosage being increased.

training, may be options for people with OA. Many arthritis consumer organizations also offer group exercise programs in community facilities, often led by trained lay personnel.

Technology-enhanced exercise strategies may be useful for some patients and increase access. Several internet-based home exercise programs for knee and hip OA have been described in the literature.[99–102] A recent RCT showed that a 6-month freely available self-directed online strengthening exercise and physical activity program (www.mykneeexercise.org.au) resulted in improved pain and function compared with online education in people with knee OA.[99] A digital, structured, and individualized treatment program including neuromuscular exercises for people with hip or knee OA (Joint Academy www.jointacademy.com) improved pain and function in an uncontrolled cohort study.[101] The well-researched ESCAPE-pain program is also available via an online web-based version or via an app and provides users with a structured education and exercise program of 12 sessions over 6 weeks (https://escape-pain.org/support-tools/support-homepage). Healthy Weight for Life is an Australian program that includes a remotely delivered 18-week diet and exercise program[102] (https://healthyweightforlife.com.au/osteoarthritis-hwfl/). A meta-analysis showed that e-Health-supported home exercise interventions in knee OA resulted in less pain, improved physical function, and better health-related quality-of-life compared with no or other interventions, although the improvements were small and may not be clinically meaningful.[103] Low adherence was considered a likely factor limiting the effectiveness of some eHealth interventions.

Increasing adherence to home exercise

There is some evidence that use of web-based exercise programming systems by clinicians can improve patient adherence to home-based exercise in people with musculoskeletal conditions, compared with traditional pen and paper handouts.[104,105] Specifically in people with knee OA, behavior change text messages have also been found to increase adherence to a home-based strengthening program over 6 months[106] (now available as a free app "My Exercise Messages" Google Play and the Apple App Store). In contrast, computer-based telephone counseling did not influence longer-term adherence over 2 years.[107] Systematic reviews and meta-analyses show that consumer-based wearable devices[108] and smart-phone-based interventions including apps and text messaging[109] increase daily step counts and amount of physical activity in adults.

Activity pacing and behavioral graded activity for people with OA

People with chronic pain and fatigue can often "overdo it" or push themselves too hard. This can lead to more severe symptoms or pain flares forcing the person to rest for long periods (Fig. 5.5). This overactivity–underactivity cycle, with large fluctuations between high and low levels of activity, can have negative consequences including increased symptoms, fear of movement, anxiety, and eventually, avoidance of physical activity. Activity pacing is a behavioral strategy aiming to achieve a balance between activity and rest so that an individual with OA can undertake valued and necessary activities, including occupational tasks. It involves teaching awareness of the effect of activity on current symptoms, conserving energy for valued activities, and setting activity quotas with scheduled breaks before symptom exacerbation. It uses a time-contingent, rather than symptom-contingent, approach (Fig. 5.6). Current evidence from a limited number of studies in people with chronic pain supports the delivery of a learned pacing intervention to reduce the interference of fatigue, reduce

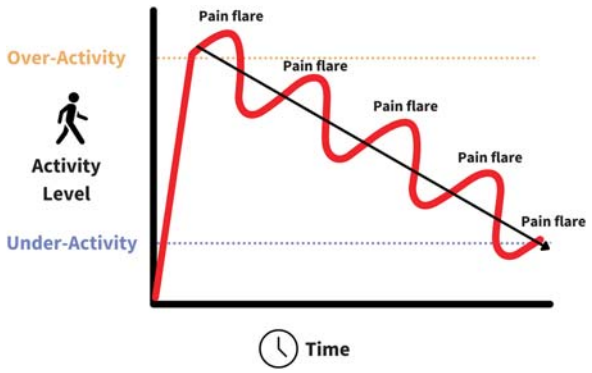

FIGURE 5.5 Overactivity–underactivity cycle leading to reduced activity over time. *Adapted from https://aci.health.nsw.gov.au/chronic-pain/brain-injury/fatigue/boom-and-bust.*

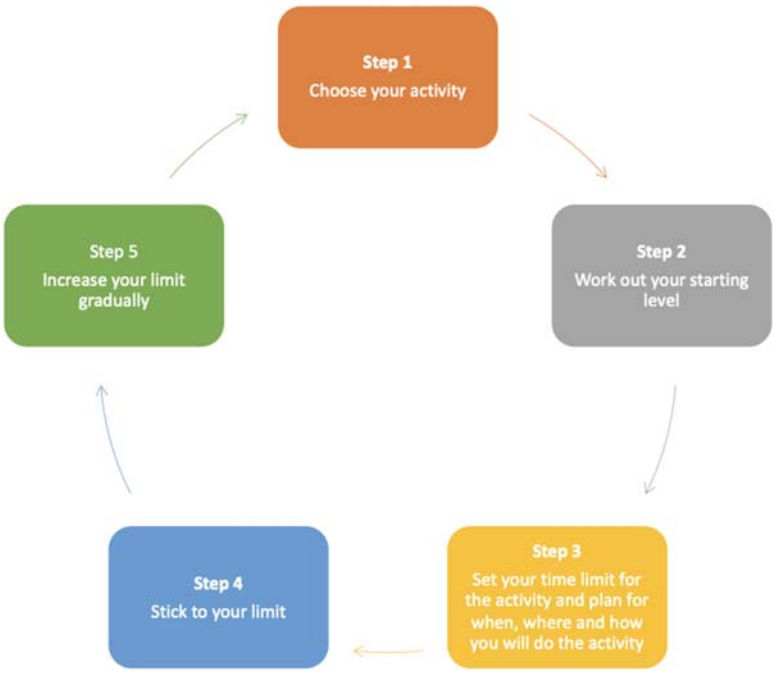

FIGURE 5.6 Principles of activity pacing.

joint stiffness, and decrease physical activity variability, but it does not support the use of learned pacing to reduce pain severity.[110] A small RCT in people with OA found that individually tailored activity pacing was more effective than a general activity pacing intervention.[111,112] Resources to assist patients with learning about activity pacing can be found at https://aci.health.nsw.gov.au/chronic-pain/brain-injury/fatigue/boom-and-bust.

Behavioral graded activity is a related treatment approach using the principles of operant conditioning that can help overcome pain as a barrier to physical activity. In this approach, the amount of activity is gradually increased in a time-contingent manner using individually tailored preset quotas, despite the amount of pain, in order to achieve individual functional goals in relation to daily living or occupation.[113] A cluster RCT in the Netherlands evaluated the effect of a behavioral graded activity program delivered by physiotherapists for patients with hip or knee OA.[114] Results showed no differences in pain and function outcomes compared with usual exercise care, although behavioral graded activity led to superior exercise adherence and more physical activity, and in those with hip OA, fewer joint replacement surgeries.[114–116] To increase access and reach, the researchers converted the program into a self-guided online program (Join2Move)[117] and while improvements in function and physical activity were noted compared to wait list control, engagement with the program was relatively low.[117] Subsequently, a blended approach combining the online program with face-to-face physiotherapy consultations was found to give similar pain and function benefits to face-to-face physiotherapy only, but with fewer consultations.[118]

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Chapter 6

Module 6: core components of best evidence OA care – weight control

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Clinical practice points/evidence summary:

- Taking a dietary approach with a significant reduction in calorie intake is the best option to achieve an impactful weight loss.
- Group-based weight loss programs are most effective for optimizing adherence and motivation.
- Large and rapid weight loss results in better sustainability of the achieved benefits.
- Professional support increases the chances of success of both initial weight loss and subsequent weight control.
- Exercise and physical activity as a single tool for weight loss is not effective but should be considered an adjunct to increase calorie expenditure, overall health and well-being, and counteract the undesirable loss of muscle mass and bone minerals.

AIMS

- To improve knowledge and understanding of body weight management to reduce symptoms, improve functional abilities, and impact osteoarthritis (OA) disease progression.
- To describe a range of weight management options for a person with OA who wishes to lose weight, including dietary changes, referral to professional support services, improved physical activity by an individual, or organized community activities.
- To outline sustainable and person-centered strategies for weight control.

A brief introduction to the chapter

Weight management is one of the most effective nonpharmacological therapies to improve pain and physical function for OA, particularly knee or hip OA. This chapter summarizes the best available evidence on weight loss to manage OA. It focuses on dietary approaches, their pros and cons in weight loss and weight maintenance in people with OA. We emphasize weight management should be patient-centered and provide strategies to lose weight successfully. Finally, we offer guidance to health professionals on overcoming barriers to weight loss at the patient level, the clinician level, and during patient–clinician interactions.

Effect of weight control in OA pain management and OA disease progression

With an increasing trend of aging populations and increased prevalence of overweight and obesity, OA is a common musculoskeletal disorder contributing to the global burden of disease as a major cause of disability.[1] While pain and

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disability are the cardinal symptoms in OA, other consequences of OA[2] include impaired sleep, fatigue, and depression[2] associated with obesity. Furthermore, the pathophysiology of OA and overweight share a common increased risk of co-morbidity and mortality associated with heart disease, diabetes, and mental health issues.[3] This evidence highlights the importance of targeting an effective regimen to prevent and manage overweight in people with OA.

Overweight or obesity is a strong risk factor for OA

Obesity is widely acknowledged as a causal risk factor for both the incidence and progression of OA—both structurally and symptomatically. Meta-analyses suggest that overweight and obesity increase the risk of developing knee OA by two- to fourfold.[4] Being overweight or obese also increases the risk of developing OA in other joints, including the hands and hips. The association is particularly evident for knee OA, in which being overweight (body mass index [BMI]: 25−29.9 kg/m^2) increases the risk by twofold. Grade I obesity (BMI: 30.0−34.9 kg/m^2) increases the risk by threefold, while grade 2 obesity (BMI: 35−39.9 kg/m2) by 4.7-fold.[5] Other estimates suggest that each 5 unit increase in BMI is related to increased risks of radiographically and clinically defined knee and hip OA by 35% and 11%, respectively, but less so with hand OA. However, BMI is positively associated with clinically and radiographically defined OA risks at all sites.[6−8] Together, the current knowledge provides evidence of a strong relationship between overweight/obesity and the risk of OA.

Mechanisms of body weight contributing to the development and progression of OA

Bodyweight contributes to the development of OA via several mechanisms. The most common thought is that increased biomechanical loading to weight-bearing joints affects cartilage volume and leads to the formation of bone marrow lesions. Obesity also enhances concentrations of proinflammatory cytokines and adipokines in the serum and tissue across the joints, which may themselves accelerate disease,[9] evidenced by the relationship between obesity and C-reactive protein and OA pain[10−13].

Furthermore, obesity-induced dyslipidemia, inflammation, and adipokines have been suggested to have links with OA, where adipokine production further induces a state of low-grade systemic inflammation to promote the progression of OA in all joints.[14,15] However, it is important to realize that not all obese individuals develop knee OA, and not all knee OA patients are obese.[16] Thus, the relationships between knee OA, obesity, biochemical, hormonal, and biomechanical factors are complex.

As mentioned above, a body of evidence suggests that obesity is associated with hand OA, despite the lack of an intuitive link between joint loads and OA in non-weight-bearing joints, such as those in the hand.[17,18] This relationship indicates the roles of other nonmechanical mechanisms in OA. For example, inflammatory cytokines and adipokines (cytokines secreted by adipose tissue) are likely involved. Leptin has long been considered implicated in the pathogenesis of OA, independent of the mechanical effects of obesity.[19] Indeed, data indicate that a significant part of the obesity−OA association may be due to elevated levels of leptin[20]. The infrapatellar fat pad, an adipose tissue depot located in the knee joint, may contribute to some of the pathophysiological changes occurring in the OA knee joint via local secretion of cytokines and adipokines.[21] Signs of increased perfusion (a possible marker of inflammation) of the infrapatellar fat pad have been shown in obese individuals with knee OA, suggesting a local inflammatory activity.[22] Loss of muscle mass and strength over time may also contribute to the onset of OA in obese individuals. Although both muscle and fat mass increase with weight gain, muscle mass remains relatively low and inadequate to match the demands placed upon it.[23]

There is also evidence that OA is associated with the release of a range of proinflammatory mediators from joint tissues, such as interleukin (IL)-1beta, cyclooxygenase (COX)-2, prostaglandin (PG)E_2, matrix metalloproteinase (MMP)-2, MMP-3, IL-6, MMP-9, MMP-13, receptor activator of nuclear factor-kappaB ligand (RANKL), fibroblast growth factor (FGF)-2, IL-8 (36−39), and adipokines.[21] In addition, proinflammatory cytokines, such as IL-6 and C-reactive protein (CRP), predict both the incidence[24] and progression of arthritis.[25,26] Another critical aspect is the association of obesity and OA with metabolic abnormalities, such as hyperinsulinemia and other cardiometabolic defects. A review of the potential complex and multifactorial mechanisms linking obesity and OA can be found in previous work by Vincent et al.[23] (Fig. 6.1).

Benefits of weight loss in OA

Weight loss improves both pain and functional status and is considered one of the most effective nonpharmacologic treatment options for OA.[27] Multiple clinical guidelines, including the American College of Rheumatology guidelines[27]

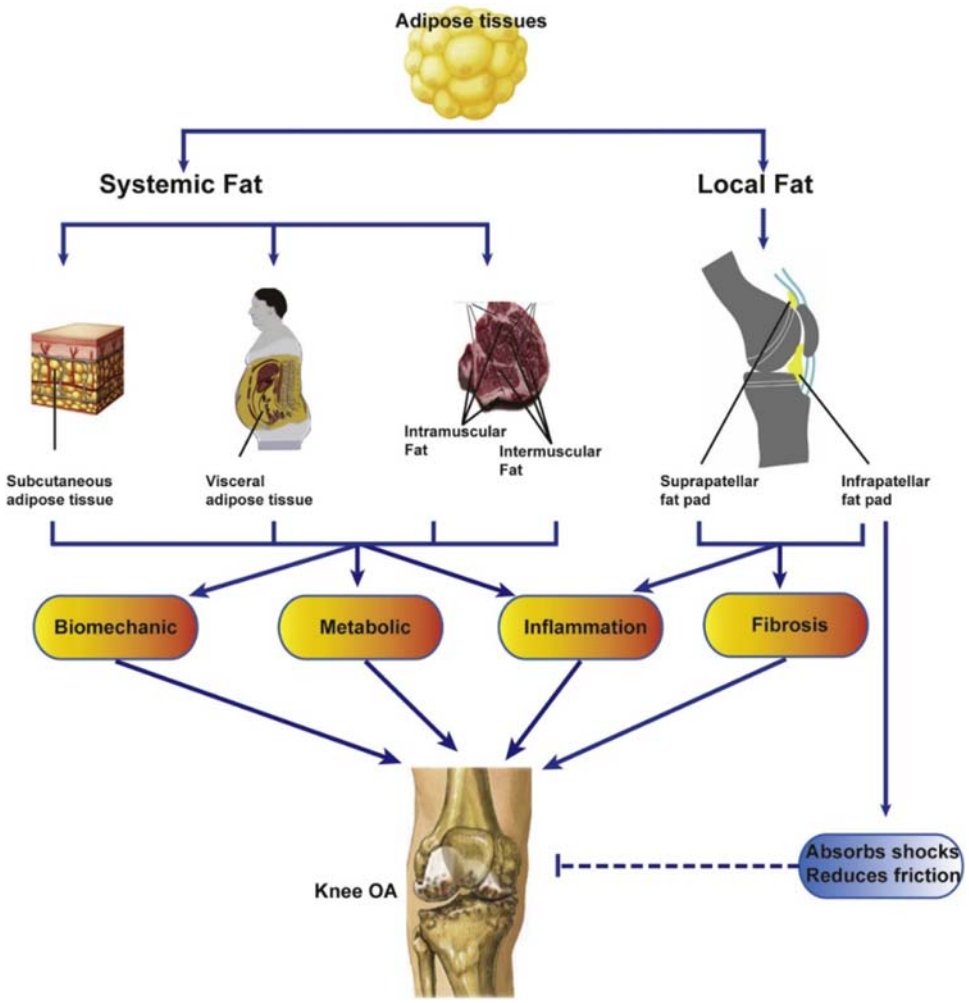

FIGURE 6.1 Mechanisms of body weight in OA. *Adapted from Chang et al. Osteoarthritis and Cartilage. Volume 26, Issue 7, 2018.*

and the Osteoarthritis Research Society International (OARSI) guidelines, strongly recommend weight loss to overweight or obese individuals with knee and/or hip OA.[27] These recommendations are based on the dose–response relationship between weight loss and improved symptoms or functions in patients with OA and clinically meaningful outcomes in OA.[28–30]

A large body of evidence shows the health benefits of weight loss, with the greater weight loss, the better outcomes on managing OA progression and symptoms.[31] For example, a systematic review shows that weight loss between 5% and 10% significantly improves pain (effect size 0.33), self-reported disability (effect size 0.42), and quality of life (physical) (effect size 0.39) in obese adults with a mean BMI of 33.6–36.4 kg/m^2 and with mild to moderate knee OA.[32] Some studies have suggested a dose–response relationship between weight loss and OA symptoms improvements,[28,30] but the evidence is not clear.[28,30] The evidence on the effects of weight loss on OA structural pathology in people who are overweight or obese is also quite unclear.[33]

Other benefits of weight loss

Besides the specific benefits of weight loss in knee OA, there are many other general health benefits of weight loss, including cardiovascular benefits, lower medication use, and improved quality of life.[34] A comprehensive review by Rueda-Clausen and colleagues highlighted many sustainable weight-loss benefits from cardiometabolic diseases to OA, cancer, mental health, and other conditions, along with reduced mortality and improved quality of life.[35] As mentioned above, obesity contributes to metabolic syndrome and inflammatory cytokines as part of the pathological mechanisms that affect OA. It follows that improvement of metabolic health may, in turn, reduce the further progression of OA to relieve

symptoms and/or structural damage. Furthermore, other conditions such as depression[36,37] and sleep quality[38] have been increasingly associated with the severity of OA. For instance, weight-loss interventions have positively impacted depression.[37] For sleep apnoea, the effect of weight loss tends to be even more apparent. Several clinical trials, either through behavioral changes, such as diet and physical interventions, or bariatric surgeries, demonstrated the effectiveness of weight loss on reducing the severity of obstructive sleep apnoea.[39,40]

Additionally, sustained weight loss was associated with greater clinical benefits, such as lowering the risk of developing cancers in women and delaying the onset of OA incidence among those who had over 15% weight loss maintenance. On the other hand, weight loss rebounders and maintainers had an increased risk of future treatment for anxiety by 14% and depression by 25%.[41] Thus, this body of evidence demonstrates that the health benefits of weight loss are beyond OA.

Diet and OA: Summary of dietary components and their effects on the prevention and management of OA

Weight loss, especially maintenance, is challenging to both patients and clinicians.[42,43] One of the issues is that many clinicians lack knowledge of recommended practices and ways to implement lifestyle changes relevant for weight loss into routine care.[42–44] In the following, we will highlight current knowledge about effective strategies to gain confidence and guide their patients with OA in effective and safe bodyweight management.

Diet and weight loss

Indeed, dietary intake and quality play a crucial role in overweight and obesity. The World Health Organization[45] and different countries' dietary guidelines recommend increased consumption of whole grains, fruit and vegetables, legumes and nuts, and lean protein to control body weight and reduce obesity. Furthermore, a growing body of evidence has suggested that healthy diets may reduce chronic musculoskeletal pain[46], including fibromyalgia,[47] rheumatoid arthritis,[48] and gout.[49]

Antiinflammatory diets

Evidence for the effects of the Mediterranean diet (this diet typically includes proportionally high consumption of olive oil, legumes, unrefined cereals, fruit, and vegetables, moderate to high consumption of fish, but low consumption of other meat products, moderate consumption of dairy products, primarily as cheese and yogurt, and moderate wine consumption)[50] and antiinflammatory diets (based on the principles of the Mediterranean diet)[51] on OA symptoms or structural changes are promising. A meta-analysis has suggested statistically significant differences in weight change and inflammatory biomarkers, such as in C-reactive protein (CRP), interleukin (IL)-6, and IL-1β in arthritis, but no significant effects were found for physical function or pain[51]. However, it should be noted that no definitive conclusion can be made due to the limited number of studies on anti-inflammatory diets and OA, and there is high heterogeneity across the studies. An anti-inflammatory diet per se has not been proven to provide weight loss, but adopting an anti-inflammatory diet will likely be paralleled with other lifestyle changes that may induce weight loss or weight maintenance (Fig. 6.2).

Dietary components

Although the efficacy of an antiinflammatory diet or the Mediterranean diet remains further confirmed, single dietary components such as long-chain fatty acids and dietary fiber have shown health benefits related to OA pain or symptoms. In one clinical trial, comparing a high dose of fish oil (4.5 g/15 mL) with low-dose (0.45 g/15 mL n-3 polyunsaturated fatty acids, PUFAs) resulted in better pain and function scores at 18 and 24 months in the low-dose arm than the high-dose arm. However, there was no difference in structural outcomes of cartilage volumes and bone marrow lesions over 24 months.[52] Furthermore, a systematic review of five trials found no effect of marine oil supplements on OA-related pain[53]. However, there is limited evidence supporting the use of omega-3 fatty acids such as supplements of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in managing OA.[54]

With the health benefits in weight control, reduced inflammation, and lowering the risk of symptomatic knee OA, higher intake of dietary fiber has been shown to lower the risk of symptomatic knee OA and knee pain with significant results per 5 g/daily increments in two observational studies.[55,56] However, no randomized clinical trials have tested the effect of dietary fiber on OA pain or function.

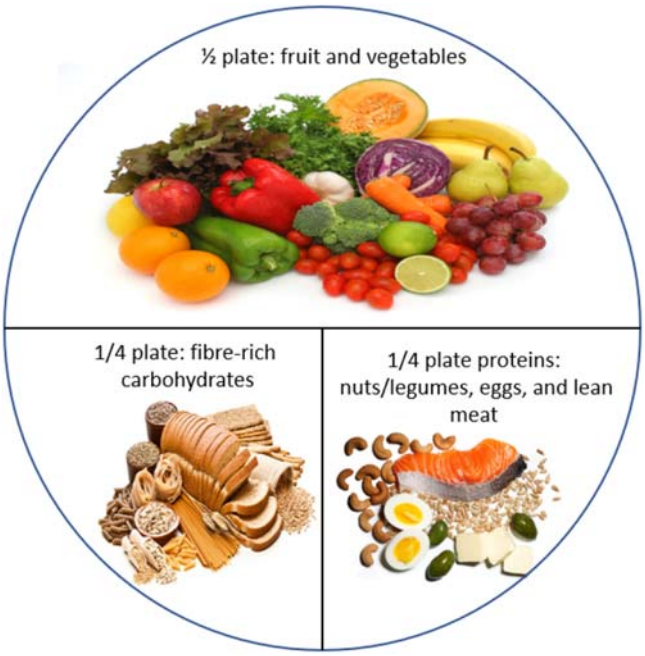

FIGURE 6.2 An example of a food plate of lean and plant-based proteins, fiber-rich carbohydrates, and fruit and vegetables.

In light of the health benefits, safety, and cost-effectiveness, accumulating evidence has demonstrated the effects of fiber-rich diets or Mediterranean diets on weight control and cardiometabolic health.[57,58] Therefore, these diets are likely the current best option available for long-term weight maintenance after an initial weight loss and a dietary means to manage the illness of OA in the long term. It should be noted that these are data from observational studies, and well-designed randomized controlled trials are lacking at the time of writing this chapter.

Meal replacement and low caloric diets

A meta-analysis of eight RCTs has indicated that dietary meal replacement or very low dietary energy interventions (also known as the ketogenic diet) for weight loss significantly improved the physical function score in Western Ontario and McMaster Universities Arthritis Index (WOMAC) at clinically relevant levels.[59] Another review also has suggested that low-calorie diet and exercise, and intensive weight loss and exercise, were the most effective interventions to reduce joint pain with clinically meaningful changes in OA symptoms' measured on the WOMAC.[60] Although restricted caloric diet (e.g., 500−1000-kcal/d calorie deficit) and meal replacement (e.g., substituting two meals with a low-calorie diet per day) can help achieve significant and faster weight loss than other diet approaches[61] and even improve pain and function in OA,[57,62] long-term adherence to such diets is not likely feasible. One trial that used a less aggressive long-term meal replacement strategy showed sustained weight loss over 3 years.[58]

A systematic review and meta-analysis of 249 behavioral weight loss program interventions involving partial meal replacements report that people in the intervention arms regained weight compared with those in the control group with no meal replacements.[63] Furthermore, − people in the intervention groups had faster weight regain than in the respective control group (0.12−0.32 kg/year). However, the difference between the groups was maintained for at least 5 years. Additionally, programs with financial incentives or partial meal replacements tend to have a faster rate of weight regain, while the programs available outside of a study period had a slower rate.[63]

Over recent years, weight loss medication has been introduced to treat type 2 diabetes and obesity, such as glucagon-like peptide-1 (GLP-1) receptor agonists. Liraglutide is one such medication labeled for chronic weight management.[64] It has been used recently in a trial that compared combined exercise and liraglutide with either exercise or liraglutide alone for 1 year in obese adults.[65] The combined exercise and liraglutide treatment group showed more weight loss (9.5 vs. 4.1 vs. 6.8 kg) and body fat reduced (3.9% vs. 1.7% vs. 1.9%) and fewer adverse events than the individual treatment groups alone. However, long-term safety and sustainability using this intervention for weight maintenance remain unknown and require further data to confirm.[65]

Patient-centered weight control to manage OA

How can we best support people with OA to lose body weight?

The overarching principle of weight loss and weight management is to reduce and control calorie intake in relation to calorie expenditure (Fig. 6.3). This can be achieved in several ways, the most obvious being through the diet. Pharmacological and surgical options (bariatric surgery) can also induce significant weight loss.

The most effective diets are either low-carbohydrate or low-fat diets or combination therapy, including meal replacements and enhanced support.[66] In knee OA, complete meal replacement therapy for 8−16 weeks has induced significant weight loss.[67−69] Therefore, calorie restriction through meal replacement programs seems the most effective nonpharmacological/nonsurgical option. A recent systematic review showed that group-based weight loss programs were more effective than one-to-one programs.[70] People in group programs are more likely to lose more weight and to lose at least 5% of their initial body weight. Group-based programs also allow for more efficient use of resources allocated to weight loss programs.

Initiating or increasing physical activity or exercise is not an effective weight-loss tool on its own[66] but can be applied to increase calorie expenditure. Attempts to lose weight without a change in diet require high levels of physical activity or exercise (225−420 min/week of intensive exercise). It has, however, been documented that exercise is extremely important for improving a range of health outcomes, including the maintenance of weight loss.[71]

A combination of diet and exercise in knee OA patients has been shown to induce weight loss (6% over 18 months),[72] but to a smaller degree than the total meal replacement therapies that achieved 10%−12% over 16 weeks.[67−69] Other types of interventions such as physical activity and various technologies (phone calls, resources, and support provided via smartphones/tablets, text messaging, and computer-based support) can also induce weight loss, but the weight losses reported are typically less than 2 kg.[66]

Other diets and dietary supplements have also been studied. These include dietary fibers, whey protein, green tea, chitosan, glucomannan, calcium, black seed extract, and omega-3s. Only a few studies showed weight loss with effects ranging from 0.5 to 4.5 kg.[66] Few trials have examined the effectiveness of behavioral weight loss programs delivered in everyday contexts. These trials suggest that commercial interventions delivered in the community effectively achieve weight loss, whereas interventions delivered in primary care only yield small and clinically irrelevant effects.[73]

Over recent years, effective pharmacological options have been introduced, such as glucagon-like peptide-1 (GLP-1) receptor agonists (e.g., Liraglutide and Semaglutide). The physiologic effects are plenty, including inhibition of gastric emptying, acid secretion, and motility, which altogether reduces appetite and effectively induces weight loss.[74−76] One study has applied it on patients with knee OA and shows that GLP-1 maintains an initial low-calorie diet-induced weight loss for 52 weeks.[69] Moreover, when combined with pharmacological options with exercise, the efficacy of weight loss is augmented.[65]

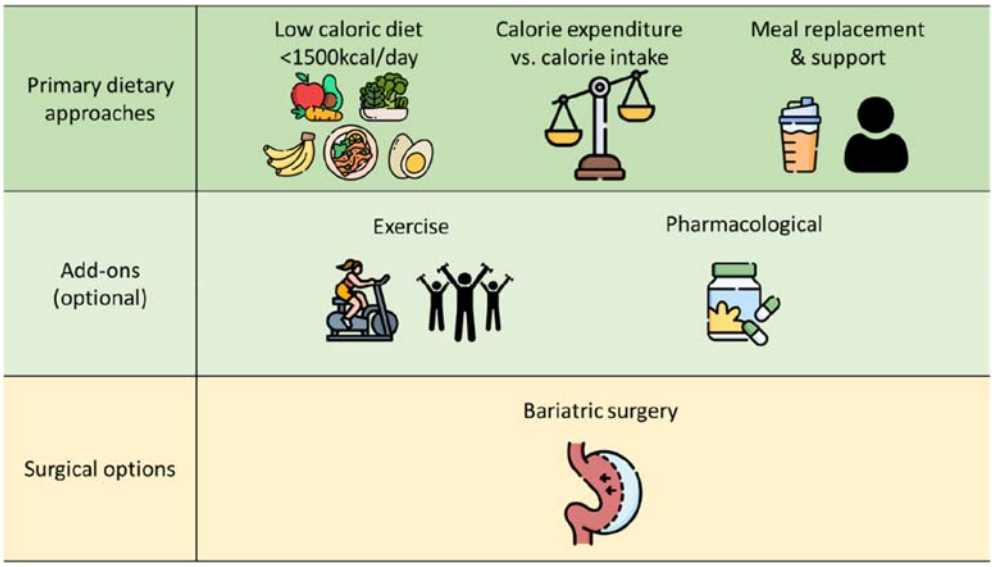

FIGURE 6.3 Approaches to patient-centered weight control for people with OA.

Finally, bariatric surgery can be an option for some people. The indications for such procedures vary from country to country, and a specialist assessment is necessary. Bariatric surgery should be considered the last resort option for a very selected group of people with serious health problems caused by being overweight. Some procedures limit how much the individual can eat, and other procedures inhibit the ability to absorb nutrients. Some procedures do both.

How to maintain weight loss?

While complete meal replacements can be cumbersome and challenging to adhere to, most of the products available include necessary basal nutrients, and hence they are considered safe if used appropriately. Good adherence to a complete meal replacement diet has the advantage of inducing fast and considerable weight loss. A disadvantage is returning to "normal" food, which may regain weight if the individual returns to the habitual preweight loss diet. Therefore, a careful introduction to a healthy and appropriate diet is important in conjunction with information and education. In light of health benefits, safety, and cost-effectiveness, accumulating evidence has demonstrated the effects of fiber-rich diets or Mediterranean diets on weight control and cardiometabolic health.[57,58] Therefore, these diets appear to be good options for long-term weight maintenance after an initial weight loss and a dietary means to manage the illness of OA in the long term.

In general, participants regain the weight when a weight loss intervention is stopped. Regaining weight after weight loss is faster with greater initial weight loss, but it takes an average of 5 years to remove the weight advantage that more significant initial weight loss induces.[63] Therefore, aiming for a fast and large initial weight loss is probably an efficient weight-loss method.

There are several approaches to improve adherence to a diet and support long-term weight control. A review of factors associated with weight loss maintenance suggests that a successful long-term weight loss builds upon an initial weight loss, reaching a self-determined goal weight, acquiring a physically active lifestyle, a regular meal rhythm including breakfast, healthier eating, exerting control of overeating, and starting self-monitoring of behaviors.[43] In addition to such internal motivation factors, other important factors include social support, coping strategies, and ability to handle life stress, taking responsibility for one's own life, and having overall more psychological strength and stability.[43] Group-based weight loss programs with frequent patient–therapist contact appear to be a critical factor in weight loss. Continued contact is effective whether by attending weight maintenance classes[58,70] or through telephone, post, or email-based communications.

Safety considerations

With a loss in fat mass, the proportion of lean mass to total mass increases. This has beneficial effects, although rapid and intensive calorie restriction diets also can result in an absolute loss of lean mass.[77] This may be counteracted by employing physical activity or exercise in conjunction with a weight loss program. Weight loss can also result in bone loss and increased fracture risk[78]. However, the data is not clear on the effects of exercise to mitigate this problem. It is suggested that weight-loss-induced bone loss may be attenuated by exercise.[79]

Obesity can be associated with mental health issues, which can be a significant barrier to effective and sustainable weight loss. Many people have all-or-nothing thinking, meaning that even the smallest deviations from a plan result in a feeling of failure, resulting in the entire plan's termination. Such all-or-nothing thinkers may likely benefit from additional support and a reminder that occasional minor deviations from a plan may be acceptable and may not hinder the fulfillment of the long-term goal. More serious mental health issues should be assessed and managed by specialists and maybe more pressing to manage than the overweight issue.

A paramount concern is the effects of weight loss in people who are both obese and frail. Weight loss could worsen frailty by accelerating the normal age-related loss of fat-free mass, leading to sarcopenia.[80,81] Fortunately, a concurrent exercise program may ameliorate frailty in obese older adults.[82] Also, for those who are frail, it may be advisable to focus on the nutritional aspects of the diet to ensure appropriate intake of essential nutritional substances (e.g., minerals, vitamins, protein) while losing weight.

The Internet is full of weight loss programs—most for-profit, and few are evidence-based. Therefore, initial professional guidance is critical to ensure that weight loss is achieved in the most effective, appropriate, and safe way. Group-based interventions provide a social framework for support and perseverance to a proper diet. Continuous support sessions with a dietician can aid weight maintenance, ongoing goal setting, and adherence to plans.[58] Regular booster periods can also help achieve the long-term weight maintenance goal, but weight increase (also called the "yo-yo" effect or weight cycling) in between the booster periods is a likely consequence. The yo-yo effect has been suggested to be unhealthy, although the evidence is unclear. Physical activity and exercise habits are also tricky to keep, and one should focus on maintaining these exercises once the initial weight loss has been achieved.

In conclusion, a group-based dietary approach with a significant reduction in calorie intake is the best option for impactful weight loss, as a rule of thumb, a large and fast weight loss results in better sustainability of the achieved benefits. The success of both the initial weight loss and the subsequent weight control is better achieved via professional support from dieticians or nutritionists. Exercise and physical activity should not be considered a single tool for weight loss but should be viewed as an adjunct to increase calorie expenditure, overall health, and well-being, and counteract the undesirable loss of muscle mass and bone minerals.

Barriers to implementing weight control in persons with OA

Overall factors for weight loss

Weight loss, whether an initial regimen or long-term maintenance, is complex, with the latter remaining a bigger challenge to many people and for health professionals who aid their patients to achieve such success. A literature review has listed **factors such as initial weight loss, goal setting for ideal weight, physical activity, healthy eating, and control of overeating, and self-monitoring of behaviors** associated with weight loss and maintenance[43]. Furthermore, both healthcare professionals and people who are overweight or obese should understand the environmental factors, including reduced caloric intake and increased physical activity, the primary tools for weight control.[42] Health professionals and patients should also understand the biological mechanisms such as genetic, hormonal, thermogenesis, and neural factors that work together to undermine weight loss effects and promote weight regain in individuals (Fig. 6.4). This will help both

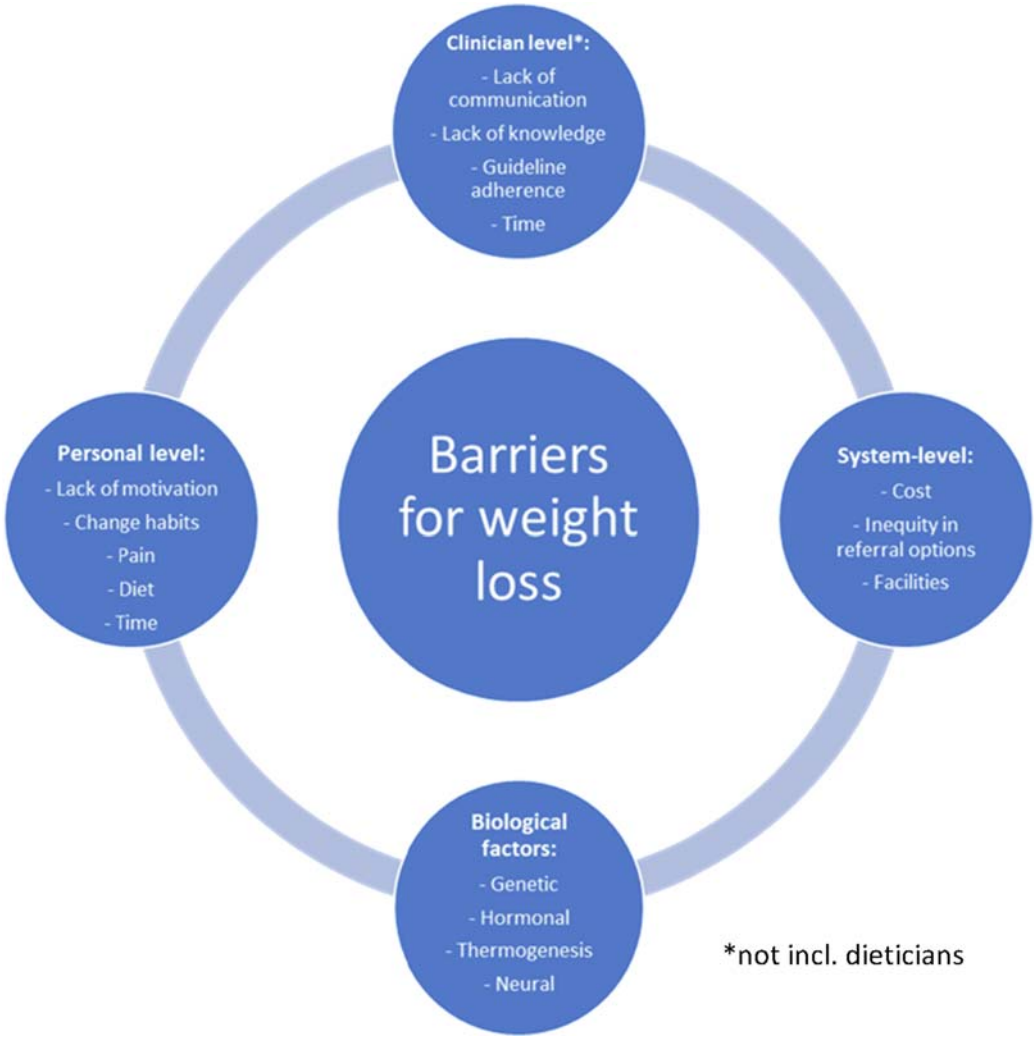

FIGURE 6.4 Barriers to weight loss in people with OA.

parties to reduce stigmatism and frustration to achieve weight maintenance. Importantly, clinicians and patients need to work closely together to monitor, communicate, and adjust weight loss goals or treatment options during this process to achieve the goal of ideal body weight.[42]

Secondly, understanding the barriers is vital for both patients and clinicians to achieve a better outcome on initiating and sustaining weight loss to manage OA. Due to pain and symptoms at the patient level, persons with OA often lack the motivation to change their lifestyles, including diet and physical activity.[83,84] For clinicians, barriers may include a lack of time, capacity, or skills to address effective strategies on weight loss.[85,86]

Studies have suggested that the majority of the patients with OA have discussed weight or weight management with their healthcare providers.[87] Here, we summarize common barriers from the literature on weight loss and suggest strategies to overcome them. This session aims to provide a general concept or ideas for clinicians to adopt and modify. Of note, the specific strategy should be tailored to suit each individual's situation to make it person-centered.

Patient level

Lack of motivation to lose weight or change habits

A qualitative study conducted among persons with OA suggests that the biggest barrier to achieving ideal weight loss was a lack of motivation among 89% of the study participants.[83] Another qualitative study also mentioned that a lack of motivation to change lifestyle was common among persons with knee OA.[88] This is also mentioned in another survey of clinicians and patients, which reports that lack of patient motivation and compliance is the most significant barrier to the treatment and management of obesity.[87]

Pain as a barrier to losing weight and exercise

In the same qualitative study mentioned above, the second barrier to achieving ideal weight loss was pain in the knee joint.[83] Additionally, patients with OA also expressed fear of pain and adjusted their physical activities according to the pain level.[89]

Healthy eating

Furthermore, many patients have expressed their desire to manage OA through healthy eating as the most common strategy for losing weight.[83] In another study, patients with knee OA mentioned negative experiences with drugs as treatment options.[88] However, many clinicians felt that asking patients to make lifestyle changes for weight loss and exercise was daunting and unachievable due to reasons such as food and meal replacement products costs, food environment, and location of homes to access healthy food and facilities to exercise.

Clinician level

Lack of communication from healthcare providers

In several studies, patients expressed a lack of communication with their clinicians about disease progression and treatment options.[88,89] For example, many patients reported a poor understanding of OA and the available treatment options; they often obtained information from sources other than the medical team.[89] In another study, while clinicians expressed lacking capability and knowledge to communicate with their patients on lifestyle changes on weight loss, patients with OA, in turn, expressed that communication with their healthcare providers was insufficient (poor communication by the healthcare professional).[88] Specifically, patients mentioned limited time from their healthcare providers on informed treatment options, disease progression, or patient-tailored treatment options.[88]

Guideline adherence

Inconsistency between clinical practice and clinical guideline recommendations was reported in an Australian study in general practice (primary care). Only 20% of the patients felt that they had been sufficiently educated about the diagnosis, treatment options, and prognosis, and 33% had not previously engaged in any nonpharmacological management strategy considered a core clinical practice guideline recommendation.[90] Other studies mentioned that lack of adherence to guideline recommendations was one of the barriers to weight loss to treat or manage OA. In addition, the low utilization of clinical guidelines for OA and obesity management by clinicians is reported as a barrier to effectively controlling weight.[87]

This is further illustrated in an earlier study in which some patients reported that they experienced difficulties in adopting the guideline recommendations into practical use.[88]

Lack of time (patients and clinicians)

Both patients and clinicians expressed a lack of time to address and/or achieve weight loss. For example, clinicians expressed difficulties managing OA given time constraints and competing for agenda items at appointments.[89] In addition, most clinicians reported they provided information on OA management to their patients at diagnosis, with a pamphlet or website being the most common. However, almost half of patients indicated their care providers did not provide them with any resources.[87]

Education and training with reliable resources are essential to both clinicians and patients with OA to overcome these barriers. Some of the strategies may include the following when helping persons with OA to manage body weight.

Plan for regular assessment and communication of overweight and obesity between patients and healthcare professionals. Health professionals should advise on long-term strategies and available treatment options, including and beyond diet and physical activity as interventions. Both patients and health professionals should first agree on weight loss goals and the preferred treatment plans. Health professionals need to assess an individual's barriers to weight loss and provide adequate resources and referral services based on patients' needs and learning styles, including referrals to dieticians, physical therapists, bariatric surgeons, or exercise specialists. Early referrals are essential to increase additional beneficial healthcare providers.[87]

To implement clinical guidelines into practice more effectively, widespread and multifaceted distribution of information about the weight loss program and predesigned material (in print when needed and updated regularly) need to be available at the beginning of the management consultations for both the patients and clinicians. Furthermore, to increase evidence-based knowledge among clinicians, professional education activities such as a certified course including evidence-based knowledge about OA and treatment options are also suggested. Another suggestion is to create an electronic registry to monitor and evaluate weight loss and OA outcomes to reinforce patients and clinicians to implement regimens more effectively while adjusting to tailor to meet personal needs and preferences[91] (Fig. 6.5).

Concluding remarks

For individuals with concomitant OA and overweight, weight loss is pivotal for the management of the OA illness and general health. A large and fast weight loss seems to be the most optimal strategy for long-term benefits. Low-calorie diets are the most effective nonpharmacological means for this initial significant and rapid weight loss, and delivering group-based programs augments the likelihood of success. A return to a healthy diet consisting of fiber-rich diets or Mediterranean diets, possibly with intermittent periods with low-calorie meal replacements, is probably the best strategy for long-term weight loss maintenance. The introduction of exercise after or in parallel with dietary interventions should be considered to increase calorie expenditure and prevent unwanted loss of lean muscle mass. Muscle-strengthening exercises, low-impact aerobic exercise (such as walking or cycling), and low-impact activities such as Tai Chi and Yoga are suggestions of adjunct exercise types that can be used in the long-term management of bodyweight and OA.

FIGURE 6.5 Potential approaches to overcoming barriers to weight loss for people with OA.

Both healthcare providers and patients should be educated and informed about the underlying principles of weight loss, and both parties need to invest time and energy in addressing overweight. Referral to specialists and dieticians who can provide the necessary support and knowledge are crucial for success.

Selected links to any helpful online resources

Europe

https://www.bda.uk.com/resource/osteoarthritis-diet.html
https://tdmr-europe.com/(Note: Industry sponsored).

US

https://www.hopkinsarthritis.org/patient-corner/disease-management/role-of-body-weight-in-osteoarthritis/

Asia

https://www.singhealth.com.sg/patient-care/conditions-treatments/osteoarthritis;

Australia

https://www.aihw.gov.au/reports/chronic-musculoskeletal-conditions/osteoarthritis/contents/treatment-management;
https://www.nps.org.au/news/osteoarthritis-an-opportunity-to-promote-weight-loss-with-patients;

Africa

https://www.westerncape.gov.za/general-publication/everything-you-need-know-about-osteoarthritis.

Case study 3: Katrina

Katrina is an obese 55-year-old sedentary female with symptomatic knee OA.

She has depression, sleep apnea, and hypertension. Her hypertension is currently well controlled on medication. She has previously had a peptic ulcer.

Katrina experiences pain in and around one knee, including pain in the patellofemoral joint. She has not had an adequate response to either intermittent dosing of over-the-counter acetaminophen, over-the-counter NSAIDs, or over-the-counter nutritional supplements (e.g., chondroitin sulfate, glucosamine). But she never really had a good routine with these medications and took everything haphazardly. Her X-ray shows OA involvement in both the medial tibiofemoral and patellofemoral compartments. She also has varus deformity. Katrina has friends that had successful knee replacement surgeries and thinks that she'll inevitably have surgery on her knee and therefore hasn't tried/been offered nonsurgical and nonpharmacological treatment. Her general practitioner (GP) has recommended her to see a physio, but she's not keen because she tried it when she was younger, and it didn't work; Katrina is married and fills her day with home duties. She goes swimming at an indoor pool once a week. She likes to socialize but is limited because she can't walk long distances (e.g., if she goes out for lunch, she needs to park nearby). Katrina can only walk 100 m before having to sit down. She also struggles walking up and down stairs at home and has to use railings or take lots of breaks.

One day Katrina sees her GP and measures Katrina's body mass index. It is 34, which means that Katrina is obese. The GP and Katrina agree that losing weight will be beneficial to Katrina, and the GP tells Katrina that weight loss will also improve her knee pain. Katrina is referred to a dietician to start a weight loss program.

The dietician recommends Katrina start an intensive weight loss program. It is a 2-month program with complete meal replacements. Katrina is told that it can be hard and challenging, but if she hangs in, the reward will come. The meal replacement products have a cost, but Katrina thinks that the money she saves on food can be used to buy the products. Katrina's husband and children are supportive of the idea and say that they will help and do their own cooking while Katrina is going through the program.

At first, the hunger and craving—especially for sweets and the snacks that Katrina used to eat outside the regular meals—are difficult to handle. But Katrina can call her dietician when she feels the need for support. After 3–4 days, it starts to be easier. After 1 week, Katrina goes to a group session with her dietician, where she meets other people like her. It

feels good to share thoughts and concerns with other people. Katrina is being weighed, and she has already lost 1.5 kg. At the meeting, the dietician also teaches the group about the principles of healthy eating, and Katrina realizes that her diet has been too unhealthy over the last 10 years.

Over the following weeks, Katrina sticks to the program (more or less), and she starts to feel so much better. She sleeps better during the night; she has more energy and is happier. Katrina keeps on losing about 1.5 kg each week, and after the 8 weeks, she has lost a total of 12 kg. She sees her GP and measures her BMI, which is now 29.6. The GP also reduces her hypertension medication.

After the program, Katrina feels much better. She can now get up and down the stairs at home without noticing knee pain. She can take longer walks without needing breaks, and she has started seeing her friends and family more often. Katrina is convinced that the weight loss has really helped, and she decides that she will do what she can to avoid regaining the weight.

Luckily, the dietician has taught her how to shop and cook healthier, and she is getting comfortable with the new ways of cooking. The family also thinks that Katrina's new way of cooking is tasty and delicious.

Katrina revisits her dietician after 3 months. Things are going well, but she is no longer losing weight. The dietician and Katrina talk about this and decide that it is OK if Katrina can maintain the current bodyweight for a while. However, Katrina is not yet ready to take another 8 weeks of meal replacement because the holiday season is coming. The dietician ensures that Katrina understands the importance of a proper and healthy diet in order for her to keep the weight off. Katrina is quite confident that she has understood that she and her family need to eat more vegetables and fruits, whole grain pasta and bread, lean meats, and fish. Luckily, Katrina and her family have discovered that the new diet is actually quite delicious, and they enjoy discovering new ways of cooking.

Katrina visits her GP for her medication check-up, and the GP is pleased to hear that Katrina is doing so well. Her sleep apnoea is almost gone, her hypertension is under excellent control, and her knee pain is now manageable—some days, Katrina even forgets that she has a bad knee. So, together they decide that the knee replacement surgery can wait.

Katrina is so happy that she has lost weight—the only drawback is that she needs to buy new clothes.

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Chapter 7

Module 7: adjunctive rehabilitative interventions

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AIM: to provide an overview of the proposed mechanisms, evidence, expected benefits, limitations and risks, advantages, and disadvantages of key adjunctive rehabilitative interventions for people with osteoarthritis (OA).

Clinical practice points and evidence summary

- Adjunctive interventions are recommended as supplemental approaches to support core treatments for osteoarthritis
- Recommendation inconsistencies for adjunctive interventions are commonly caused by a lack of effectiveness data or variability in the interpretation of low-quality findings
- Sometimes the quality of data far exceeds the quantity (e.g., directly measured knee compartment contact pressures in a single subject design study)
- The evidence for adjunctive rehabilitative interventions would benefit from additional randomized controlled trials (RCTs) and metaanalyses.

Introduction to adjunctive rehabilitative interventions

Proposed mechanisms for osteoarthritis (OA) include the following: (1) excessive mechanical stress on the tissues within the synovial joint, (2) an inflammatory response, (3) an enzymatic breakdown of synovial tissues, and (4) the gut-microbiome. All the tissues within the synovial joint have been implicated at the macromechanical to micromechanical (i.e., tissue, cellular, and subcellular) levels. Each rehabilitative intervention may treat OA via a different mechanism. To date, there is no cure for OA and the precise mechanisms of onset, progression, and treatment are predominantly unproven. There is a large possible spectrum of treatments for managing OA which may be administered based upon disease severity. The Kellgren and Lawrence (KL) radiographic scale is one approach for describing OA disease severity (i.e., *Grade 1: doubtful joint space narrowing with possible osteophyte, Grade 2: possible joint space narrowing with definite osteophyte, Grade 3: definite joint space narrowing, moderate osteophyte formation, some sclerosis, and possible deformity of bony ends, Grade 4: large osteophyte formation, severe joint space narrowing with marked sclerosis, and definite deformity of bone ends).* Fig. 7.1 illustrates the possible spectrum of treatments as a function of KL grade which is, by and large, based upon opinion and not evidence. Although joint replacement, considered the treatment of choice for KL4 patients, has been successful for managing pain, this is a smaller group compared to those with KL2 and KL3 grades which we refer to as "the desert" where patients are looking for an effective treatment analogous to a "thirst quenching glass of water." This chapter will provide the evidence available for proposed mechanisms, expected benefits, limitations and risks, advantages, and disadvantages for adjunctive rehabilitation strategies in the following areas: biomechanical devices and strategies, classic rehabilitation approaches, complementary and alternative medicine (CAM), and psychosocial strategies.

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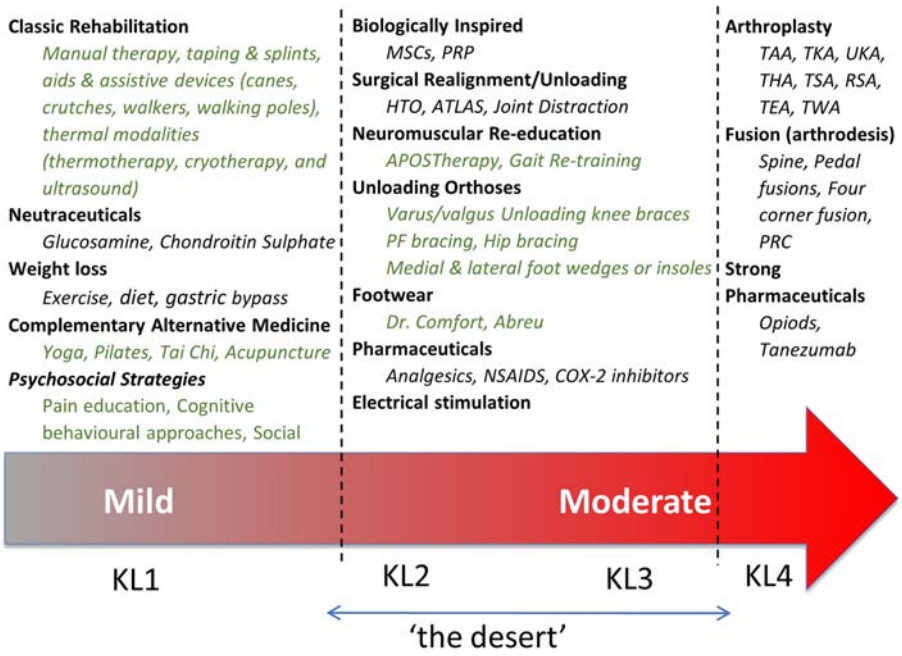

FIGURE 7.1 Possible Spectrum of Treatments for Managing OA as a Function of Disease Severity. *APOSTherapy*, a shoe-based neuromuscular reeducation therapy; *COX-2*, Cyclooxygenase-2; *HTO*, high tibial osteotomy, ATLAS is an internal unloading implant; *MSCs*, mesenchymal stem cells; *NSAIDs*, nonsteroidal antiinflammatory drugs; *PF*, patella-femoral; *PRC*, Proximal Row Carpectomy; *PRP*, platelet-rich plasma; *RSA*, Reverse Shoulder Arthroplasty; *TAA*, Total Ankle Arthroplasty; *TEA*, Total Elbow Arthroplasty; *THA*, Total Hip Arthroplasty; *TKA*, Total Knee Arthroplasty; *TSA*, Total Shoulder Arthroplasty; *TWA*, Total Wrist Arthroplasty; *UKA*, Unicompartmental Knee Arthroplasty.

Biomechanical devices and strategies

Varus/valgus unloader braces

Orthoses, often referred to as braces, are devices for the correction of disorders (e.g., malalignment) of the limbs or spine. Made from a variety of lightweight materials (e.g., plastics, filamentary composites, etc.), orthoses can alter alignment and provide support to the anatomical region of interest. They are not intended to replace a limb, such as a prosthesis, but to augment the function of an existing limb or body region and is fitted by a certified orthotist.

One of the primary proposed mechanisms for the onset and progression of knee OA is to overload medial or lateral compartments of the femoral−tibial joint. This may occur over time through wear and tear (primary knee OA) or as a result of trauma (secondary knee OA). As originally described by Maquet (1983), consider the lower limb as an eccentrically loaded column (Fig. 7.2).[1] The osseous geometry of the lower limb is shown in Fig. 7.2 (left). The ground reaction force acts upon the center of gravity of the body (~2″ anterior from S2), which is eccentric (displaced by a moment arm (distance, d)) to the long axis of the lower extremity. To simulate this loading condition, we have represented the lower extremity as a column (Fig. 7.2 center) with 600N of vertical load applied eccentrically about the central axis at a distance d. The resulting stresses are from (a) vertical load divided by the cross-sectional area of the column and (b) the bending moment imposed by the eccentric load. Notice how the medial part of the column is in compression, while the lateral is in tension. The combined load results in ~70% of body weight (BW) in compression on the medial aspect of the knee with ~30% of BW in compression on the lateral knee. If we double the load (1200N) but apply it symmetrically at a distance ± d from the central axis, we will double the compressive stress, but the bending moment will be "0" and hence not contribute any additional compressive stress. Furthermore, if you impose a varus deformity on the column, similar to a genuvarum knee, the moment arm d will increase, further increasing the medial compartment stress. Conceptually, this places the lower extremity symmetry of loading and alignment as important factors for managing compartmental stress within the knee. Lower extremity alignment is a modifiable risk factor for treating medial or lateral compartment knee OA, as well as patellofemoral (PF) OA.[2]

Braces for treating knee OA are typically designed to impart an opposing moment, or torque, to minimize the forces and stress on the involved compartment of the knee. For example, Fig. 7.3 depicts a posterior lower limb view with genuvarum, medial joint space narrowing, and a large moment arm from the ground reaction force to the knee center (left). As illustrated in the center the subject is wearing a knee brace with 3-point bending that substantially reduces the moment arm while reducing the varus deformity. On the right, a patient with genurvarum (anterior view) is shown eliciting a clockwise moment (right hand rule). The patient is wearing a knee brace (upper right) that generates an opposing counterclockwise moment to unload the medial knee compartment.

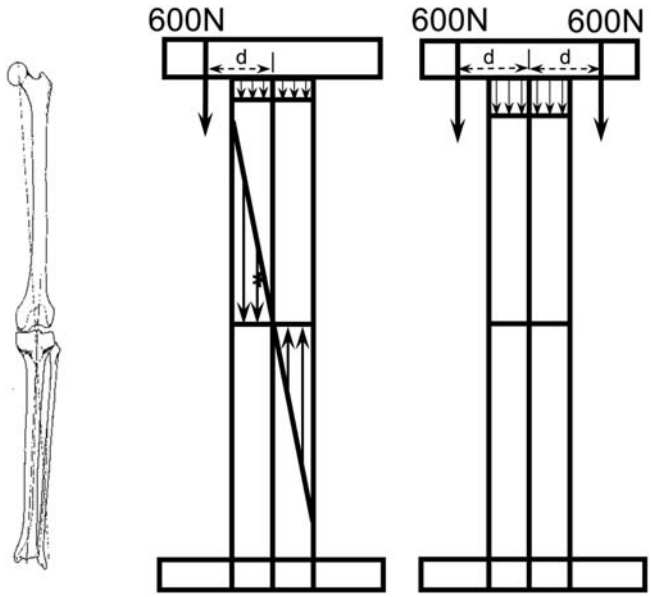

FIGURE 7.2 Eccentrically loaded column — (left) lower extremity, (middle) eccentrically loaded column — 600N vertical load applied at a moment arm d, (right) symmetrically loaded column — 1200N vertical load applied at moment arms ± d, concept adapted from Maquet, P.G.J.[1].

Unloading knee braces have demonstrated their ability to reduce pain and improve function in several studies.[3–10] Some insight has been obtained as to the efficacy of unloading knee braces from two studies where an electronic total knee replacement (TKR) was employed to measure the joint reaction force directly. In the Kutzner et al. study, three patients with an e-tibia (electronic TKR), two different German braces (Ottobock and Bauerfeind), demonstrated reduced forces in the electronic knee prosthesis when the patients wore these unloading braces while walking.[11] In a case study examining four different brace conditions, joint reaction forces were reduced on a 69-year-old female subject with an e-tibia while wearing these unloading braces (Fig. 7.4).[12] As the individual stood or walked, the knee joint reaction forces were transmitted to a laptop computer. The joint reaction force in the medial and lateral compartments versus % stance phase was graphed for unbraced (red) and braced conditions. Four brace conditions were examined (Unloader One, Unloader

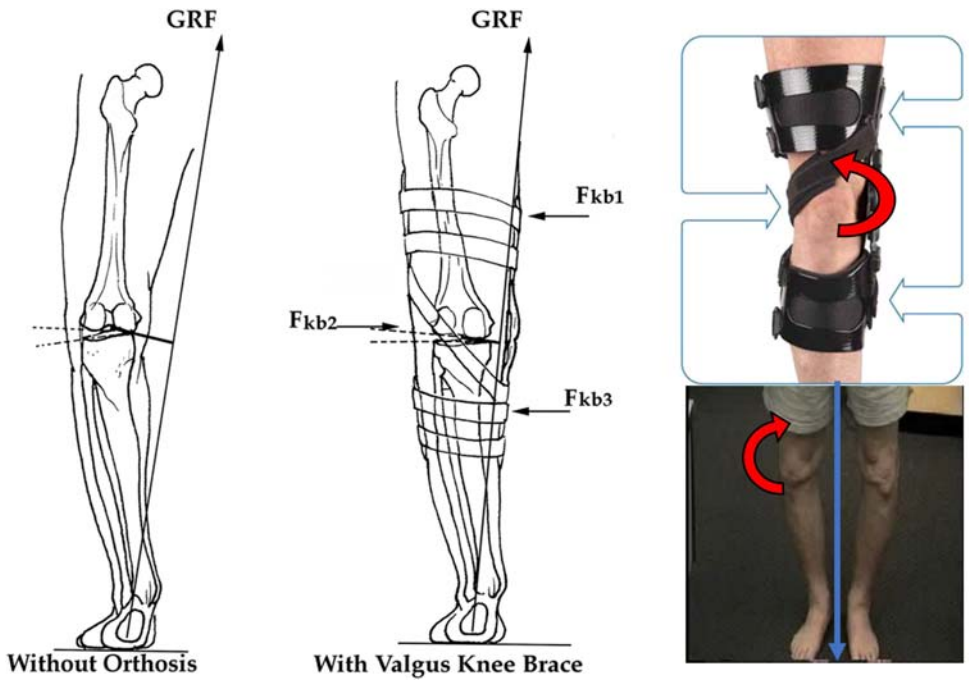

FIGURE 7.3 A posterior lower limb view with genuvarum, medial joint space narrowing, and a large moment arm from the ground reaction force to the knee center is shown on the left. As illustrated in the center, the subject is wearing a knee brace with 3-point bending that substantially reduces the moment arm and varus deformity. On the right, a patient with genurvarum (anterior view) is shown eliciting a clockwise moment (right hand rule). The patient is wearing a knee brace (upper right) that generates an opposing counterclockwise moment to unload the medial knee compartment.

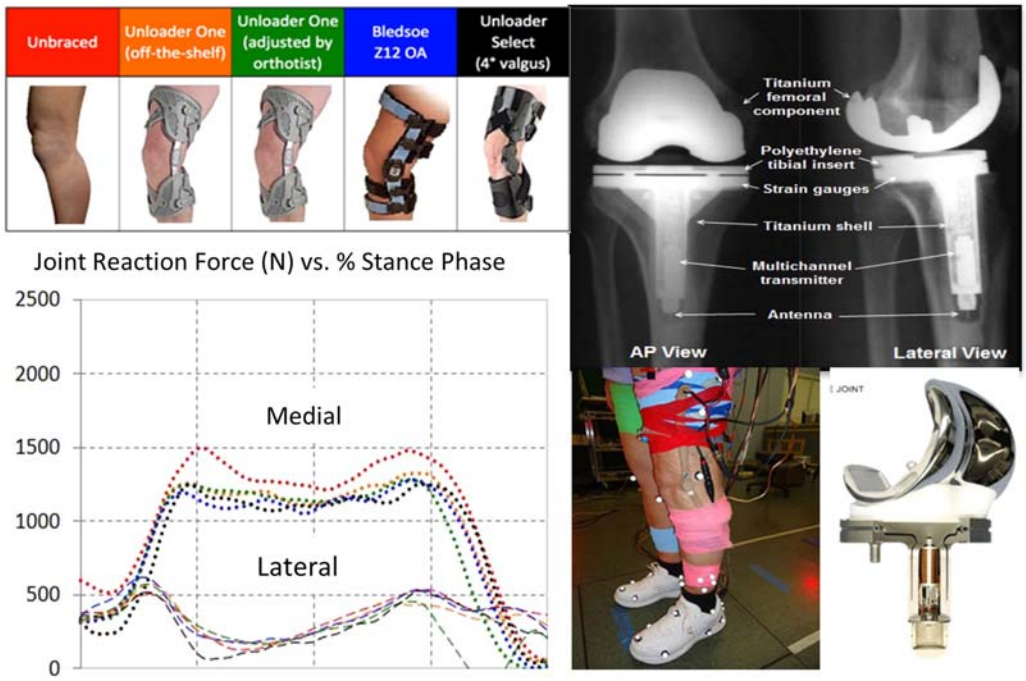

FIGURE 7.4 An electronic total knee replacement (e-tibia) was installed in a 69-year-old female (right). As the individual stood or walked, the knee joint reaction forces were transmitted to a laptop. The joint reaction force versus % stance phase was graphed for unbraced (red) and braced conditions. Four brace conditions were examined (Unloader One, Unloader One adjusted by an orthotist, Bledsoe Z12 OA, and the Unloader Select). The first and second peaks of the joint reaction forces on the medial compartment of the knee were reduced by ~15% through the use of an unloading knee brace, irrespective of which type.

One adjusted by an orthotist, Bledsoe Z12 OA, and the Unloader Select). The first and second peaks of the joint reaction forces on the medial compartment of the knee were reduced by ~15% through use of an unloading knee brace, irrespective of which type. Although this is a single subject case study and therefore not generalizable, the evidence is compelling in its quantitative support of the concept that unloading knee braces do in fact "unload" the medial compartment of the femoral−tibial joint. Using different unloader braces, the study of three patients with an e-tibia by Kutzner's group also supports this concept. Such data is rare for obvious reasons. An alternative approach has been developed to study this phenomenon using computational models.[13] This group estimated the joint reaction forces with a musculoskeletal model with and without a corrective moment imposed by the knee brace. This work also supported the concept that unloader knee braces can unload the medial compartment of the femorotibial joint.

The knee is a tricompartmental structure comprised of the medial and lateral compartments of the femorotibial joint and the PF joint. PF joint OA is often confused with femorotibial OA and therefore misdiagnosed.[14] Not only can PF OA occur as an individual compartment disease, but it can also occur in conjunction with femorotibial joint OA as a bicompartment or tricompartment disease.

There are several new brace designs employing pneumatics,[15] advanced assessment methods such as computational biomechanics,[13,16,17] and regenerative medicine concepts in conjunction with unloader braces[18] that have arisen. For the interested reader, these studies each contribute to our knowledge about unloading the knee compartment with OA. Still, most of the published studies in this area have not been designed as randomized controlled trial (RCTs) or comparative studies with other traditional unloader knee braces. This does not imply they are not effective but that they have not withstood the rigor or level of evidence of a double-blind RCT or have been included in a structured review or meta-analysis. Importantly, a well-conducted double-blind trial involving orthopedic devices such as knee braces, expecting the patient to be unaware of which is the placebo control and which is the treatment, is very difficult to achieve.

Patellofemoral bracing

The primary purpose of the patella is to serve as a mechanical pulley for the quadriceps as the patella changes the direction of the extension force throughout the full range of knee flexion. At 0° to <20 degrees of flexion, the patella is superiorly

oriented to the knee and not in direct contact with the femur. As the knee flexes from 20 degrees, the articulating surface of the patella changes throughout the range of knee motion. The contact point moves proximally along the patella and inferior–posterior along the femoral condyles. The patellar contact area increases with increasing knee flexion, which distributes joint forces over a greater surface area to reduce diarthrodial joint tissue damaging stress. During a deep squat, one can expect a peak of ~8 times BW of compressive force from the patella upon the femur. When the patella does not track in the trochlea (maltracking), it could result in structural damage of the PF joint as well as PF pain. Patellar taping, a technique employed to enhance patellar tracking, has served as a first line of defense in managing patellar pain syndrome. In a structured review and metaanalysis, which included 20 studies, tailored patellar taping (customized to the patient to control lateral tilt, glide, and spin) had moderate evidence for reducing pain.[19] One proposed mechanism is that patellar taping promotes earlier vastus medialis oblique onset and improved ability to tolerate greater internal knee extension moments. Almost all the evidence to date is based upon the immediate effect of taping. This is important because orthopedic taping can loosen over time while performing exercise (e.g., basketball).

PF pain or OA can arise from patellar malpositioning, irregular PF geometry, or malalignment of the femoral–tibial joint.[14] Classic PF bracing consists of a donut-style sleeve that circumscribes the patella and through tightening of Velcro straps can affect medial or lateral repositioning of the patellar with the goal of improving tracking in the condylar grooves of the femur. In an RCT comprised of 136 individuals, patellar bracing has been shown to improve the symptoms of PF pain syndrome.[20] More recently, 38 PF OA patients were treated with a PF brace which resulted in significant correlations between mean minimum clinically important difference categories for the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) global and function groups when analyzed against percentile groups for bisect offset ($P < .01$) and patellar subluxation distance ($P < .05$). This study suggested that those patients in higher percentile groups of aberrant patella positioning were more likely not to improve after 6 months. A unique brace design permits offloading of the PF and femoral–tibia joints.[16] From a biomechanical perspective, this makes sense because improved femoral–tibial alignment should improve patella–femoral tracking.

Hip bracing

Hip bracing has a variety of configurations from basic Velcro straps designed to adduct or abduct the hip to more sophisticated designs targeting unloading the hip joint and managing instability. Hip braces are sometimes referred to as hip abduction braces because they maintain the femur safely in the acetabulum preventing subluxation and dislocation. This type of orthosis is commonly used postoperatively to maintain joint integrity while healing is in progress. Hip unloading braces[21] in an uncontrolled repeated measures designed study have demonstrated reduced pain, hip adduction moment, hip adduction, and internal rotation during gait. Research on the efficacy for treating hip OA with bracing is sparse although Eyles et al. conducted an exploratory RCT and supported brace use for hip health Quality of Life (QoL), pain, symptoms, and function.[22]

Medial and lateral wedges or insoles

Medial and lateral wedges or insoles represent an in-shoe treatment strategy that can impose a valgus or varus correction to the femoral–tibial joint alignment.[23] Several studies have met with a mixed set of positive[24–34] or null[35–41] findings for the management of medial knee OA with lateral wedge insoles. Studies employing 5 degrees or less wedge geometries may result in small effect sizes but may be well tolerated by the patient. Studies employing 10 degrees wedge geometries may result in larger effect sizes but maximally pronate or supinate the foot and may be less tolerable to the patient. Tezcan et al.[42] employed an RCT to assess the effect of lateral wedges upon the ankle and hip joints. There were no significant differences in joint space width at the ankle or hip through use of a lateral wedge orthosis versus a neutral insole. A lateral wedge insole with an elastic strap around the subtalar joint outperformed the lateral wedge alone[43] for improving knee mechanics. Arnold et al. and Xing et al. both conducted systematic reviews and metaanalyses that did not support use of lateral wedged insoles for patients with medial knee OA.[40,41] Moyer et al. found that a custom-fit knee brace and custom-made foot orthotic concurrently produced a greater overall reduction in the knee adduction moment (KAM), through the combined effects of decreasing the frontal plane lever arm.[32,33] The use of lateral wedged insoles is inconclusive given both the positive and null findings for managing medial knee OA. Performance of the lateral wedge insole may be improved through the use of an elastic strap around the subtalar joint[43] or a custom-fit knee brace.[32,33] Additional research is necessary to determine which patients are likely to respond to lateral wedge insoles alone, medial wedge insoles, or insoles in combination with knee bracing. Of course, compliance of patients wearing either of these orthoses may also be an important factor.

Footwear

The "mobility" shoe was developed based upon the observation that KAMs were smaller in barefoot than traditional shoes.[43] A "Variable Stiffness" shoe with different medial versus lateral outsole compliance was developed to reduce the varus thrust at the end of weight acceptance by encouraging initial protonation after heel strike.[44,45]

Radzimski, Mundermann, and Sole conducted a systematic review examining the effect of footwear on the KAM, which included 33 articles.[46] "Stability" and "mobility" shoes were likely to increase KAM, while "variable stiffness" shoes reduced KAM compared to control shoes. When comparing a minimalist flexible shoe to a standard shoe, the latter was found to have higher KAM, which suggests that different shoe designs, especially those that reduce the external knee moment arm, could provide reduced KAM and be used to treat medial compartment knee OA.[47,48]

Walking poles

Use of walking or hiking poles has been suggested for offloading the medial compartment of the knee in individuals with OA.[49,50] In a study of 34 patients with medial knee OA, Bechard et al. found using typical gait analysis methods (inverse dynamics) that peak KAM values did not decrease through the use of walking poles. In fact, small but statistically significant increases ($P < .001$) in KAM for its first peak, second peak, and angular impulse were observed when using the poles. There was a decrease in the vertical ground reaction force but an increase in lever arm; hence, use for treating knee OA could not be supported. Kinney et al. used a similar protocol as described in Fig. 7.4, in a single subject with an e-tibia, and found that medial contact force was reduced most effectively by walking with long hiking poles using a wide pole placement. Medial and lateral contact force during stance phase was reduced by up to 34% (at 75% of stance) and 26% (at 50% of stance) in this study supporting their use for treating knee OA.

Gait retraining

Rynne et al. conducted a structured review and metaanalysis for treating hip and knee OA with gait retraining methodologies.[51] The goal was to determine if gait retraining strategies improved gait biomechanics and symptoms in individuals with hip or knee OA. Of the 18 studies included, only 1 investigated gait retraining in participants with hip OA and demonstrated limited evidence for improving gait biomechanics. The remaining 17 studies on knee OA were included in the structured review of which 6 were included in the metaanalysis. Those gait retraining strategies which incorporated real-time biofeedback had strong evidence for modifying walking biomechanics. Moderate evidence was observed for kinesiology taping for improving pain scores. The metaanalysis pooled effect demonstrated significant improvements for KAM and the WOMAC in support of gait retraining for treating knee OA although the authors recommended additional RCTs to strengthen the support and add to the paucity of literature in gait retraining of individuals with hip OA.

APOSTherapy is a biomechanical technology that places a hemispherical perturbation element beneath the forefoot and rearfoot of shoes and is custom calibrated to provide a neuromuscular reeducation that alters one's walking pattern with the goal of reducing pain and improving function. Haim et al. from the Teknion evaluated 25 females with symptomatic bilateral medial knee OA who were fit to APOSTherapy devices.[52] KAM magnitude significantly reduced during barefoot walking after 3 and 9 months. The knee adduction impulse and the first and second KAM peaks were reduced by 13%, 8.4%, and 12.7%, respectively. In addition, elevated walking velocity, significant pain reduction, and increased functional activity were observed which the investigators believe may be attributed to the reductions in KAM. In a study to assess long-term follow-up,[53] patients with knee OA were enrolled to active (APOSTherapy) and control (usual care) groups. The active group showed a larger improvement over time between subgroups in WOMAC (pain, stiffness, and function; all $P < .001$), SF-36 Physical Scale ($P = .02$), Knee Society Knee Score ($P = .044$), and Knee Society Function Score ($P = .014$). At the 2-year endpoint, the active group showed significantly better results (all $P \leq .001$). In the largest study to date, Reichenbach et al. enrolled 220 participants with symptomatic, radiologically confirmed knee OA.[54] The effect of APOSTherapy (n = 111), compared with control footwear (n = 109), was assessed over 24 weeks of follow-up. The mean standardized WOMAC pain subscore improved from 4.3 to 1.3 in the APOSTherapy footwear group and from 4.0 to 2.6 in the control footwear group (between-group difference in scores at 24 weeks of follow-up, −1.3, $P < 0.001$). WOMAC physical function (between-group difference, −1.1), stiffness (between-group difference, −1.4), and global (between-group difference, −1.2) scores at 24 weeks follow-up improved, supporting the APOSTherapy's ability to improve pain and function in patients with knee OA.

Electrical stimulation for pain management

Lawson et al. investigated the effects of transcutaneous electrical nerve stimulation (TENS) on knee pain for the management of mild to moderate knee OA, albeit a controversial topic.[55] 20 participants with KL grade 2−3 OA performed the

stair climb test [SCT], timed up and go test [TUG], 6-minute walk test, knee extensor strength test, and 2-step test [2ST]. Knee pain, as measured by visual analogue scale, during SCT, TUG, and LSR2ST tests, was significantly lower when subjects used the active TENS, compared with the inactive unit.

Bichsel et al. compared clinical guideline recommendations for managing hip and knee OA.[56] 17 guidelines were included of which 6 were of high quality, 10 of moderate quality, and 1 of low quality. Pain management was primarily pharmacological (oral nonsteroidal antiinflammatory drugs) with cautious recommendations for paracetamol and strong opioids. TENS had conflicting recommendations as did braces and insoles, whereas severe and persistent pain with loss of function was considered an indication for total hip replacement (THR) and TKR.

Classic rehabilitation approaches

Traditional evidence-based rehabilitation strategies are often considered supplemental to first line, core interventions with appropriate implementation targeting the individualized clinical requirements of each patient. A lack of high-level evidence available to assess the effectiveness of each rehabilitation approach continues to dictate the inconsistent recommendations among current guidelines. The number of clinical trials that exist to evaluate outcome, patient optimization, and prescription varies by treatment, limiting the data available to influence clinical decision-making and challenge how each treatment is implemented in practice. The following subsections will address the individual mechanisms, evidence, advantages and disadvantages, and recommendations for each rehabilitation approach across OA populations and their subclassifications, when available.

Manual therapy

Passive physiotherapy techniques that involve a structured hands-on approach to apply forces to the body can be implemented to address range of motion or flexibility impairments, improve blood flow, and improve patient symptoms such as pain. Although these methods may include joint mobilizations, manipulations, soft tissue treatment, and myofascial techniques, the evidence to support their physiological mechanisms is limited. Two systematic reviews evaluating manual therapy in individuals with knee[57] and carpometacarpal[58] OA suggest improvement in pain, range of motion, and knee function, despite high risk of bias[59,60] among the few clinical trials that do exist, and moderate to high evidence for functional improvements of the thumb. However, these limited findings result in inconsistent guideline recommendations. Few guidelines[61,62] support their use as a short duration intervention with a low risk of harm; therefore, clinicians must acknowledge that long-term benefits are more likely achieved if manual therapy is used as a conduit to support patient participation in active treatment programs. Other guidelines[63–66] remain undecided on, or recommend against, their use for OA management with the caveat that manual therapy may still be useful for concurrent, individualized patient presentations of signs and symptoms.

Taping

Kinesio taping is a flexible taping approach that can be implemented with various tape configurations enabling individualized patient application. Mechanisms underlying Kinesio tape effectiveness propose to support and stabilize the joint and surrounding contractile tissue and stimulate cutaneous receptors to provide patients with somatosensory feedback. A 2021 systematic review[67] suggests that some good quality evidence for patellar taping may exist when used in combination with additional core physiotherapy treatment to reduce short-term pain, but long-term effectiveness remains unknown. Clinical trials[68,69] evaluating Kinesio taping for knee and first carpometacarpal[70] OA suggest short-term effects beyond placebo for improved pain, function, and range of motion but not muscle strength. However, the quality of available evidence varies, ranging from low to moderate/high across systematic reviews as sample sizes are small and short follow-ups may mask possible complications. No evidence exists for taping for hip OA. The debate also continues as to where on the disease severity continuum that Kinesio taping may be most effective as the available evidence is lacking. Guidelines[63,66,71] remain undecided on their recommendation for, or conditionally recommend against, patella and Kinesio taping strategies for individuals with knee and first carpometacarpal OA.

Assistive devices

Splinting and Other Devices for ADLs. The mechanisms underlying the design and implementation of hand and thumb splinting for OA remain uncertain but are likely associated with the warmth, support, and stabilization of joints as a

preventative or corrective strategy against structural deformity. Various types of splints are available to patient consumers and are designed on an assortment of spectrums, including softness, customization, or duration of use. Although the best type of splint remains unclear,[72] splints that are softer, more readily accessible (off-the-shelf), or worn at night may be more appealing to the patient.[73–75] The updated EULAR 2018 guidelines,[71] among others,[73] suggest that individuals experiencing biomechanical joint pain or instability should be assessed for splinting as an adjunct therapy for core OA treatment to achieve the pain benefits observed following long-term use and potential improvements[76,77] in function at the carpometacarpal joint. On the contrary, clinical trial findings and guidelines[71,73,78] are less clear on symptom relief for other regions of the hand. Correct fit, appropriate use instructions, and "joint protection education" are important to consider for maximizing adherence, safety, and treatment response.[79] Alternative devices also exist to facilitate activities of daily living (ADLs) for individuals with pain and impaired function in hand OA and may include, but are not limited to, shoehorns, sock or stocking devices, and jar grips. Direct evidence to evaluate the effectiveness of these interventions on OA is lacking; however, their clinical implementation should be considered on an individualized patient need and supplemental to first- and second-line core treatments for hand OA.

Canes and Walkers. Mobility assistive devices intended to reduce loads of the lower limb, increase stability, improve pain, and function, and assist with movement patterns and posture can be individually prescribed to target specific lower extremity osteoarthritic joints.[62] Regardless of their proposed mechanism, data on the effectiveness of these devices is limited, yet strongly recommended[63,65,66] for individuals with knee and/or hip OA. A clinical trial[80] for single-point cane use reported pain and function improvements for individuals with knee OA. Despite the low-quality evidence, there is reasonable transfer of these findings to individuals with hip OA, but the lack of evaluation for adverse effects fails to clarify their risk–benefit assessment. A more recent trial[81] suggested no effect on symptoms or structure for knee OA. Although the evidence primarily exists for knee OA populations, lower extremity assistive devices are conditionally recommended[66] to support other osteoarthritic joints including multijoint pathology due to the favorable outcomes reported and minimal associated risk in knee OA. Consistent with upper extremity assistive devices, patient instructions for mobility devices are important for ensuring proper fitting and minimizing negative outcomes or stigmas associated with "looking older." Overarching recommendations are also driven by the general safety benefits that can be achieved by prescribing walking aids to support stability for reducing falls risk.[82,83] Clinicians are encouraged to recognize whether a current mobility device is used in response to a previous fall and what impact that may have on future fall risk.

Thermal modalities

Cryotherapy. The superficial application of cryotherapy can include various modalities from accessible ice packs to specific use applications such as cryo-cuffs (a pneumatic pump that projects continuous chilled water with reciprocating pressure to reduce hemarthrosis). Cryotherapy is proposed to stimulate the noradrenergic vasoconstrictor system to reduce blood flow and swelling, decrease nociceptive signaling to improve pain management, decrease muscle spindle firing to reduce spasticity, and slow cellular metabolism to decrease inflammatory mediators. Conflicting clinical practice guidelines[61–63] for the effectiveness of cryotherapy on pain and function in OA exist with insufficient evidence for, or against, cold application in this population. A recent systematic review concluded that low-level evidence and poor study quality (including high variability among cold application methods) impede our understanding of the clinical utility of cryotherapy for pain management, knee stiffness, knee range of motion, and physical function.[84,85] Although the recent clinical guidelines conditionally recommend[61] the use of cold for OA, the limited evidence suggests that further investigation on the effects of superficial cold application for osteoarthritic joints is required.[66,86]

Thermotherapy. The delivery of superficial heat also varies by mode and may include moist heat, hot packs, paraffin wax, and diathermy, although the evidence for the continued clinical use of diathermy is questionable beyond potential placebo benefits. Thermal modalities may be used to stimulate sympathetic cholinergic vasodilation for increased circulation, decrease sympathetic activation for reduced smooth muscle contraction, increase metabolic activity for improved tissue healing, and inhibit local pain receptors.[61,63,87] Evidence from clinical trials to support the use of heat in OA management is minimal and the evidence that does exist stems from small, low-quality studies concluding that only short durational benefits can be achieved.[62] Therefore, limited and conflicting conditional recommendations exist across guidelines and osteoarthritic joints.[61–63,71] Although the application of heat could be a suitable adjunct approach to core treatment as it is easily accessible and associated with low risk, individuals with altered proprioception or sensation in this population should be monitored closely for burn.

Ultrasound. An alternative thermal-based approach is ultrasound, a noninvasive treatment that appears safe with few adverse effects and is relatively inexpensive to implement. Ultrasound is designed to use sound waves to generate mechanical vibration for decreasing pain or improving joint function via thermal or nonthermal physiological mechanisms.

Studies evaluating the effectiveness of therapeutic ultrasound on OA are mixed ranging from minimal-to-no benefits,[88–91] particularly in knee OA. Recent systematic reviews[89,92] update previous knowledge with conflicting clinical trials[93–95] on whether ultrasound is a safe or meaningful modality for pain and functional benefit and underscores previous guideline uncertainty for knee and hip OA.[61,62,64] Overall, the longevity of any observed benefit is unclear beyond 3 months.[94,95] No recommendation advancements have been made for multijoint OA[65] and potential benefits for nonweight bearing regions[96,97] require further investigation. Additionally, limited work exists evaluating phonophoresis (the use of ultrasound to enhance drug delivery) with low but potential pain-relieving capability compared to standard ultrasound for knee OA and no reported improvements in function.[98–100]

Complementary alternative medicine

Yoga and pilates

Vina et al. has evaluated race and gender components of CAM for treating knee OA.[101] The data set included 517 participants (52.2% African American; 27.1% female). The African American participants were less likely to use joint supplements, yoga, Tai Chi, or Pilates, compared with white participants although they were more likely to participate in spiritual activities. Women were more likely to use yoga, Tai Chi, or Pilates; acupuncture, acupressure, or massage; and spiritual activities compared with men. Since there are race and gender differences in the use of various CAM therapies for treating OA, clinicians must be aware of these differences. In a metaanalysis conducted by Lauche et al. 9 trials examining yoga were included encompassing 640 individuals with lower extremity OA.[102] Results suggested that yoga may be effective for improving pain, function, and stiffness in individuals with knee OA, compared to exercise and nonexercise control groups. Although yoga appears effective for treating knee OA, better quality evidence is needed.

A systematic review was conducted to examine the effectiveness and delivery of Pilates to reduce pain and disability and to improve physical function and QoL in adults with several chronic musculoskeletal conditions.[103] Seven studies which encompassed 397 participants (73% female) were included. Pilates was significantly effective ($P \leq .05$) for reducing pain associated with knee OA as well as back pain, neck pain, and pain due to osteoporosis. Significant disability, physical functioning, and QoL effects were found for individuals with knee OA as well as those with back pain and osteoporosis. Pilates may be as effective as any other exercise but higher quality research is required.

Tai chi and acupuncture

Kelley et al. conducted a metaanalysis to assess the clinical relevance of Tai Chi on pain, stiffness, and physical function, using WOMAC in adults with knee OA.[104] In total, 407 participants (216 Tai Chi, 191 control) with knee OA were included. Results suggested that Tai Chi provided statistically significant and clinically important improvements in pain, stiffness, and physical function in adults with knee OA. The Arthritis Foundation and the American College of Rheumatology (2020) developed an evidence-based guideline for the management of OA which also supported the use of Tai Chi.[63]

Jia et al. examined the risk of bias and methodological issues concerning the design, conduct, and analysis of RCTs evaluating acupuncture for treating knee OA. Methods of randomization, missing details on who were blinded, incomplete methods of sample size calculation, and a lack of standardization in Tai Chi treatments were found. The authors concluded that the risk of bias was high among published RCTs testing acupuncture for knee OA.[105] Contextual effects, such as placebo, were observed in 61% of RCTs studying the efficacy of Tai Chi.[106] Taken together, the evidence for acupuncture in the treatment of knee OA is weakened by the methodological concerns across numerous studies.

Psychosocial strategies

Coping strategies for effective OA pain management intersect the emotional, cognitive, and behavioral aspects of pain, and to date have been poorly implemented despite their potential benefits that could be achieved in this population. Interventions that interrupt destructive mind–body interactions include talking therapy, and more specifically, cognitive behavior therapy, in which the primary goal is to provide patients with strategies and skills to learn self-management of their perceptions and facilitate their understanding of the links between their emotions, thoughts, and behaviors to empower positive outcomes. Despite a lack of supporting evidence for their individual use, when combined with core OA management approaches, cognitive behavior therapy and pain coping strategies were generating clinically meaningful pain improvements.[107–109] The mechanism underlying this potential benefit is unclear and likely multifactorial via changes in

mood, sleep, coping ability, and/or other factors such as depression and self-efficacy.[110–112] Although most current evidence stems from other clinical populations, OA-related cognitive behavioral therapy investigations primarily include individuals with knee OA. However, clinical guidelines conditionally recommend[63,66] these strategies for individuals with osteoarthritic joints, including the knee, hip, and hand, given the minimal-to-no risk associated with the approach.[112,113] Additional research is required in this emerging field.

Summary and concluding remarks

Adjunctive rehabilitative interventions for OA management include several treatment options each with different mechanisms underlying their effectiveness. Patients with OA may be prescribed a combination of pharmacological and biomechanical therapies which makes interpretation of the effectiveness of any one therapy very difficult. Few adjunctive interventions can be recommended for most patients with OA such as bracing, mobility aids, or selective splinting for hand OA. Some treatments are not well supported by the literature and hence not recommended (e.g., electrical stimulation) unless all other treatments have been exhausted and the patient is trying to avoid more invasive interventions. How the spectrum of adjunctive interventions may be considered and contribute to the management of patients with OA is challenging. Not all patients with OA respond equally to all therapies and there is a need for more high-quality RCTs and metaanalyses to support the selection of rehabilitative interventions. One of the challenges for the future of OA management is how best to personalize interventions. Enhanced understanding of patient-specific OA disease mechanisms and the most effective corresponding treatment to address that mechanism is needed. Despite the inconsistencies noted across guidelines, most adjunctive rehabilitative interventions are recommended by one or more clinical practice guidelines. Recent evidence contributes to improved study quality; however, well-designed, high-quality investigations are still needed to better inform these recommendations and align guidelines between international OA organizations.

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Chapter 8

Pharmacotherapy

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Aims for module

To improve knowledge of the proposed mechanisms, evidence, expected benefits, limitations and risks, advantages, and disadvantages of common pharmacological, injectable, and supplemental therapies for people with OA. This may include acetaminophen (paracetamol), nonsteroidal antiinflammatory drugs, corticosteroids, opioids, platelet-rich plasma (PRP), stem cell therapy, hyaluronan products, dietary supplements (e.g., glucosamine sulfate, chondroitin, fish oil, methylsulfonylmethane (MSM), boswellia serrata, pine bark oil, and curcumin).

Clinical practice points/evidence summary:

- Use of pharmacotherapy should be in conjunction with nonpharmacotherapy measures
- Decisions on whether pharmacological agents are indicated need to take into account patient's comorbidities to minimize potential side effects
- Based on OA treatment guidelines, NSAIDs (topical and oral) are first-line pharmacological therapies
- The role of intraarticular injections with corticosteroid or hyaluronic acid products should be situation-based, mainly when other therapeutic options have been exhausted.
- There is currently no role for PRP or stem cell therapy in OA management
- Glucosamine and chondroitin are not recommended. There may be potential for other dietary supplementations such as Boswellia or turmeric/curcumin, but more studies are required to advocate for their role in OA management.

Role and rationale of pharmacotherapy in OA management

Improved function is a key goal of pharmacotherapy in OA, which is more likely achieved if pain is relieved. The management of OA has shifted from the traditional approach of pain control and ultimately joint replacement surgery to include interventions to improve quality of life and functional activity. Optimal management should have a strong focus toward nonpharmacological components comprising exercise therapy, weight management, and if required, mobility aids. The decision to prescribe pharmacotherapy can be delayed until the impact of "nondrug" options upon pain and function are assessed. A key consideration is that to date, no pharmacotherapeutic has been proven to slow the progression of the osteoarthritic process nor registered or incorporated in treatment guidelines. Indeed, there is conjecture and evidence that some of the pharmacological options that are registered may accelerate the progression of OA.

Understanding the current evidence behind pharmacotherapy will promote safe and effective counseling of patients and prescribing habits of health professionals as well as assist in the determination of when patients should be referred for surgical intervention. Treatment should be individualized, based on the patient's symptoms, comorbidities, functional status, and preferences, as well as considering the potential benefits and side effects of the pharmacological options.

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Oral medications

Acetaminophen (paracetamol)

This very widely used medicine has analgesic and antipyretic properties but very limited antiinflammatory activity. There is good evidence for pain relief in many types of pain, including headache and toothache; however, the efficacy for the common musculoskeletal presentation of OA is marginal.

Mechanism of action: the analgesic and antipyretic actions of acetaminophen are ultimately the result of the inhibition of the production of prostaglandins.[1] This pharmacological action occurs most prominently in the central nervous system (CNS) . Acetaminophen is most effective as an analgesic when the painful condition is not primarily an inflammatory one, such as in simple headache. However, in a systematic review of systematic reviews, the quality of the evidence available supporting the effectiveness of paracetamol in 44 painful conditions was rated as low or very low.[2] Acetaminophen has little effect on the massive increase in prostaglandin synthesis in the synovial lining of joints in active rheumatoid arthritis, and therefore, the drug has small antiinflammatory effect in this condition.

Efficacy: A systematic review of 10 RCTs comparing acetaminophen with placebo in hip or knee OA in 3541 patients reported high-quality evidence of no clinically important improvements in pain or physical function at 3 weeks to 3 months follow-up.[3] On a 100 mm scale (100 maximal pain, 0 no pain), the percentage difference in absolute pain reduction was 3% better for acetaminophen (95% confidence interval (CI) 1%, 5%). However, the accepted minimally important clinical difference is 9%. Similarly, physical function showed an absolute improvement of 3% (95% CI 1%, 5%) with acetaminophen but the minimally clinically important difference is 10%. No contrast in daily dose rates, (3.0 g or less daily vs. 3.9 g or more daily) was discerned. Despite the absence of a clinically significant reduction of pain in OA of hip and knee, some patients experience a worthwhile response. Explanations for this variation from the average effect in some individuals have not been identified. Therefore, consideration of use, especially in those at risk from NSAIDs from peptic ulceration, asthma exacerbation or bleeding, is reasonable.

Adverse effects: The safety of paracetamol remains a matter of contention. Reassuringly, a systematic review from the Cochrane database of systematic reviews concluded that the incidence of adverse events (high-quality evidence), serious adverse events or withdrawals from studies (moderate-quality evidence) did not differ between acetaminophen and placebo.[3] Relative safety in all age groups and in patients with comorbidities in comparison to NSAIDs is a significant advantage of acetaminophen. This is especially the case in the elderly, who commonly harbor comorbidities such as cardiovascular and renal impairments that confer increased risks with NSAIDs. However, concerns have been expressed, largely based on observational studies where, however, there is a risk of "confounding" and the paucity of evidence regarding safety in the elderly.[4,5] There is a need for well-controlled larger studies to resolve these concerns. An important caveat is that serious liver damage is a hazard if an intentional or accidental overdose is taken. As tolerance to acetaminophen is generally excellent, it remains a very reasonable first option for pharmacotherapy, even if a positive effect is due to a placebo response.[6] Acetaminophen taken with nonsteroidal antiinflammatory drugs and aspirin may increase the risk of adverse effects from NSAIDs.[7] How much additional analgesia results from the combination is uncertain and unlikely clinically significant.

Nonsteroidal antiinflammatory drugs (NSAIDs)

NSAIDs have a long history of use for pain relief in OA and are used extensively for this condition. NSAIDs contrast with acetaminophen in having pronounced antiinflammatory effects in addition to their analgesic and antipyretic properties. Although OA is primarily a noninflammatory condition, inflammation is a contributor to the pain experienced, and likely the reason NSAIDs are somewhat more effective than acetaminophen in OA.

Mechanism of action

Inhibition of prostaglandin synthesis. Like acetaminophen, NSAIDs inhibit the cyclooxygenase enzymes that produce prostaglandins that contribute to pain and inflammation, but NSAIDs do so more potently. The products of these enzymes are also important in maintaining the integrity and functions of the gastrointestinal tract and blood vessels. Inhibition of the production of prostaglandins involved in the maintenance of physiological functions accounts for the common adverse reactions of NSAID (Fig. 8.1). In contrast to acetaminophen, NSAIDs are more obviously active outside the central nervous system and are therefore more effective than acetaminophen for peripheral painful conditions such as OA and rheumatoid arthritis (RA).[8]

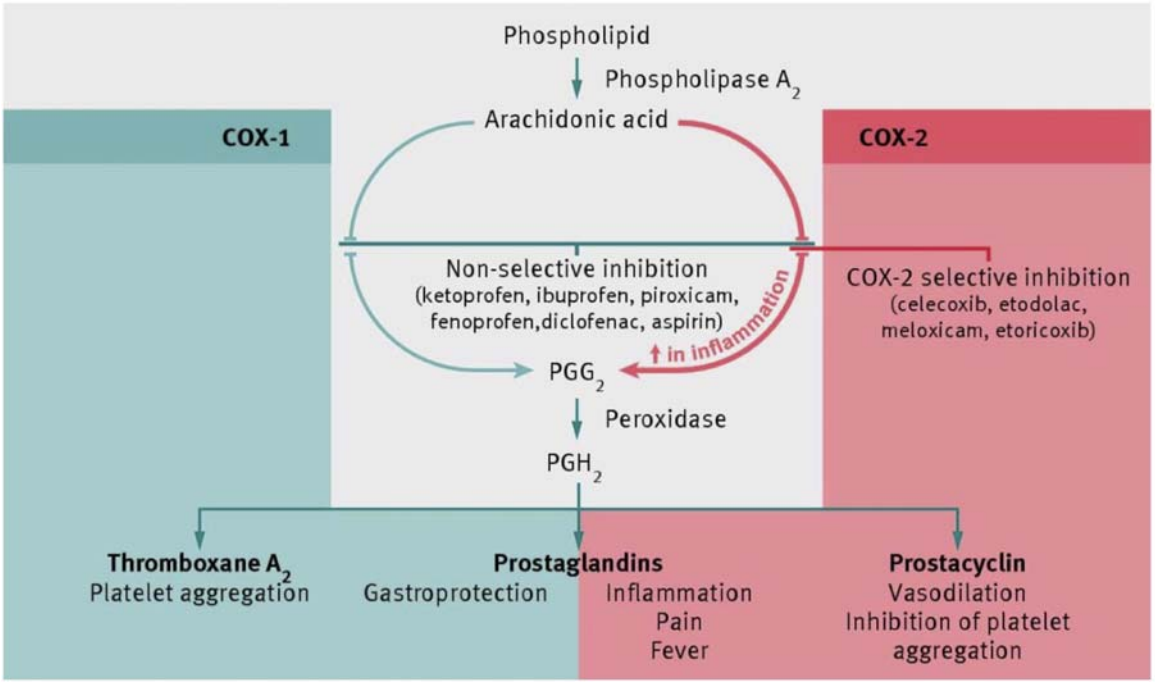

FIGURE 8.1 Arachidonic acid is metabolized by the cyclo-oxygenase isoenzymes COX-1 and COX-2 to intermediate prostaglandins (PGG2, then PGH2), which are then converted to other prostaglandins that are mediators of pain, inflammation, and fever and are gastroprotective. Thromboxane A2 causes platelet aggregation, and prostacyclin produces vasodilation. By blocking COX enzymes, NSAIDs inhibit the synthesis and thus the effects of prostaglandins, prostacyclin, and thromboxane A2. *Reproduced with permission Day RO, Graham GG. Non-steroidal anti-inflammatory drugs (NSAIDs).* BMJ. *2013;346:f3195*

COX-1 and COX-2 There are two cyclooxygenase enzymes known as COX-1 and COX-2, quite similar in structure but different enough in the "active sites" of the two enzymes to allow "selective" inhibition of COX-2 compared to COX-1. COX-1 produces the prostaglandins essential for maintenance of physiological functions of the gut and blood vessels, whereas COX-2 is "upregulated" to produce very large amounts of prostaglandins in inflammatory states such as RA. This feature has led to the development of a subset of NSAIDs known as COX-2 selective inhibitors. The rationale for the development of the selective inhibitors was that inhibiting COX-2 but not COX-1 would deal with pain and inflammation without the serious adverse effects, notably gastrointestinal ulceration and bleeding.

Nonselective NSAIDs: These "traditional" NSAIDs are among the most widely used globally, reflective of their role in the treatment of pain, and notably OA. There are a number of chemical subclasses such as the "profens" (e.g., ibuprofen, naproxen), "fenacs" (e.g., diclofenac), and "oxicams" (e.g., piroxicam, meloxicam) (Table 8.1). The nonselective NSAIDs

TABLE 8.1 NSAIDS. Comparisons.

NSAID	Common dose for OA	Routes for OA	Half-life (hours)	Oral immediate release dose frequency per day	Selectivity for COX-2 enzyme	Notes
Ibuprofen	200–400 mg	Oral	3–4	Once, twice or three	Nonselective	Wide dose-range; OTC
Ketoprofen	200 mg MR*	Oral	2	Once*	Nonselective	
Naproxen	250–500 mg *750 –1000 mg MR × once daily*	Oral	12–15	Twice	Favors COX-1	Favored if arterial thrombosis risk; increased GI risk

Continued

TABLE 8.1 NSAIDS. Comparisons.—cont'd

NSAID	Common dose for OA	Routes for OA	Half-life (hours)	Oral immediate release dose frequency per day	Selectivity for COX-2 enzyme	Notes
Diclofenac	25–50 mg	Oral, topical, rectal	1–2	Twice, three	Favors COX-2	Avoid if risk for MI
Indomethacin	25–50 mg	Oral, rectal	4–6	Two, three, four	Nonselective	GI toxicity risk; used for acute gout flares
Piroxicam	10–20 mg	Oral	30–50	Once	Nonselective	GI toxicity
Meloxicam	7.5–15 mg	Oral	20	Once	Selective COX-2	Less GI toxicity; platelets not -inhibited; less bronchospasm risk
Celecoxib	100–200 mg	Oral	11	Once, twice	Selective COX-2	Less GI toxicity; platelets not -inhibited; less bronchospasm risk
Etoricoxib	30–60 mg	Oral	22	Once	Selective COX-2	Less GI toxicity; platelets not -inhibited; less bronchospasm risk

*MR, *Modified Release;* OTC, *Over the counter;* MI, *myocardial infarction;* GI, *Gastrointestinal.*

such as ibuprofen, diclofenac, and naproxen are very commonly accessed "over the counter" without prescription in most markets globally, but usually at smaller dose sizes than prescription only NSAIDs. There is not much to distinguish between clinical outcomes from the use of the nonselective NSAIDs. Purported distinctions, focused largely on risk of adverse reactions, are marginal.[8] Relative COX-2 selectivity and pharmacokinetic differences have been suggested explanations for some of the claims for clinical contrasts across the nonselective NSAIDs range. Although assays used to establish degrees of COX enzyme selectivity have varied, it is generally accepted that naproxen is relatively less COX-2 selective while diclofenac is relatively more COX-2 selective, and ibuprofen falls somewhere between these two. Largely observational studies suggest naproxen is less likely to lead to thrombosis, myocardial infarction, and stroke, but more likely to cause gastrointestinal bleeding than diclofenac. This contrast has been related to COX-2 selectivity differences between these drugs. However, dose sizes and dosing schedules being compared contribute to contrasts in clinical outcomes. Much has been made of the different half lives across the nonselective NSAID range. Thus, naproxen has a half-life of about 13 h and can be taken less frequently than diclofenac or ibuprofen that has half-lives of around 4–5 h. However, the effects of bigger doses last longer and drug concentrations in joints fall more slowly than blood concentrations of short half-life NSAIDs, also maintaining effects longer. Thus, ibuprofen twice or three times a day provides satisfactory concentrations in joints.

COX-2 selective NSAIDs: This later developed subset of NSAIDs heralded much promise for similar efficacy as nonselective NSAIDs (similar COX-2 inhibition) but enhanced gastrointestinal safety (less or no inhibition of COX-1) and large RCTs confirmed these predictions.[9,10] However, these large studies also revealed a significant risk of thrombosis and myocardial infarction that was confirmed in other studies.[11] Rofecoxib was withdrawn from the market as a result. Remaining are celecoxib and etoricoxib with an older NSAID, meloxicam, being reclassified as a COX-2 selective NSAID. What had been under appreciated was that inhibition of the production of vasodilatory prostacyclin (via COX-2 inhibition) but maintenance of thromboxane production and platelet responsiveness (via continued COX1 activity) presented a risk of thrombosis. It also soon became apparent that the thrombosis risk extended to nonselective NSAIDs also, although to a lesser extent, through inhibition of prostacyclin production from COX-2 inhibition. The older traditional NSAIDs had not been subject to more modern, very large, RCTs required for registration with U.S. Food and Drug Administration (FDA) and other regulators so that this risk had not been appreciated previously. COX-2 selective NSAIDs deliver some advantages with respect to adverse effects. Relatively, there is no contrast in expectations for antiinflammatory efficacy as

both classes inhibit the COX-2 enzyme, responsible for producing the prostaglandins driving inflammation and contributing to pain.

Efficacy: In a network meta-analysis in 58,451 patients with OA, NSAIDs provided marginal reduction in pain severity compared to placebo over a 12-week period. Mean differences were only marginally greater than the minimally clinically relevant difference of 10 mm on 100 mm pain scale in a few instances and only at the high daily doses recommended for RA. For example, diclofenac 150 mg daily delivered −13.9 mm (95% CI −16.8, −11.2 mm) reduction compared to placebo (Table 8.1).[12,13.]

Adverse effects − all NSAIDs

Adverse reactions from NSAIDs are a major global concern, largely because of their extensive use in older people with OA. Older people are at greater risk for gastrointestinal, cardiovascular, and renal adverse reactions because of their high rates of comorbidities. Maintaining function in failing organs such as the kidney is reliant upon prostaglandin synthesis that is at risk from NSAID use. Higher doses, administered for longer periods, increase the risk of adverse effects (Fig. 8.2).

Gastrointestinal ulceration and bleeding. A previous peptic ulcer or bleed, or concurrent anticoagulant treatment, increases the risk for evident bleeding with NSAIDs. The presence of dyspepsia or indigestion does not predict peptic ulceration. Symptomatic ulceration, bleeding, and perforation of stomach or intestine can occur at any time after commencement of NSAIDs, the risk being steady over time. Long-term use of NSAIDs can lead to gradual onset anemia due to slow blood loss from the upper and lower gastrointestinal tract that is otherwise unaccompanied with symptoms.[14]

Cardiovascular. There is raised risk for arterial thrombosis with all NSAIDs. Higher doses increase risk; thus, ibuprofen 2400 mg/day, much higher than recommended for OA, had a significant risk but 1200 mg a day, did not in people with low background risk of myocardial infarction. Low-dose naproxen is the safest NSAID in those at higher risk for myocardial infarction, but differences are not great.[15,16]

Hypertension. This is observed with all NSAIDs but is more commonly seen in those who are being treated for the condition.[17] The NSAID-induced reduction in the vasodilatory prostacyclin in the arterial tree along with salt and water retention is the mechanisms involved. Monitoring blood pressure upon initiation of NSAIDs is important as are the warnings on packaging of NSAIDs to sensitize patients to the risks. A particular risk, sometimes referred to as the "triple whammy," occurs with concomitant NSAID, angiotensin-converting enzyme inhibitors (ACE) inhibitory, or angiotensin 2 receptor inhibitors (AII) blocking antihypertensives and potassium supplements, commonly taken in people with

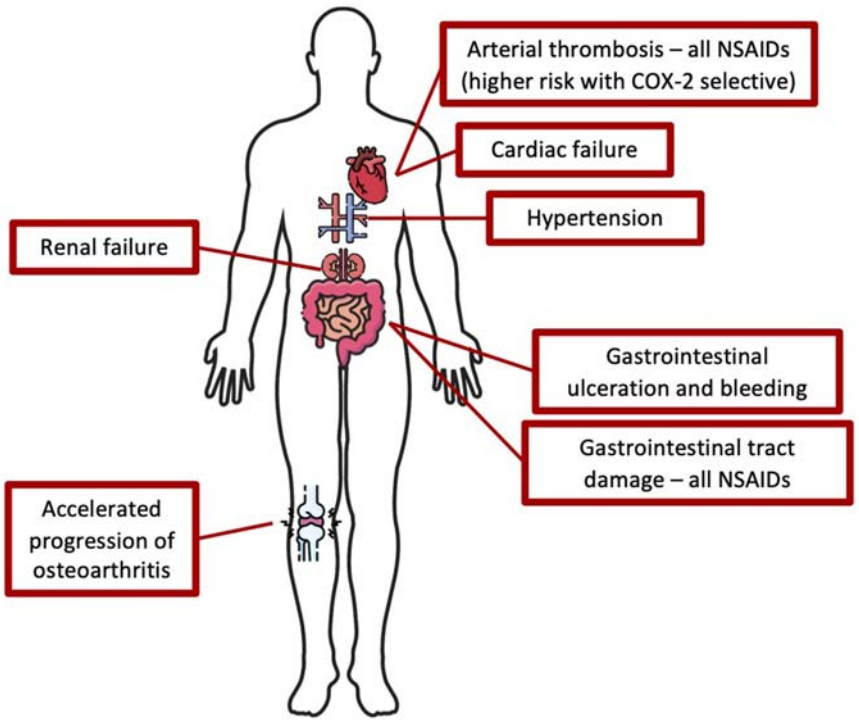

FIGURE 8.2 Common adverse events from anti-inflammatories for people with osteoarthritis.

hypertension also on diuretics. The risks are dangerous elevation of potassium in the blood, escalation of blood pressure, and precipitation of renal failure.

Cardiac failure. An exacerbation or new presentation of cardiac failure is a not uncommon complication following initiation of NSAIDs, including "over-the-counter" NSAIDs, in those with preexisting cardiac failure. Higher doses and longer duration of exposure to NSAIDs increase the risk and diclofenac and celecoxib may be more problematic, although this is contested.

Renal. In people with impaired renal function, there is a reliance on synthesis of prostaglandins, notably prostacyclin, to maintain function. NSAIDs are a common reason for precipitation of renal failure in people with already impaired function commenced on NSAIDs. If identified early, the process can be reversed by cessation of the NSAID. Rarely an immunological reaction leading to interstitial nephritis can occur with any NSAID, leading to irreversible damage.[18,19]

Accelerated progression of osteoarthritis. There has been long-held concern that NSAIDs might enhance progression of OA of hip and knee. Suggestions are that this could be a result of analgesia-induced insensitivity to ongoing traumatic damage via "wear and tear" from overuse. Alternatively, NSAIDs could have deleterious actions on joint structures directly. At this time, whether NSAIDs are a risk for accelerated progression is unclear, but it is a question that requires a definitive answer[20,21]

Adverse effects – contrasts between nonselective NSAIDs and COX-2 selective NSAIDs

Gastrointestinal. The major adverse effect of nonselective NSAIDs is gastrointestinal tract damage (dyspepsia/indigestion; stomach and duodenal peptic ulceration, perforation, and bleeding). This adverse effect was the major impetus to the development of the selective COX-2 inhibitors as it is inhibition of COX-1 that leads to mucosal damage.

COX-2 selective NSAIDs are less likely to cause dyspepsia, ulceration, or bleeding than nonselective NSAIDs, but the extent of this is contested. It is best to consider all NSAIDs a risk for gastrointestinal adverse effects. If injury occurs to the gastrointestinal mucosa, the lack of inhibition of platelet function with COX-2 selective agents should lead to less bleeding, but this has not been demonstrated. Doses and exposure matter—smaller doses given less often are less risky. Concomitant gastroprotective therapy is advised for all NSAIDs that are taken regularly, and this is especially for the elderly as their baseline risk is substantially greater. Most effective are the proton pump inhibitors.[22]

Cardiovascular. COX-2 selective NSAIDs are more likely to cause a thrombotic event notably myocardial infarction, but this contrast is marginal and contested. The loss of prostacyclin, the vasodilatory prostaglandin through inhibition of COX-2 is the explanation for the contrast with nonselective NSAIDs. However, dose and duration of therapy are other influences as well as the background risk of the individual.

Bleeding. Platelet function inhibition via COX-1 inhibition with nonselective NSAIDs leads to a propensity to bleeding from impaired clotting function. This is significant if ocular, prostate, and plastic surgeries are indicated. COX-2 selective NSAIDs do not block platelet function and bleeding risk is less than with less-selective NSAIDs; however, definitive clinical evidence for this contrast is unavailable.

Pulmonary. NSAID-induced exacerbations of asthma are a significant and important risk in a substantial subset of asthmatic sufferers. People who have aspirin-sensitive asthma are at great with any nonselective NSAID and need education on this risk. This is not a risk with COX-2 selective NSAIDs although cautious testing to confirm safety is recommended in guidelines.

Key points

- Treatment guidelines recommend the lowest effective dose of NSAIDs for the shortest period of time.
- NSAIDs can be administered via oral, topical, rectal, or parenteral via intramuscular or intravenous routes.
- Differences in efficacy across the NSAID class are marginal.
- Some individuals appear to respond better to particular NSAIDs (low-quality evidence).
- Recommended doses for RA are higher than for OA.
- Marginal increments in efficacy with dose increases.
- Concomitant gastroprotective proton-pump inhibitors are recommended with both nonselective and selective NSAIDs, especially in the elderly.
- Oral NSAIDs should be avoided in people with previous peptic ulceration or bleeding or who are taking anticoagulants.
- Topical NSAIDs are effective and substantially safer in OA.
- NSAIDs present risk for myocardial infarction especially in those already with increased risk, namely elderly, comorbid cardiac disease, diabetes, obesity, hypertension.
- NSAIDs present risk for worsening hypertension, precipitation of cardiac failure, and deterioration of renal function.

Opioids

The deleterious effects of opioids in some people with chronic, nonmalignant pain, namely dependence, cognitive dulling, central nervous system depression leading to respiratory depression and risk of falls and constipation have been of most concern. The risks in elderly with OA are greater than in younger people. Thus, fracture rates were high in elderly patients prescribed opioids for nonmalignant pain.[23] **Opioids are not first-line treatments for OA** and given the risks and minimal efficacy, very careful consideration for appropriateness along with the patient's understanding of risks is important. Unfortunately, there is good evidence for the excessive prescription of opioids for people with pain of OA, despite guideline recommendations against their use in OA.[24] Prescription of opioids should only be contemplated if all other options have been exhausted. Lack of response to acetaminophen and/or NSAIDs and/or intraarticular corticosteroid injections and/or duloxetine (see below) and nonpharmacological measures ought to be established before consideration of opioids. Review and recommitment to nonpharmacological measures are recommended as often they have not been instituted or adhered to by the patient. An important perspective, especially for patients, is that as pain becomes chronic it becomes more critical that the nonpharmacological, evidence-based intervention options are instituted to deal with pain and loss of function more effectively. Also evident is that pharmacological options, especially opioids, become less effective with time in many patients and more difficult to reduce dosage or cease. In fact, considerable benefit can follow deprescribing of opioids in people with OA. Thus, opioid prescription is a very significant step in management of OA and needs very careful consideration of significant potential costs versus minimal if any benefits before institution. However, in the common scenario of people with OA already taking opioids, there are benefits evident from referral of patients with ongoing pain despite opioid use to multidisciplinary pain management services. These benefits include reduction in pain as well as opioid dose rates in a significant proportion of patients.[25] Interventions to deprescribe opioids in people with OA are increasing and likely to be more successful being based more on identified barriers and enablers perceived by not only health professionals but also people with OA.[26]

Efficacy: Efficacy of opioids in OA is contested, but at best, effect sizes are small. There has been great concern about excessive prescription and dose sizes because of adverse effects. A direct comparison of opioids with nonopioid medicines (acetaminophen, NSAIDs) over 12 months indicated no substantial difference between the groups but more adverse events with the opioids, the results from this influential study being a driver to down-grade support for opioids in guidelines.[27] However, Lo, 2021, has pointed out that well-designed clinical trials to test effectiveness of opioids in OA in patients in whom nonopioid options have failed or are not feasible is needed.[28] The American College of Rheumatology/Arthritis Foundation guidelines continued listing of opioids as an option is appropriate in those patients who cannot be accommodated by other options including surgery, albeit in their "conditionally recommended against" category. Tramadol, however, a "weaker" opioid with serotonin and nor-epinephrine-reuptake inhibitory actions and perhaps less addictive potential, is "conditionally recommended" based on a number of studies in OA patients.[29] An equivalent, more recently registered opioid is tapentadol, a more potent mu receptor agonist with nor-epinephrine reuptake inhibitory actions. It contrasts with tramadol: dose reduction only in severe renal impairment; not a prodrug. Tramadol needs functioning CYP2D6 enzymes in the liver for metabolizing to its active form rendering it susceptible to drug−drug interactions. Not all people have active CYP2D6 and some have extra amounts due to multiple copies of the responsible gene, so some patients will have no analgesic effect and rarely, some may have excessive effect. However, important clinical contrasts between tapentadol and tramadol have yet to emerge.[30]

A recent systematic review and meta-analysis of RCTs of opioids in over 9000 patients in 18 trials with hip and knee OA assessed pain and function at 2-, 4-, 8- and 12-weeks post commencement of treatment. Only small improvement was noted for both pain and function (best result for standardized mean difference pain reduction −0.28 (95% CI -0.38, -0.17)) with stronger opioids less effective but more likely to cause adverse reactions.[31] Studies of any opioid in OA have been short-term only, for 3 months to a year, and have shown modest efficacy at best.

Important principles for judicious prescribing of opioids include:

- Avoid use of opioids unless all other avenues for OA management have been exhausted.
- Take every opportunity to institute deprescribing of opioids in people with OA by optimizing other evidence-based options.
- If opioids are to be used:
  - Dose rates cognizant of patient factors—age, comorbidities such as renal impairment, concomitant medications, especially other CNS depressants, alcohol, and other recreational drug use. A general rule is elderly people require about half the daily dose of young people.
  - Start with low dose rates of the immediate release (IR) formulations.

Continued

Important principles for judicious prescribing of opioids include:—cont'd

- Titrate up every 2–3 weeks if needed. Do not exceed maximum recommended doses for chronic nonmalignant pain.
- Convert to controlled release formulations if therapy is helpful and safe.
- If there is an unsatisfactory response by 6–8 weeks, agree to taper doses and cease.
- Oral therapy and slow or controlled release formulations are preferred; avoid parenteral (IV, IM); suppositories or topical controlled release formulations reasonable options if oral therapy not successful.
- Combination formulations, e.g., with antihistamine, acetaminophen are acceptable but care with potential contribution to CNS depression.
- Undertake regular review to ascertain suitability and safety, especially in the weeks following initiation.

Adjuvant analgesics

Antidepressants and gabapentinoids are very commonly prescribed for people with OA and spinal pain. This group of medicines not classified as analgesics per se, are useful in some individuals where acetaminophen/NSAIDs are insufficient, contraindicated, or not tolerated. They may be of more value if aspects of the pain experience include sleep disturbance, anxiety, reduced mood, and neuropathic qualities of the pain. Their value lies in modification of the central nervous system-based sensitization of pain but without the strong, dose-related central nervous system depression that occurs with opioids.

Antidepressants are one of the most prescribed groups of medicines globally and their use is increasing. Much of their use is for relief of pain. Tricyclic antidepressants, namely amitriptyline and its active metabolite, nortriptyline, also a prescribed medicine, have long been recommended and used for neuropathic pain.[32] Duloxetine, an antidepressant of the serotonin-norepinephrine reuptake inhibitor (SNRI) class of antidepressants, has emerged as the only antidepressant supported in guidelines as a treatment option in OA. This may reflect the concerted effort of the sponsor to undertake trials in OA. Thus, the UK National Institute for Health and Care Excellence (NICE) lists amitriptyline and duloxetine suitable for treatment of neuropathic pain. The American College of Rheumatology/Arthritis Foundation and the Osteoarthritis Research Society International (OARSI) conditionally recommend duloxetine for knee and hip OA, with the caveats that the drug might be considered when the pain is widespread and/or associated with low mood.[29,33]

Efficacy: A comprehensive, recent systematic review and meta-analysis of placebo-controlled RCTs of antidepressants for the treatment of OA of knee and hip, evaluated primary outcomes of pain intensity and disability with adverse events as secondary outcomes, at time periods of 2 weeks or less, 3–13 weeks, 3–12 months, and greater than 12 months.[34] Surprisingly, there were only 8 RCTs, all involving SNRIs and knee OA and none examining responses beyond 3 months. Using pooled between group difference of scores converted to 100 mm scales, SNRIs reduced pain at 2 weeks or less (−4.66 mm, 95% CI −6.28, −3.04) the 4 trials and 1328 participants providing moderately certain evidence. Evidence was of low certainty from 8 trials in which 1941 participants taking SNRIs reported reduced pain at 3–13 weeks (−9.72, 95% CI −12.75, −6.69). Results for disability were similar. Overall, the results did not reach a degree of change that was clinically important on the 100 mm scales (10 mm reduction), although the authors noted that a clinically important effect could not be excluded as the lower limits of the confidence intervals for improvement exceeded the minimally clinically important difference. Analyses for dose relationships were negative across duloxetine 20, 60, or 120 mg/day.

Adverse effects: Combining results in this analysis in over 4000 participants across back pain and OA trials, nausea was the most prevalent adverse event, and SNRIs were more likely to be associated with adverse events than placebo (62.5% v 49.7%; relative risk 1.23, 95% CI 1.16, 1.30; 13 trials, 3447 participants), but not serious adverse events. However, SNRIs were associated with more study dropouts because of adverse events (12.4% v 5.3%; relative risk 2.16, 95% CI 1.71, 2.73).

Duloxetine, and the adjuvant analgesic group, being centrally acting can induce drowsiness or paradoxically insomnia. Blood pressure can increase and should be checked regularly. Because of platelet inhibition, duloxetine poses a small risk for bleeding that will be enhanced with concomitant aspirin or NSAIDs. There is a risk for serotonin syndrome when other medicines that enhance the effects of serotonin are also taken, for example, tramadol and illicit drugs such as amphetamine. Duloxetine as for other antidepressants ought not to be ceased quickly but tapered.

Large uncertainty with trials of other classes of antidepressants did not allow assessment of the risk of adverse events and drop-outs.[34] Also, despite heavy use of gabapentin and pregabalin (gabapentinoids), which are primarily anticonvulsants, for people with pain, there are not definitive clinical trials in OA to support the use of either.[35] A recent well-powered, independent RCT indicated that pregabalin was ineffective for acute or chronic sciatica.[35] There are serious

risks for addiction and CNS depression when combined with opioids, benzodiazepines, and other CNS depressants. Gabapentinoids have efficacy in postherpetic neuralgia, diabetic peripheral neuropathy, and, for pregabalin, fibromyalgia in 10% of sufferers.[36] Particular circumstances and features of an individual's pain experience in OA, for example, with features of fibromyalgia, might be reason to consider judicious use of a gabapentinoid. However, these data emphasize the critical need for large, well powered, independent RCTs of adjuvant analgesics including gabapentinoids to test their effectiveness in carefully selected patients for the treatment of OA. The American College of Rheumatology/Arthritis Foundation Guidelines note that any of the adjuvant analgesic group might reasonably prescribed to people with OA to assist them deal with their individual pain experience.

Topical therapies

Capsaicin

This agent derived from the chilli pepper, deactivates peripheral pain receptors, or nociceptors. There are two commonly available strengths of capsaicin creams or ointments, 0.5% or 0.1% capsaicin. There is evidence for modest but significant reduction in pain, equivalent to that achieved with topical NSAIDs.[37] Application can be painful, in keeping with known effect of chilli peppers. The treatment is conditionally recommended for knee OA.[29,38]

Topical NSAIDS

Topical NSAIDs (creams, solutions, sprays, patches) are more effective that placebo and as effective as oral NSAIDs in OA but the effect sizes are only marginally different from minimally clinically relevant effect sizes.[36,39] They are very much safer than other routes of administration as systemic absorption is low. This is especially useful in the elderly, who are more likely to be at risk of worsening hypertension, myocardial infarction and stroke, renal impairment, and recurrence of cardiac failure with oral NSAID therapy. Usage is more likely to be intermittent according to need for pain relief, which is another safety feature.

Intraarticular therapies

The use of intraarticular therapies is seen as an attractive option, especially in patients with symptomatic monoarthritis or oligoarthritis, where the systematic effect of oral medications raises concerns in the individual. Presently available therapies are mainly corticosteroids and hyaluronan products, but other agents such as PRP and stem cell therapy are available commercially. Apart from corticosteroids, the majority of injectable therapies are of high cost burden to the patient. Based on current OA management guidelines, intraarticular therapies are not first-line treatment options and are preferred as the last nonoperative option when all other pharmacological therapies are unsuccessful or contraindicated.

As it is an invasive procedure, intraarticular injections should always be performed by a trained doctor/health professional, under sterile conditions with aseptic technique to reduce risk of infection. The use of imaging with ultrasonography can be employed to guide the injections particularly in difficult to access joints.

Corticosteroids

Mechanism of action: Corticosteroids are used among a wide range of medical conditions, particularly inflammatory disorders. Corticosteroids have antiinflammatory and immunosuppressive effects, acting on inflammatory cells, and influencing the immune responses.

Multiple corticosteroid preparations are available: Methylprednisolone acetate (Depo-Medrol, Solu-Medrol, Medralone, Duralone), dexamethasone sodium phosphate (Adrenocot, Decadron Phosphate Decaject), triamcinolone acetonide (Kenalog), triamcinolone acetonide extended release (Zilretta), betamethasone acetate (Celestone), and betamethasone sodium phosphate (Betaject). There is no superiority of a particular preparation over another for clinical effectiveness.

Efficacy: Cochrane review of IA corticosteroid has demonstrated effects up to 2 weeks for pain and function in the individual, with meta-analysis of pooled results of corticosteroid injections studies showing a high effect size for short-term reduction in pain at 0.72 (95% CI 0.42, 1.01) at 1 week compared to 0.2 (95% CI 2, 11) by week 6.[40] Therefore, the routine use of intraarticular corticosteroid is not advised due to the short duration of its effect. Moreover, there is now increasing evidence that repeated use may accelerate OA progression. In the OARSI *Good Clinical Practice Statement*, the use of intraarticular corticosteroids was conditionally recommended in individuals with knee OA.[33] Its use can be considered in

individuals who present with acute OA exacerbations with joint effusion and local inflammation, where other less invasive options are contraindicated or have failed.[41,42]

Adverse effects: Possible side effects include infection. The risk estimate is very low but varies greatly ranging from 0.0002% to 0.035% depending on the study.[43] Reactive flare after the injection can occur, usually around 6−12 h after with acute onset of swelling and pain that resolves spontaneously in up to 3 days.

Hyaluronan products

Mechanism of action: Hyaluronic acid (HA) or hyaluronan is a naturally occurring polysaccharide (glycosaminoglycan) and a constituent of cartilage and synovial fluid. It is synthesized by synovial cells, fibroblasts, and chondrocytes. It enhances the viscosity and elastic nature of synovial fluid, enabling it to act as a shock absorber or lubricant. The function and concentration of HA are decreased in an OA joint, thus the concept behind use of intraarticular HA is to restore the viscoelastic properties of the OA joint. There are also possible analgesic, antiinflammatory, and chondroprotective effects on the synovium and articular cartilage.[44,45]

The term "viscosupplement" is often used in the context of intraarticular HA injections. It is usually extracted from animal tissue (i.e., rooster combs) or by bacterial fermentation. There are many preparations of intraarticular HA products available: Hyalan GF-20 (Synvisc One, Synvisc), Sodium hyaluronate (Hyalgan, Supartz/Durolane, Gel-syn, Euflexxa), high-molecular-mass hyaluronate (Orthovisc).

Efficacy: There continues to be ongoing controversy about the efficacy of treatment, as well as cost-effectiveness of this. Multiple studies have examined the effectiveness of various HA preparations with mild "statistical" positive effects, but there are issues around the quality of trials, publication bias, and unclear clinical significance. In double-blinded trials, demonstrated effect was only 29% compared with 152% of the minimal important difference (MID) for pain in trials with no control for placebo effect. Therefore, the effect of these injections is not large enough to show clinical relevance.[46] In addition, single injection appears to provide similar results to multiple injections.[47]

Intraarticular HA may have beneficial effects on pain at and beyond 12 weeks of treatment with reasonable long-term safety profile, but international guidelines recommendation for its use varies. The OARSI guidelines conditionally recommend the use of intraarticular HA only for knee OA patients where other agents with higher level of evidence have been exhausted or are contraindicated,[33] while the American Academy of Orthopedic Surgeon clinical practice guidelines completely negate its use.[48,49]

Adverse effects: Potential minor adverse effects include injection site pain and skin reactions, local joint pain and swelling.[50] More serious side effects reported include development of a pseudoseptic reaction or flare of crystalline arthritis. True joint infection, which is always a risk in any intraarticular injections, though rare, has been reported with hyaluronan products.[51−53]

Platelet-rich plasma

PRP is a blood product that is prepared via a small amount drawn blood from an individual and then centrifugation to obtain a highly concentrated preparation of platelets. The product is then injected into the joint. Multiple protocols exist of how to prepare PRP, and controversy exists about the best method.

Mechanism of action: The mechanism of action is not fully understood, but it is thought that the platelets undergo degranulation to release a combination of growth factors and molecules, which can mediate the proliferation of mesenchymal stem cells and increase matrix synthesis and collagen formation in the joint.[54,55]

Efficacy: PRP generally has been shown to be a safe treatment with the potential to provide symptomatic benefit for up to 12 months. However, most of the randomized controlled trials to date in hip and knee OA, compared PRP to another type of intraarticular injection therapy (i.e., steroids or hyaluronic acid), and the studies are of low to moderate methodological quality and have variable PRP protocols.[55] Additionally, the structural benefit of PRP has not been assessed in most clinical trials, to validate its proposed potential structural modification benefits. Recent high-quality evidence assessing PRP in OA of the ankle and knee has not shown difference from placebo.[56,57]

Presently, the use of PRP in OA is not recommended despite commercial availability of it.[33]

Stem cell therapy

Mechanism of action: Stem cells are precursor cells that contain the capacity to self-renew, expand, and develop into cells of a particular body tissue, and they have the potential to replace aged or damaged cells. Mesenchymal stem cells (MSCs)

are connective tissue cells that can be isolated from multiple human tissue including skeletal muscle, adipose tissue, and blood. They are thought to give rise to all mature cells that produce cartilage, bone, and fat tissue.[54] MSCs accumulate in OA joint and adjacent bone marrow lesions, suggesting that they may play a role in the response to joint pathology, and the regenerative function of native MSCs may be altered or deficient in OA.[58]

MSCs are typically harvested from an individual's own tissue (autologous MSCs), usually bone marrow or adipose tissue via liposuction, but commercial preparations of MSCs from unrelated people (allogeneic MSCs) are increasingly available. After laboratory preparation, the stem cells are injected directly into the OA joint.

The mechanism by which stem cell therapy may be effective in OA remains unclear. It is thought that the injection of a sufficient volume of stem cell into the OA joint may improve joint structure, function, and pain either by restoration of cartilage volume loss, enhance the nature repair mechanisms via the secretion of growth factor and other repair cells, and through immune modulation, affect the underlying inflammatory process.[59,60] There is uncertainty regarding the behavior of the injected MSCs and if they remain viable or able to produce their presumed effects following IA injection.

Efficacy: A systematic review of available randomized controlled trials demonstrated a positive effect of autologous MSCs compared with controlled treatments in areas of patient reported outcomes and disease severity, but due to the high risk of bias identified in most of the trials, the certainty of this evidence is low.[61]

Despite stem cell therapy being a potential therapeutic option for OA, presently there is a low level of scientific evidence, not just for symptom control, but also structural benefit. Based on OARSI guidelines for management of osteoarthritis, stem cell therapy is not recommended.[55]

Dextrose prolotherapy

Mechanism of action: Hypertonic dextrose injection or "prolotherapy" is an injection of D-glucose (a form of sugar) in water mixed with local anaesthetics. It has been used to treat musculoskeletal pain, i.e., injection into tendons, ligaments, or joints for decades. There is a lack of understanding regarding the mechanism of action of prolotherapy, but it is thought that injection of an irritative solution initiates a local inflammatory process, leading to tissue proliferation and remodeling that is involved in the healing process.[62]

Efficacy: Systematic reviews and meta-analyses have shown that prolotherapy may have potential benefits for OA pain and function, but the studies available are of low quality with high risk of bias, and majority compared prolotherapy with another controversial IA injection therapy or interventional procedures such as radiofrequency.[63–65] In the 2019 American College of Rheumatology/Arthritis Foundation Guideline for the Management of Osteoarthritis of the Hand, Hip, and Knee, the use of prolotherapy was conditionally recommended against in patients with knee OA.[66] Similarly, OARSI guidelines strongly recommended against dextrose prolotherapy due to extremely low-quality evidence available.[33] Further high-quality studies are required before its use can be advocated.

Key points

- Intraarticular therapies should be reserved when first-line pharmacological therapies have failed to relieve pain and improve function or are contraindicated based on a patient's comorbidities.
- IA corticosteroid has short duration of effect and can be used in situations such as an acute OA flare with increased swelling, effusion, and warmth in the OA joint.
- IA hyaluronic acid has shown variable efficacy across different trials. Consideration of use is only when other agents with better evidence have been exhausted.
- Risk of septic joint is common across all IA injection therapies but a rare complication.
- PRP, stem cell injections, and prolotherapy are not endorsed, given existing scientific evidence.

Dietary supplements/nutraceutical products

Glucosamine sulfate

Mechanism of action: Glucosamine is one of the most used complementary products in the Western world for osteoarthritis. It is typically derived from ground shellfish shells or from processed grains. It is an amino monosaccharide and a natural constituent of glycosaminoglycan in the cartilage matrix and synovial fluid. *In vitro*, the addition of glucosamine to chondrocyte cultures increases aggrecan synthesis, which is necessary for the function of cartilage matrix.

Efficacy: Evidence for it is controversial, with several studies that show some positive effects over placebo. Whether the sulfate is superior to the hydrochloride formulation is debated. The disparity is likely due to the heterogeneity of existing

studies and adequacy of study design. With increasingly improved study quality over time, the reported effect size of glucosamine has decreased. The effect size for pain can range from 0.17 (95% CI 0.05, 0.28) to 0.47 (95% CI 0.23, 0.72).[67,68] Guidelines from OARSI and The National Institute for Health and Care Excellence (NICE) emphasize the lack of evidence and support for use of oral glucosamine in the symptomatic management or disease modification in OA.[69]

Chondroitin

Chondroitin sulfate is a natural glycosaminoglycan that is found in the cartilage and extracellular matrix. It is typically made from bovine (cow) or shark cartilage.

Efficacy: Evidence regarding chondroitin sulfate is similarly inconsistent as glucosamine, with marked heterogeneity of trial outcomes. Higher quality of studies has not been revealing of significant clinical benefits.[70,71] The estimated effect size of chondroitin for pain ranges from 0.13 (95% CI 0.00, 0.27) to 0.75 (95% CI 0.50, 0.99).[72,73]

Commercially, chondroitin and glucosamine are often combined into one supplement. However, the combination therapy has not shown to be superior to placebo with regard to pain reduction or improvement in function, although at 2 years, a significant but small reduction in "joint space narrowing" (JSN) was observed[74,75]

Fish oil/krill oil

Fish oil supplements are available in capsule or liquid form. It is extracted from the tissue of oily fish such as tuna, herring, anchovies, and mackerel. Different brands contain different amounts of total omega-3 and eicosapentaenoic acid (EPA) and docosahexaenoic acid (DPA). EPA and DHA decrease synthesis of the cyclooxygenase omega-6 fatty acid metabolite, prostaglandin E2 (a target of NSAIDs). EPA and DHA are also precursors of E and D-resolvins that suppress inflammatory cytokine production.[76] The main side effects of fish oil are gastrointestinal-related, ranging from bad breath, reflux, nausea to diarrhea or constipation. It may interact with drugs that affect blood clotting.

Krill oil is made from a small crustacean (*Euphausia superba)* with similar appearance to prawn/shrimp. It contains high concentrations of EPA and DHA, but its chemical structure differs to that of fish oil (phospholipids, rather than triacylglycerol or fatty acid ethyl esters). The bioavailability of krill oil is better than fish oil.[77] Krill oil has been shown in animal models to have antiinflammatory effects.

Observational data suggest that omega-6 and omega-3 polyunsaturated fatty acids from dietary sources may have beneficial effects on synovitis and cartilage damage.[78] A randomized controlled trial first done in 1992 showed no significant benefit in those taking cod liver oil (10 mL containing 786 mg of EPA), compared with those taking placebo (olive oil).[79] A 2016 study assessed low-dose (combination of fish oil and sunflower oil) versus high-dose fish oil (4.5 mg omega-3 fatty acid), demonstrated benefit in both groups in relation to OA pain and function.[76] Two randomized controlled trials are available for krill oil in OA, which showed daily krill oil is effective in pain, function, and stiffness symptoms, but the studies are of limited quality.[80,81] However, from recent systematic review and meta-analysis of randomized trials of all marine oils, it showed that while significant effect was seen in patients with rheumatoid arthritis (standardized mean difference (SMD) −0.24, 95% CI −0.42, −0.07), this was not seen in OA patients (−0.17, 95% CI, −0.57, 0.24).[82]

Vitamin D

Vitamin D is a regularly recommended supplement for the maintenance of bone health, particularly in relation to prevention of bone loss and for increase in bone mass. It can be obtained through foods such as mushrooms and fatty fish, or through skin exposure with ultraviolet B. While evidence for vitamin D is well studied in the areas of osteoporosis, the protective effect of it in OA is unclear from clinical studies. Most trials in OA did not show an improvement in joint pain with vitamin D supplementation,[70] and radiological improvements were also not seen.[83]

Vitamin K

Vitamin K is a trace nutrient essential for the normal function of several proteins in the body. It is divided into vitamin K1 and K2. Vitamin K1 is found in plant-based food, while vitamin K2 is found in dairy and meat sources.

Vitamin K is a cofactor of γ-glutamyl carboxylase, which plays an important role in the activation of γ-carboxyglutamate (gla)-containing proteins that negatively regulate calcification. Thus, the status of vitamin K in the system may be associated with cartilage calcification, which plays a role in the pathogenesis of OA. Mechanistic studies show that vitamin K activates matrix Gla proteins that inhibit bone morphogenetic protein-mediated cartilage calcification.[84] Study of

community dwelling individuals showed those with very low vitamin K1 were more likely to have progression of articular cartilage and meniscus damage[85] and vitamin K antagonist anticoagulant was shown to be associated with increased risk of OA incidence and progression in both hips and knees.[86] Evidence from clinical trials is limited for vitamin K supplementation, therefore its use is not presently recommended, but it is an area probably worthy of further research.

Avocado soybean unsaponfiables (ASU)

ASU is a vegetable extract that combines unsaponifiable fractions of one-third avocado oil with two-thirds soybean oil. It is thought to have an inhibitory effect on interleukin-1 (a cytokine that plays a central role in the regulation of immune and inflammatory responses), has a stimulating effect on collagen synthesis in articular chondrocyte cultures, and has a potential action on subchondral bone osteoblasts.[87]

A 2008 systematic review and meta-analysis comparing ASU with oral placebo in 644 patients with knee and hip OA demonstrated a small benefit for pain in favor of ASU that was more evident in knee OA.[88] Moderate effects were demonstrated in hip and knee OA from a systematic review with ASU doses of 300 or 600 mg/day in the short term, but high-quality evidence did not show symptomatic or structural improvement in the long term.[70]

Collagen

Collagen is a nutritional supplement made from animal or fish materials. It is high in amino acids that play an important role in the synthesis of joint cartilage and may have antiinflammatory effects, and decrease cartilage degeneration through the promotion of proteoglycan and type II collagen synthesis.[89] Collagen derivatives include collagen hydrolysate, gelatine. and undenatured collagen.

A systematic review of different derivatives of collagen identified pain reduction when comparing collagen hydrolysate to placebo; however, the other derivatives failed to show significant improvements.[90] There is insufficient evidence presently to recommend the generalized use of collagen hydrolysate in patients with OA. More independent high-quality studies are needed to confirm its therapeutic effects.

Methylsulfonylmethane (MSM)

MSM is a naturally occurring organosulfur compound. It has a variety of names including methyl sulfone, dimethyl sulfone, sulfonylbismethane, or crystalline dimethyl sulfoxide. Possible mechanisms of action in vitro include inhibition of transcription factors such as nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB), which is thought to be a proinflammatory signal pathway. By inhibition of NF-κB, it can result in downregulation of mRNA for IL-1, IL-6, and tumor necrosis factor-α as well as diminish expression of inducible nitric oxide synthase (iNOS) and cyclooxygenase-2. Therefore, production of vasodilating agents such as NO and prostanoids is reduced.[91]

Systematic reviews showed modest to large treatment effects for pain relief and function, but it must be noted the quality of evidence is poor.[70] To date, optimal dosage of MSM is unknown and some possible side effects include mild gastrointestinal discomfort.

Tumeric/curcumin

Tumeric (*Curcuma longa)*, a spice from a plant related to ginger root, has been used in Ayurvedic, Chinese, and traditional eastern medicine for centuries for inflammatory diseases. There are several components in the turmeric root, with curcumin (diferuloylmethane), a polyphenol, being the principal active ingredient. Tumeric and curcumin modify NF-κB signaling, proinflammatory cytokines such as interleukin production, phospholipase A2, COX-2, and 5-lipoxygenase activities.[92] Curcumin also modulates the expressions of various transcriptions factors involved in energy metabolism.

One of the issues is that most pharmacokinetic and pharmacodynamic studies show that curcumin has poor absorption and bioavailability. Thus, several formulations that include nanoparticles, liposomes, micelles, and phospholipid complexes have been developed.

Potential adverse effects include mild gastrointestinal symptoms, but as it can have anticoagulant activities, hence potential interaction with blood thinners requires review.

Turmeric and its components have been reported to be beneficial in OA with systematic reviews and meta-analysis of curcumin showing large and clinically meaningful effects in OA patients. But the quality of the evidence was low (SMD -1.19, 95%CI -1.93, −0.4). Another study assessing 8 RCTs showed reduction in pain when compared with placebo in

three RCTs (mean difference −2.04, 95% CI −2.85, −1.24) with five studies showing no significant mean difference in pain between turmeric/curcumin to pain medication such as NSAIDs.[93]

Boswellia serrata

Boswellia serrata extract is a gum resin isolated from the frankincense tree. It has also been used in traditional Ayurvedic medicine in India for centuries. Boswellic acid is the active ingredient in *Boswellia serrata*, and current research indicates that 3-O-Acetyl-11-keto-beta-boswellic acid (AKBA) is a boswellic acid with strong pharmacological activity. AKBA has powerful inhibitory effects on 5-lipoxygenase. Minor adverse side effects include nausea, headache, abdominal pain, diarrhea, fever, and general weakness. Systematic review of three studies has shown large and clinically important treatment effects with SMD -1.61 (95% CI −2.10, −1.13) for pain relief.[70] But it must be noted the quality of evidence is low. Another systematic review and meta-analysis of 545 participants showed the potential for Boswellia to relieve pain and function (VAS pain weighted mean difference (WMD) -8.33 (95% CI -11.19, −5.46)); WOMAC pain WMD -14.22 (95% CI -22.34, −6.09) along with improvements in stiffness and joint function.[94] Based on current evidence, the recommended duration of treatment is around 4 weeks with at least 100−250 mg daily of Boswellia. More double-blind, large sample size RCTs are required to confirm the findings to date.

Pycnogenol

Pycnogenol is an extract from the bark of the French maritime pine (*Pinus pinaster* Aiton). It consists of a concentrate of polyphenols, with the main components being procyanidins, taxifolin, catechin, and phenol acids.[95] It is thought to have an antiinflammatory effect via the inhibition of matrix metalloproteinases (MMPs).

Three studies have investigated the use of pycnogenol at doses of 50 mg twice to three times a day, large and clinically meaningful effects for pain relief (SMD −1.21, 95% CI −1.53, −0.89) and improvement in disability.[70] The quality of evidence for the three studies was deemed moderate. Additionally, there were no side effects or serious adverse events reported. More studies with larger cohorts of participants are required to corroborate the beneficial actions seen.

Key points

- Current evidence and osteoarthritis guidelines do not support widely used supplements such as glucosamine, chondroitin, and fish/krill oil for osteoarthritis.
- Limited evidence supports the use of turmeric/curcumin, methylsulfonylmethane (MSM), *Boswellia serrata* extract, and Pycnogenol.
- The use of supplements/nutraceuticals should not be recommended as the only medicine for OA management; other higher evidence nonpharmacological/pharmacological therapies should be discussed with the person with OA.

Experimental therapies

There are several other agents under investigation at present. These drugs are referred to as disease-modifying OA drugs (DMOADs) or structure-modifying OA drugs (SMOADs). As better understanding is gained in the pathogenic process in OA, there has been growing research in the development of drugs that target different aspects of the pathways involved in inflammatory, cartilage catabolism, and anabolism in OA (such as matrix metalloproteinases, fibroblast growth factors, cell signal transduction pathways such as Wingless/integrated (Wnt) signaling pathways).

A number of registered medicines for indications other than OA have been proposed as pharmacotherapies for OA. Medicines indicated for RA, namely methotrexate and hydroxychloroquine, have been tested in OA. Both are strongly recommended against by contemporary guidelines.[29] Similarly, colchicine, used for attacks of gout, is not supported by evidence or guidelines. The osteoporosis treatments, bisphosphonates, are recommended against by guidelines as are the RA biologic therapies such as tumor necrosis factor inhibitors or interleukin-1 receptor antagonists.[29]

Nerve growth factor (NGF) is needed for the growth and maintenance of sensory neurons. Tanezumab, a humanized monoclonal antibody, inhibits NGF and was shown to reduce the pain of knee and hip OA[96] leading to anticipation that finally a disease-modifying medicine for OA was imminent. However, some patients manifested rapidly progressive OA and needed early joint replacement compared to comparators in the study.[96,97] Careful selection of participants without risk factors for rapid progression, lower doses of tanezumab, and elimination of concomitant NSAIDs resulted in significant pain relief versus placebo; however, there was a dose-related increased rate of joint replacement with tanezumab.[98]

Tantalisingly, the pain relief with tanezumab was significantly better than NSAIDs or placebo. It appeared there may be a place for this subcutaneously administered medicine in individuals where the risk of rapid progression and early joint replacement was considered an acceptable risk.[99] However, Pfizer and Eli Lilly, the cosponsors of tanezumab, have ceased development of tanezumab in late 2021 given regulatory rejections in the United States and Europe. Sadly, this seems to be the "end of the line" for this promising direction of therapies for OA.

To date, there are no pharmacological agents that have been approved by regulatory authorities for disease modification in OA.

Concluding remarks

Pharmacological agents are an important aspect of nonsurgical management of OA. However, judicious prescription of these drugs is required—tailoring the treatment to the individual and reducing the potential for side effects. Patient education remains a key aspect of all OA management, including the use of medications. Table 8.2 highlights some of the

TABLE 8.2 Common opioids and opioid combination formulations.

Opioid	Common formulations	Actions	Approximate dose equivalent to 10 mg IM/SC morphine (when switching, commence with 50% of equivalent dose of new agent)	Suggested starting doses in non-malignant chronic pain in opioid naïve OA patients. Half doses in elderly. Recommend 4–8 weeks trial and if unhelpful wean off opioids
Codeine	Oral; combinations with acetaminophen, antihistamine, aspirin	Active metabolite is morphine; requires metabolism by hepatic enzyme CYP 2D6 to form morphine; CYP 2D6 inactive in 8% Caucasians, 1% Asians; risk with multiple copies CYP 2D6	200 mg oral	30–60 mg two to three times daily up to maximum 240 mg daily
Morphine	IR, CR	Active metabolites accumulate in renal impairment; lower dose or use other opioid; contraindicated in severe renal impairment (creatine clearance <10 mls/min)	30 mg oral	5–20 mg CR twice daily; unhelpful if ineffective at daily dose of 30 mg in elderly, 50 mg young adults
Oxycodone	IR, CR, suppository		15–25 mg oral	5–10 mg CR twice daily up to 30 mg/day; three times daily dose better coverage of pain in some
Buprenorphine	Oral, patch	Partial agonist; less risk of CNS depression	0.8 mg sublingual	Patch is recommended; commence 5 μg/h release rate; change every third day; maximum 30 μg/h
Fentanyl	Patch	Very short acting; potent; constant release from patch;	No oral formulation	Not recommended for OA
Tramadol	IR, CR	Serotonin norepinephrine reuptake inhibitor; requires metabolism by CYP 2D6; subject to drug − drug	150 mg oral	Always commence with IR formulation; 50–100 mg every 4–6 h; for CR formulation 50–200 mg 12 hourly; maximum dose 400 mg/day (300 mg in elderly >75y). Risk of

Continued

TABLE 8.2 Common opioids and opioid combination formulations.—cont'd

Opioid	Common formulations	Actions	Approximate dose equivalent to 10 mg IM/SC morphine (when switching, commence with 50% of equivalent dose of new agent)	Suggested starting doses in non-malignant chronic pain in opioid naïve OA patients. Half doses in elderly. Recommend 4–8 weeks trial and if unhelpful wean off opioids
		interactions; dose reduction with renal impairment (creatinine clearance <30 mL/min)		serotonin toxicity with other drugs associated with serotonin toxicity
Tapentadol	IR, CR	Norepinephrine reuptake inhibitor; dose reduction in severe renal impairment (creatinine clearance <10 mL/min)	75 mg oral	Contraindicated with irreversible MAO inhibitors

CR, controlled release; *IR*, immediate release

available medications as detailed in this chapter, with emphasis on the main safety concerns, and effect size of the pharmacological agents.

In addition to this chapter, there are multiple international OA management guidelines/recommendations available for reference, with Table 8.3 presented as a summary of the strength of recommendations based on these guidelines (Table 8.4).

TABLE 8.3 Summary table of drug purpose and main safety concerns of pharmacological agents in osteoarthritis.

Medication	Purpose	Mechanism of action	Side effect
Acetaminophen/ paracetamol	Mild to moderate pain relief	Inhibit COX-3 activity and synthesizing prostaglandin	Liver toxicity; transient liver enzyme elevations
Nonsteroidal antiinflammatory drugs (NSAIDs)	Mild to moderate pain relief and antiinflammatory	Inhibit cyclooxygenase enzymes and prostaglandin synthesis; inhibit COX-1 and COX-2 activity	Gastrointestinal complications, kidney disease and adverse cardiovascular events
Opioid analgesics	Pain relief	Inhibit pain pathways in the central nervous system	Nausea, vomiting, headache, constipation, fatigue and drowsiness
Serotonin-norepinephrine reuptake inhibitors (SNRIs)	Treatment of depression and mood disorder	Inhibit serotonin-norepinephrine reuptake	Fatigue and somnolence; gastrointestinal problems
Intraarticular injections of corticosteroids	Relief of moderate-to-severe pain and inflammation	Down-regulate genetic expression of proinflammatory proteins; decrease inflammatory markers and cytokines	Postinjection pain and flushing; septic arthritis; possible rare tachon syndrome
Intraarticular injection of hyaluronic acid	Relief of pain	Possible restoration of the viscoelastic properties; possible analgesic, antiinflammatory and chondroprotective effects	Postinjection pain and flare in joint; septic arthritis

TABLE 8.4 Summary of recommendations of pharmacological agents from National Institute for Health and Care Excellence (NICE), American Academy of Orthopedic Surgeons (AAOSA), Osteoarthritis Research Society International (OARSI), American College of Rheumatology (ACR), and European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Diseases (ESCEO) guidelines for OA.

Organization	Acetaminophen or paracetamol	Oral NSAID-Non-selective	Oral NSAID (Cox-2 Inhibitors)	Topical NSAID	Topical capsaicin	Tramadol	Opioids[&]	Duloxetine	Glucosamine	Cchondroitin	Fish oil	Vitamin D	Intra-articular corticosteroids	Intra-articular hyaluronic acid	Platelet-rich plasma	Stem Cell injection
NICE 2014* (update 2020)	R	R	R	R		R	R		NR	NR			R	NR		
AAOS 2021[#]	S	S	S	S		S	S		L	L		L	M	NR-M	L	
OARSI 2019 (Knee, hip, polyarticular)^	4A/B	1B	1B	1A	4B	4A	4A	3 (polyarticular)	4A	4A		4A	1B	2		
ACR 2019(Hand, Knee & Hip)[&]	CR	SR		SR (knee) CR (hand)	CR (knee) CRA (hand)	CRA	CRA	CR	SRA	CRA (hand) SRA (knee/hip)	CRA	CRA	CR	CRA (hand/knee) SRA (hip)	SRA	SRA
ESCEO 2019[$]	WR	SR	SR	SR		WR	WR	WR	SR	SR			WR	WR		

* **NICE** recommends (R) treatments based on grading of evidence and formal consensus

[#] **AAOS recommendation grades: Strong** (S, high-quality evidence), **Moderate** (M, moderate quality evidence), **Limited** (L, low quality evidence), **Inconclusive** (I), **or Consensus** (C). **NR**=not recommended

^ OARSI recommendation levels: Level 1A ≥75% "in favour" & >50% "strong" recommendation; **Level 1B**- ≥75% "in favor & >50% "conditional" recommendation; **Level 2**- 60%-74% "in favor"; **Level 3**- 40%-59% "in favor"; **Level 4A**- ≥75% "against" & >50% "conditional" recommendation; **Level 4B**- 60%-74% "against"

[&] **ACR recommendation grades: A strong recommendation** (SR) required high-quality evidence and a large gradient of difference between desirable and undesirable treatment effects. **A conditional recommendation** (CR) was based on the absence of high-quality evidence and/or evidence of only a small gradient of difference between desirable and undesirable treatment effects. **CRA**=conditionally recommended against. **SRA**=strongly recommended against

[$] **ESCEO recommendation grades: Strong recommendation** (SR), **Weak recommendation** (WR), **Weak recommendation against** (WRA), **Strong recommendation against** (SRA)

Strong recommendation | **Conditional recommendation** | **Conditional recommendation against** | **Strongly againt** | **Inconclusive**

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Chapter 9

Surgery for osteoarthritis

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Clinical practice points/evidence summary

- Total joint replacement is a clinically and cost-effective modality for treating end-stage osteoarthritis in appropriately selected patients
- Patient-reported preoperative prognostic factors exist for selecting appropriate candidates for total joint replacement
- Mental well-being, physical activity, and Kellgren–Lawrence grade of osteoarthritis are important determinants of outcome after total joint replacement
- Control of body mass index (BMI) is an important driver of complications or need for surgery in relation to total joint replacement
- Patient education and alignment of surgeon–patient expectations are important for informed decision-making in relation to total joint replacement surgery

Osteoarthritis is often present for a longer period than symptom duration alone, and the constellation of symptoms (pain, discomfort, stiffness, loss of function) and signs (swelling, loss of range of motion, deformity) may not correlate with the severity of disease. Commonly, patients display significant X-ray joint changes before symptoms warrant medical attention (Fig. 9.1). Other times, very focal areas of osteoarthritis may cause significant pain and disability (Fig. 9.2). The lack of consistency between how osteoarthritis presents and its severity, and the ebb and flow of pain, and disability may result in under- and overtreatment.[1,2] This chapter reviews the role of surgery in managing end-stage osteoarthritis.

Indications for surgery

The management of severe, end-stage osteoarthritis is now well established, and surgery is the common endpoint for many patients. Decisions related to surgery for osteoarthritis are often considered when the condition has reached a stage where it

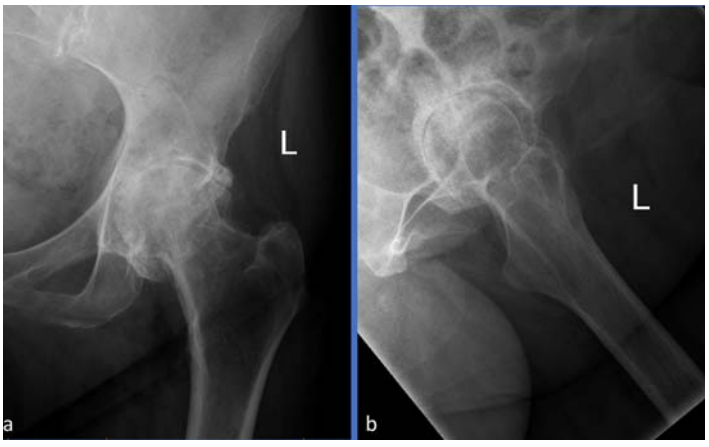

FIGURE 9.1 (A) Anteroposterior and (B) lateral X-rays of the left hip demonstrating end-stage osteoarthritis.

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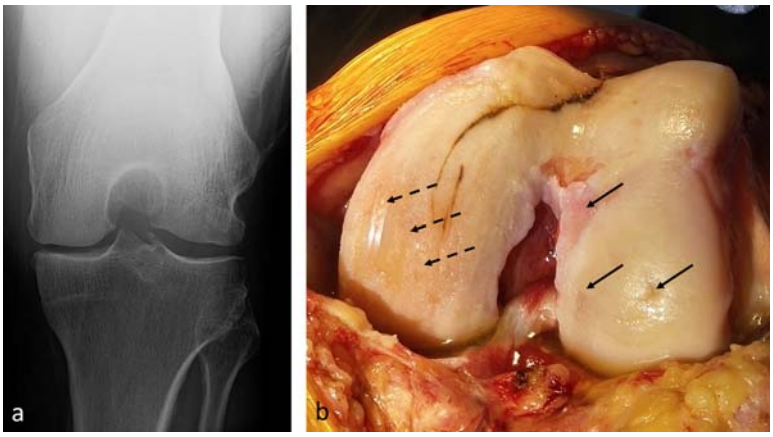

FIGURE 9.2 Patient with medial and lateral knee pain. (A) Anteroposterior X-ray demonstrating medial joint space narrowing. (B) Full thickness localized articular cartilage loss in the lateral compartment (arrow) and complete loss of articular cartilage on the weight-bearing surface of the medial femoral condyle (dashed arrows).

is significantly impacting people's quality of life, and other nonsurgical means of symptom control have either failed or are not appropriate. For example, such people include those who have known osteoarthritis and have been managed with joint and limb exercises, weight control, oral analgesics, and joint injections of corticosteroids all of which are now unable to control ongoing and progressive joint pain, or people who present for the first time with significant symptomatic osteoarthritis and functional disability such that any attempt at trials of nonsurgical therapies may be considered futile (Fig. 9.3).

Despite the established nature of operations such as total joint replacement, the evidence underpinning criteria for hip and knee joint replacement remains controversial,[3] and important efforts are underway to refine current practices.[4–8]

Notwithstanding this, most practitioners now consider several domains when arriving at a recommendation for surgery, and these include pain, function, radiological changes, failed conservative treatment, and the presence of comorbidities.[3] To qualify as a candidate for surgery, a person would be expected to exhibit significant symptoms of osteoarthritis, deformity, or loss of joint function of the affected joint, and radiologic features of severe grade osteoarthritis. Studies have reported that the outcome of total joint replacement is strongly associated with the severity of osteoarthritis[9,10] as measured using the Kellgren–Lawrence scale[11] (Fig. 9.4). Specifically, poorer outcomes after surgery have been reported where total joint replacement has been performed for less than a score of 4 in the hip[10] and less than 3 in the knee,[9] suggesting that osteoarthritis needs to be well established and of a severe nature before considering total joint replacement. It is important to note that the pain of osteoarthritis in isolation should not be regarded as a driver of surgery because the relationship between pain and structural changes of osteoarthritis is neither linear nor stable.[12] In this regard, pain should always be considered alongside other domains and in the presence of high-grade osteoarthritis when making decisions regarding the place of surgery.

The timing of surgery should be when the effects of pain or functional limitation are so great as to cause an impact on a person's quality of life. Examples of these include disturbed sleep because of joint pain, inability to complete simple

FIGURE 9.3 Patient who presented for the first time with significant left groin and thigh pain with associated stiffness of the hip joint and a limp. Anteroposterior X-ray of the hips and pelvis demonstrating significant and established osteoarthritis of the left hip.

FIGURE 9.4 Kellgren–Lawrence classification of osteoarthritis. (A) Grade 0 (none): absence of radiologic features of osteoarthritis. (B) Grade 1 (doubtful): doubtful joint narrowing and possible osteophyte lipping. (C) Grade 2 (minimal): definite osteophyte and possible joint narrowing. (D) Grade 3 (moderate): moderate multiple osteophytes, definite joint narrowing, subchondral sclerosis, possible bone deformity. (E) Grade 4 (severe): large osteophytes, marked joint narrowing, severe sclerosis, definite bone deformity.

physical activities such as rising from a chair or toilet seat, climbing stairs, or remaining housebound because of a significant restriction to walking even short distances.[4,13]

Contraindications to primary joint replacement are absolute in the setting of coexistent ipsilateral limb infection and unresolved systemic sepsis. Strong relative contraindications exist where there is dispute as to the cause of symptoms related to the joint of interest, the presence of medical or psychiatric comorbidities that may render the patient unfit for an anesthetic or surgery, and surgical hesitancy in the patient.

Surgical options for osteoarthritis

There are several common surgical procedures to treat osteoarthritic joints. These depend on several factors, including age, severity of disease, location of arthritis within the joint, and the way the arthritis is impacting the person's quality of life. The type of surgery for osteoarthritis depends on which joint (hip or knee) is being affected and which part of the joint is being affected.

Surgery may be used to replace a diseased joint with an artificial joint (joint replacement). The purpose of joint replacement is to permanently change the articulation to provide lasting symptom relief and return to normal function. This by far is the commonest approach for surgically managing end-stage osteoarthritis. The 10-, 15-, and 20-year overall revision-free prosthetic survival is estimated at 5%, 6%, and 10%.[14] Surgery may also be employed to redirect mechanical forces away from a diseased part of the joint to more normal areas of the joint (osteotomy). The purpose of an osteotomy is to slow the progression of osteoarthritis and relieve symptoms by redirecting the forces acting on the diseased area to other parts. In this regard, osteotomy may be considered as temporizing surgery for osteoarthritis in younger patients.

Procedures for hip osteoarthritis

Total hip replacement

Total hip replacement is where the natural ball and socket articulation of the hip is replaced with an artificial one (Fig. 9.5). Through a variety of different surgical approaches (anterior, posterior, lateral, and supraacetabular) (Fig. 9.6), the hip joint is exposed, and the acetabular joint surface is reshaped to receive a metal shell, which is impacted into position. After this, a separate socket made of polyethylene or ceramic is secured into the metal shell, and this forms the bearing surface for the socket. Sometimes, a decision is made to cement a one-piece polyethylene socket directly into the acetabulum rather than to use the modular metal and polyethylene components (Fig. 9.7A). This option may be chosen if patients are elderly. The ball that completes the hip joint articulation is fixed to a metal stem that is placed down the femoral shaft. The stem may be fixed in the intramedullary canal with cement or impacted tightly into position without cement. Cementless fixation is more often considered when the bone stock is good enough to support the bone, which is seen more commonly in younger patients (<65 years) (Fig. 9.7B). Bone in the intramedullary canal grows onto the surface of the cementless prosthesis and through bonding with the surface of the prosthesis provides biologic fixation.

When appropriately indicated, total hip replacement is a highly successful procedure for treating end-stage osteoarthritis,[15] has been shown to return patient-reported outcome scores of recipients to normative population values,[16] and thus, has been referred to as the operation of the century.[17] Total hip replacement has also shown itself to be a highly cost-effective procedure,[18] and this may be further enhanced by careful consideration of the timing of surgery.[19] Its popularity has predicted a rise of over 200% in the larger markets globally by 2030.[20–23] Caution with its use has been raised, however, because of a dissatisfaction rate up to 30%,[24] and an incidence of inappropriate use also of up to 30%.[25] Decision

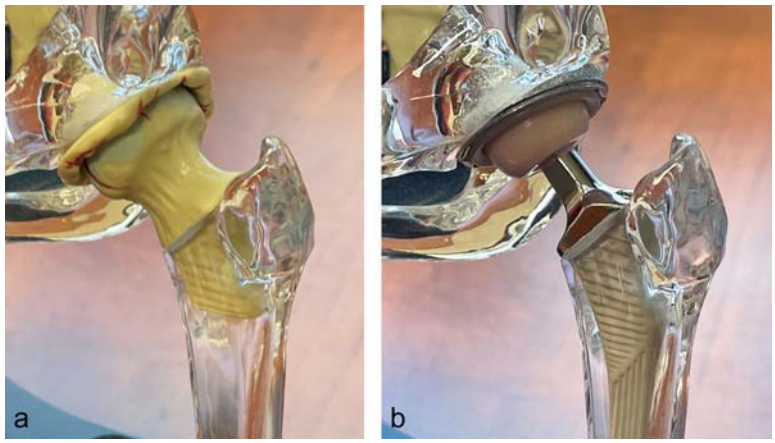

FIGURE 9.5 Total hip replacement where the (A) arthritic joint is replaced with (B) acetabular, femoral head and femoral shaft prostheses.

aids to improve the decision efficiency and therefore the effectiveness of treatment by identifying those in whom total hip replacement is likely to result in good or poor response will ensure that the most appropriate treatment is delivered to everyone.[26]

Pelvic osteotomy

In a pelvic osteotomy, the periacetabular bone is cut in several areas that allows the acetabulum to be reoriented in relation to the remaining pelvis (Fig. 9.8). The new orientation may be planned to increase the amount of socket surrounding the ball of the joint (coverage) to reduce point loading, to present a zone of healthier thicker cartilage surface to the femoral head, or to reduce capsular stretching when a hip joint is quite dysplastic (not normally shaped) and subluxation of the joint exists. Periacetabular osteotomy is generally performed in young people where the osteoarthritis is only minor, where the hip joint has a full range of motion, and where dysplasia is the primary condition. Moreover, periacetabular osteotomy is performed to slow the progression of osteoarthritis and therefore may be performed when the symptoms outweigh the radiologic signs of osteoarthritis (e.g., Kellgren–Lawrence Grade 2 or less).

Pelvic osteotomies have been popularized as a joint sparing procedure for the treatment of dysplasia-related hip disease including early osteoarthritis.[27–29] Long-term studies of pelvic osteotomy have demonstrated efficacy in delaying the need for total joint replacement in selected patients.[30,31] Success of pelvic osteotomy, however, requires careful attention to the correct indication, timing of surgery, accuracy in which the surgical technique is utilized to normalize the environment of the hip, and the grade of osteoarthritis when the procedure is performed.[32]

Procedures for knee osteoarthritis

Total knee replacement

Total knee replacement is a procedure that removes the entire degenerate joint surface of the distal femur and proximal tibia, and after careful reshaping of the ends of the bones, resurfaces the bone ends with metallic components (Fig. 9.9).

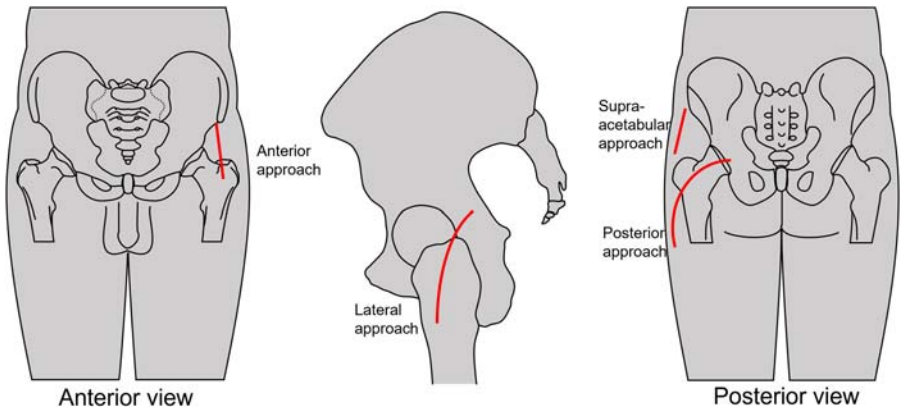

FIGURE 9.6 Surgical approach for total hip replacement.

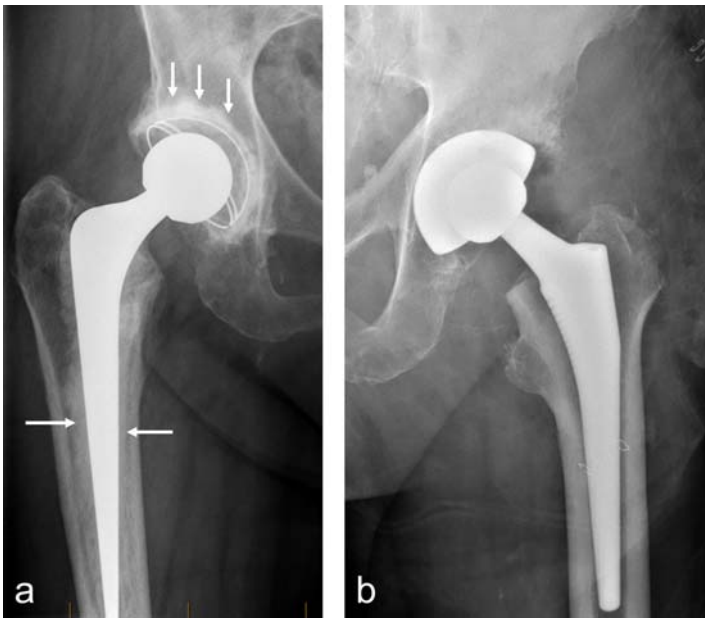

FIGURE 9.7 Total hip replacement demonstrating (A) cemented – note mantel of radio-opaque cement (arrows) and (B) cementless fixation.

A polyethylene liner is then sandwiched between the two metal components to provide a low friction articulation for the new knee joint. The knee prosthesis is designed in such a way as to allow the knee to flex and extend, to twist and to bear weight, effectively restoring the axis and kinematics of the lower limb. The prosthesis may be fixed to bone by creating a tight fit with the cut surface of the bone (cementless) or cemented into position. The articular surface of the patella may also be replaced with a polyethylene button to provide a smooth articulation with the distal femoral component.

Total knee replacement is a highly successful procedure for treating end-stage osteoarthritis[33] and similar to the hip joint, replacement surgery has been shown to return patient-reported outcome measures equivalent to the normal population.[16] It has a greater incidence than total hip and has been projected to rise globally at a greater rate than total hip replacement over the next few decades.[21,23,34] Similar to total hip replacement, a proportion of procedures are associated with dissatisfaction (24), between 10% and 34%,[35] while another proportion is also associated with inappropriate utilization (25), between 7% and 40%.[36] The use of decision aids[37] to help identify nonresponders[4] for alternate treatment strategies is an important step in ensuring the effectiveness of total knee replacement. The accuracy of the procedure, implantation, and alignment appears to be important with patients undergoing computer-navigated knee replacement reporting better early and mid-term outcomes[38] and registry studies suggesting a beneficial impact on long-term survival in young and more active patients.[39]

Unicompartmental knee replacement

In a unicompartmental knee replacement, only one compartment of the knee is replaced, namely the medial, lateral, or patellofemoral compartment. Through a similar process as with total joint replacement, the joint surfaces are removed and

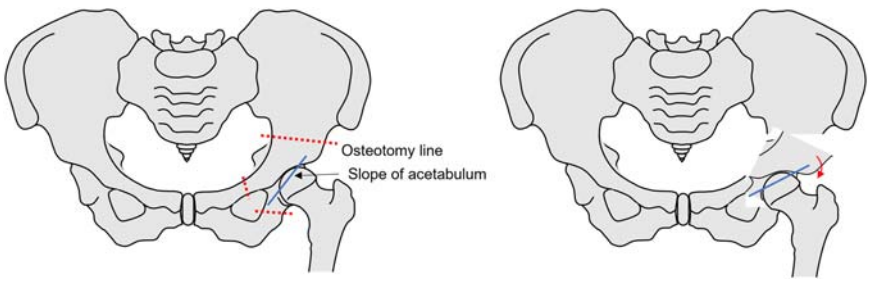

FIGURE 9.8 Osteotomies of pelvis through the ilium, pubic ramus, and ischium allow rotation of the acetabular segment to change the slope of the acetabulum to provide better coverage of the femoral head and/or exposure of more healthy cartilage to weight-bearing forces.

FIGURE 9.9 (A) Model of total knee prosthesis in situ. (B) Anteroposterior and (C) lateral X-rays of total knee replacement.

replaced with metallic components and a low friction joint created by inserting a polyethylene component between the two metal replacement parts at the end of the femur and tibia (Fig. 9.10).

Unicompartmental knee replacement is a bone and ligament conserving procedure designed to restore the function and kinematics of knees with severe unicompartmental (medial or lateral) symptomatic osteoarthritis.[40] It is a highly specialized procedure that is associated with good medium and long-term patient-reported outcome measures and implant survival but is sensitive to patient selection, surgical experience, technique, and prosthesis design.[41,42] With isolated unicompartmental disease, particularly of the anteromedial knee, unicompartmental knee replacement is associated with better postoperative knee range of motion, functional recovery, and decreased complications.[43] Despite the efficacy of unicompartmental knee replacement for unicompartmental osteoarthritis, total knee replacement even for unicompartmental disease has been found to be a more durable procedure.[40]

Patellofemoral replacement

This procedure is infrequently done and may be considered if the patellofemoral joint is the only compartment within the knee with severe and symptomatic osteoarthritis (Fig. 9.11). In this procedure, the trochlea between the medial and lateral femoral condyles is resurfaced to allow a smooth metallic surface for the patella to glide over. The undersurface of the patella is replaced with an all-polyethylene button.

Patellofemoral replacement is another highly specialized procedure that addresses localized arthritis to the patellofemoral joint.[44] While developed in the latter part of the 20th century, its popularity recently has been on account of better designs and surgical technique[45,46] including the use of robot-assisted surgery.[47,48] Computer navigation is thought to be essential as a guide to better bone preparation and prosthesis orientation when considering patella resurfacing.[49] Long-term

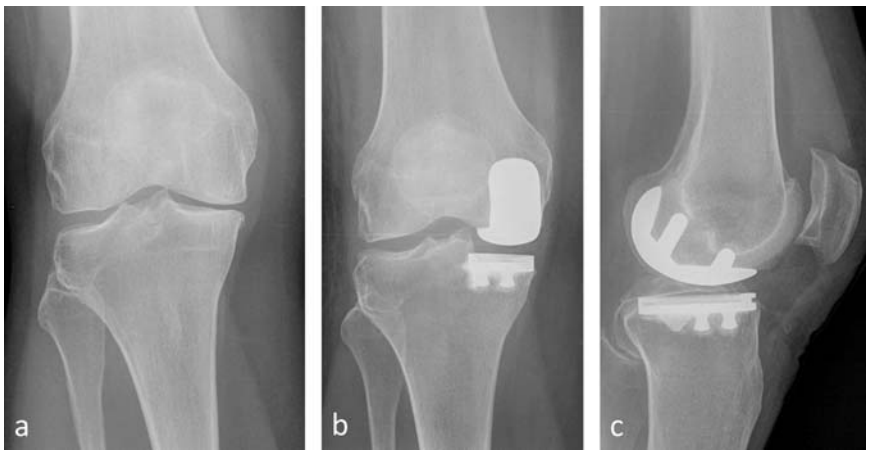

FIGURE 9.10 (A) Medial compartment osteoarthritis of the knee treated with (B) medial unicompartmental knee replacement (anteroposterior X-ray) and (C) lateral X-ray.

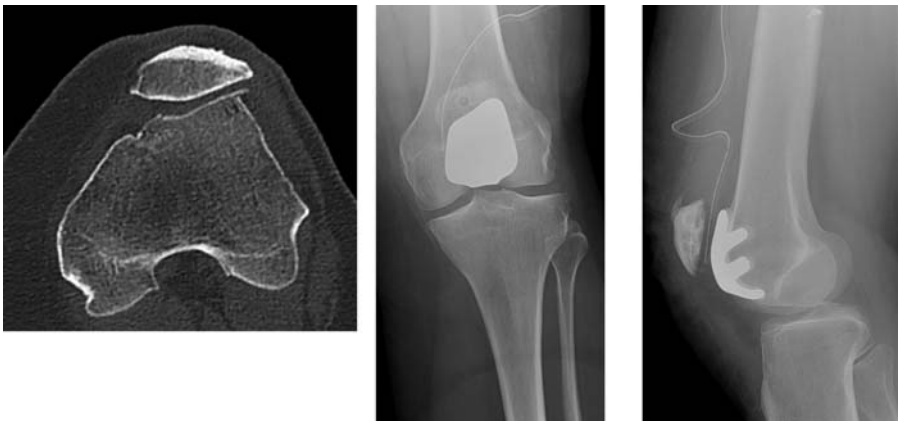

FIGURE 9.11 (A) Axial computed tomography of patellofemoral osteoarthritis treated with (B) patellofemoral prosthesis (anteroposterior X-ray) (C) lateral X-ray.

data collection will be required to confirm the efficacy of this procedure.[14] Notwithstanding this, the complications of patellofemoral knee replacement are high, and the likelihood of reoperation or revision is significant in comparison to total knee replacement[45,50] making this procedure one with very narrow indications.

High tibial osteotomy

High tibial osteotomy is a procedure where the tibia is transected at its proximal end and the shaft surgically redirected to change the mechanical axis of the lower limb (Fig. 9.12). By reorienting the mechanical axis of the lower limb, the line of compressive forces is moved away from the arthritic compartment (medial or lateral) toward the other nonarthritic side. The osteotomy may be performed as an opening[51] or closing[52] wedge (Fig. 9.12). In the former, bone graft is used to prop open the osteotomy, while in the latter, a wedge of bone is removed to close the osteotomy. High tibial osteotomy is generally performed in young people where the osteoarthritis is only in one compartment, with little or no arthritis in the other compartments, and where the knee joint is stable and has a full range of motion. Moreover, high tibial osteotomy is performed to slow the progression of osteoarthritis and therefore may be performed when the symptoms outweigh the radiologic signs of osteoarthritis (e.g., Kellgren–Lawrence Grade 2 or less).

High tibial osteotomy may be performed through a variety of techniques where specific biomechanical goal is to correct different lines of forces.[53] Their roles in managing osteoarthritis through the redirection of the lines of forces have been successful, although the extent of improvement in patient-reported outcomes remains variable.[51,52,54,55] The main issues relating to high tibial osteotomy include nonunion, avascular necrosis of the epiphyseal segment, fracture, overcorrection, and internal fixation.[56–59] There may also be complications that arise in total knee replacement after high tibial osteotomy.[55,60] Ongoing controversy exists over the superiority of unicompartmental knee replacement over high tibial osteotomy.[61–64] Valgus high tibial osteotomy is associated with better physical activity in younger patients while

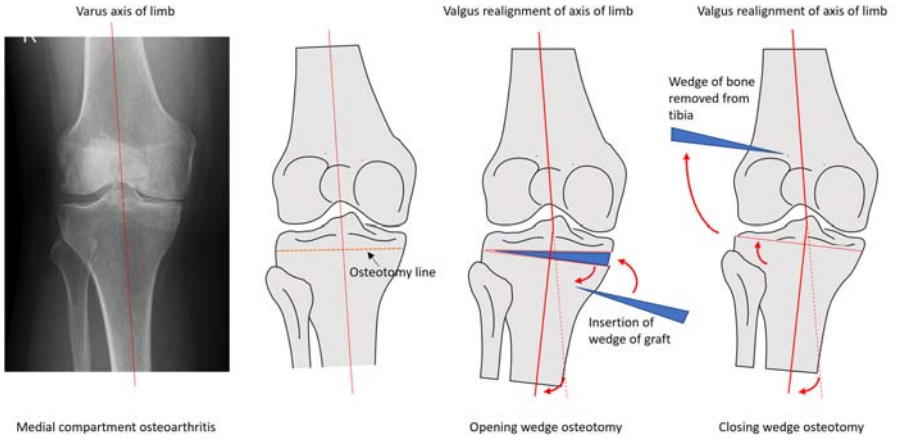

FIGURE 9.12 Varus alignment of medial compartment osteoarthritic knee realigned into valgus by either opening wedge or closing wedge osteotomy.

prosthetic replacement is preferred in older patients where shorter rehabilitation times and faster functional recovery are reported. As with other highly specialized procedures, the veracity of long-term outcomes is highly dependent on accurate indications and appropriate patient selection.

Risks of surgery

General

Total joint replacement is predominantly performed on people over the age of 60 years. With increasing age, the risks of associated comorbidities and lesser physiologic tolerance predispose individuals to postoperative complications such as blood loss requiring transfusion, pain, delirium, constipation, urinary tract infection, pneumonia, allergic reactions, and surgical site infections, among others. Of these the commonest postoperative complications arising during hospital stay include superficial surgical site infections (5%), venous thromboembolism (5%), and delirium (5%).[62]

Readmission within 30 days of surgery is another indirect marker frequently used to identify postoperative complications.[65–68] Patient-related risk factors that predispose to 30-day readmission following total joint replacement include alcohol abuse, extremes of body mass index, arrhythmias, ischemic heart and peripheral vascular disease, liver disease, hematological disorders including anemia and coagulopathy, chronic pulmonary disease, psychiatric disorder, and smoking.[68]

As a significant factor, obesity influences not only complications[69–72] but also patient-reported outcome measures after joint replacement.[73,74] Interestingly, there appeared to be no relationship between body mass index and risk of death after total joint replacement.[75] This may be related to increased effectiveness and efficiency of perioperative medical preparation of patients where comorbidities are recognized, managed, and optimized prior to surgery resulting in better health at the time of surgery.[76,77] A recent randomized control trial comparing the incidence of complications between two groups of patients undergoing total knee replacement who did or did not also undergo bariatric surgery reported that postoperative complications were not only less in those who underwent bariatric surgery but also 29% of this group subsequently declined joint replacement surgery because of symptom reduction. This raises the potential role of significant weight loss for controlling the entry of patients into the pathway toward joint replacement.[78]

Specific risks related to total joint replacement

(1) Hip – Leg length discrepancy, limp, postoperative subluxation or dislocation, intraoperative periprosthetic fracture, early prosthetic loosening, neurovascular injury, periprosthetic joint infection, nonunion of osteotomy, loss of position of osteotomy, complications of internal fixation.

(2) Knee – Malalignment, patella subluxation, early prosthetic loosening, loss of range of motion, pain with motion, anterior knee pain, avascular necrosis and fracture of the patella, skin necrosis, instability, neurovascular injury, nonunion of osteotomy, loss of position of osteotomy, complications of internal fixation.

Preoperative preparation

General fitness

Patients should aim to optimize their health prior to surgery. Although the literature is divided as to the impact of preoperative physical therapy on the outcomes of joint replacement surgery,[79,80] there is sufficient evidence to support health optimization through structured exercise plans prior to surgery that improves postoperative function and satisfaction.[81–83] Surgery should not occur precipitously, but rather should be a planned event. Therefore, people considering total joint replacement or surgery for osteoarthritis should ensure that they are as fit as possible. From a practical standpoint, this may include continuing with daily exercises prior to surgery to maintain mobility of the affected joint, strengthening of the limb and core muscles,[82] and weight reduction strategies.[84–86] Not only is such *prehabilitation* important, but there is also an important role for careful nutritional intake to prepare patients for the metabolic perturbations that surgery and the immediate postoperative activity might bring.[87,88]

Comorbidities

Comorbidities such as obesity, diabetes, lung complaints, cardiovascular conditions, and requirement for blood thinners are common in conjunction with osteoarthritis.[89–91] These not only have the potential to influence the incidence of

complications but also patient-reported outcomes following surgery. Preoperative optimization of comorbidities is important to mitigate the risks of surgery[92] Multidisciplinary physician-led perioperative care throughout the continuum of care is now recognized as an important part of perioperative patient preparation and optimisation.[93–95] Recent models of care involve institutional, medical, nursing, and allied health input, which aim for improved communication, integration, efficiency, safety, and patient satisfaction.[93]

Infections

Ingrown toenails, urinary tract infections, skin sores, and other dermatological conditions are recognized preoperative sources of organisms that are responsible for deep periprosthetic infections and yet infrequently prioritized. One-fifth of revisions for primary total hip and one-quarter of revisions for total knee replacements are because of infection.[14] General patient factors, the environment within which surgery is conducted, and the surgical technique may also lead to increased risks for infection.[96–98] It is critical that joint replacement is undertaken with a focus on strategies to prevent periprosthetic joint infection that take these three paradigms into consideration.[99,100]

The management of a periprosthetic joint infection is complex and is a devastating outcome for patients, their carers, and families. In addition, there is a considerable burden to the health system because of the need for utilization of extensive resources.[101–103] The management of periprosthetic infection is beyond the scope of this chapter, but the principles include appropriate evidence-based surgical practice to control or eradicate the infection, a multidisciplinary approach to ensure the optimum medical, physical, and functional outcome for the patient, and the specialist infectious diseases physician-led deployment of organism-specific antibiotic therapy.[104,105]

What is vitally important to consider is the prevention of periprosthetic infection. One of the most important principles is the use of prophylactic antibiotics to prevent early infection. Numerous guidelines have been promulgated to steward the use of prophylactic antibiotics in joint replacement surgery, while balancing the benefit of this against the potential for generating antibiotic-resistant organisms.[106]

The SARS-CoV-2 (COVID-19) pandemic has impacted the globe in numerous ways. How the medical community responds to the potential for infection, the management of concurrent infection or past infection is an important consideration for patients and treating teams when advising elective surgery such as total joint replacement. Perioperative COVID-19 infections are known to increase postoperative mortality.[107] In an international multiinstitutional prospective cohort study, the adjusted 30-day mortality rates when stratified by time for diagnosis of COVID-19 reported that patients with preoperative COVID-19 had up to four times increased mortality if surgery was undertaken within 7 weeks of COVID-19 infection.[108] COVID-19 infection may cause specific hematological, cardiac, and pulmonary conditions, and these need to be completely resolved before surgery is contemplated.[109,110] Comorbidities are likely to make the symptoms and duration of COVID-19 more severe.[109,110] COVID-19 variants may affect patients differently, and all patients should undergo viral testing several days prior to surgery.[111]

Anesthetic and postoperative pain relief

The type of anesthesia that is delivered during surgery will be dependent on clinician preferences. Combinations of spinal, regional, and local infiltration anesthesia are often utilized to provide good pain control and limb anesthesia to enable patient comfort while requiring only light sedation during the procedure.[112–114] Such anesthesia is preferred for safety and postoperative recovery reasons over a general anesthetic.[115]

A careful and targeted postoperative pain control plan is important for facilitating patient comfort, early mobilization, and joint movement.[116] Multimodality pain relieving medication including local infiltration of anesthetic, paracetamol, nonsteroidal antiinflammatory drugs, and synthetic opioids are effective for managing postoperative pain and when given in the right combinations may provide good analgesia and mobility without dizziness, somnolence, confusion, nausea, and delirium.[117–120] While opiates are highly effective for pain control and are employed commonly, the association with unwanted side effects and, more importantly, dependency has seen a growing caution to the liberal use of this form of analgesia.[121–123] Other nondrug strategies for controlling pain, which have been reported to provide some benefit, include cryotherapy[124,125] and the use of continuous passive motion machines.[126]

Postoperative course

The postoperative course follows three phases.

In hospital – Early Recovery After Surgery (ERAS)

With appropriate patient selection and education, streamlined coordination of processes, anesthesia that causes the least physiological upset, surgical and intraoperative practices that cause the least postoperative patient encumbrances, and a well-coordinated postoperative mobilization and rehabilitation plan, patients can experience early recovery, short stay, and rapid mobilization after surgery.[127] Such treatment strategies are referred to as Early Recovery After Surgery (ERAS) programs.[127]

With anesthesia that allows quick resolution of motor blockade and minimal impact on postoperative hemodynamics, patients should expect to be assisted out of bed on the day of surgery and to begin mobilization with walking aids under supervision. Reducing the negative impact of neuroactive pain-relieving medication such as dizziness, nausea, drowsiness, weakness, or lassitude should be a focus of treating teams and the role of multimodality analgesia to reduce these is of prime importance.[128] Patients should then quickly migrate to stair climbing and transfers between bed and chair, which will be required once they return to home.

Studies of ERAS programs have demonstrated outcomes, patient satisfaction, and low complication rates that are all like conventional care.[129] Arriving at a consensus around the best programs, however, has its challenges because of the varied protocols employed around the world.[130] While maintaining patient safety, good outcomes, and patient satisfaction, the increased efficiency of processes and resultant reduction in length of stay can result in greater cost-effectiveness and cost savings.[131]

First 6 weeks

In the first 6 weeks after surgery, the goal of rehabilitation is to return the patient to community living, with confidence, independence, and a general sense of good health. This requires adequate pain control with rapidly reducing doses of neuroactive substances (opioids, gabapentinoids, benzodiazepines), good supervision of physical activity, graduated weaning off postoperative walking aids, and encouragement to undertake joint, limb, and whole-body exercises. Care of the wound is critical during this time to avoid complications such as superficial wound infections, dehiscence, and hematoma, which can lead to deep periprosthetic infections. Regular and good communication between the general practitioner, physiotherapist, and orthopedic surgeon is encouraged to enable early detection of any potential threat to good patient outcomes.

Numerous studies have documented the successes of a variety of rehabilitation programs that have ultimately led to faster postoperative recovery and improvement in quality of life.[132–134] However, the lack of detail with regard to the duration of exercise sessions and their timings, together with inadequate description of conventional controls, has made the generalizability of many recommendations difficult.[135] It is important to also consider the impact of factors that may influence early rehabilitation, including patient comorbidities, pain control, and surgical approach.[136,137] It is clear the interrelated nature of the various steps and phases in joint arthroplasty that impact subsequent progress.

An important element of care in the first 6 weeks after total joint replacement is the prevention of venous thromboembolism because of the potential long-term consequences such as pulmonary dysfunction, including hypertension[138] and postthrombotic syndrome, which may affect up to 50% of people with deep vein thrombosis.[139] Venous thromboembolism is the leading cause of disability-adjusted life years lost and the third highest cause of cardiovascular death globally.[140] Orthopedic procedures, especially those involving the lower limb or prolonged surgical times, are regarded as some of the highest among at-risk surgical procedures.

Prophylaxis against venous thromboembolism in orthopedic surgery and particularly after joint replacement is well established.[141] A variety of lower limb devices and therapeutic agents have been described to reduce the risk of developing venous thromboembolism within the first 6 weeks after surgery. The most employed agents include low-molecular-weight heparins, which have been shown to be highly efficacious for the reduction of venous thromboembolism. These can be administered by subcutaneous injection or orally. However, the slightly higher risk of wound complications with low-molecular-weight heparins such as hematoma, ooze, and superficial surgical site infections has drawn caution to its universal use[142] and alternatives such as aspirin[143] are also recommended. Risk stratified approaches are recommended to balance the requirements of prophylaxis against the potential for developing deep vein thrombosis, and subsequent complications arising out of chemoprophylaxis.[144–146]

First 12 months

After the first 3 months from surgery, the patient may expect to increase their activities with greater independence and less reliance on walking aids as their pain becomes better tolerated or significantly subsided. After this, the goal should be

exercises to improve strength, range of motion, and proprioception. Studies have reported that the trajectory of improvement is greatest over the first 3−6 months, then followed by a gentler gradient reaching maximal improvements in function by 12 months from surgery that are usually maintained after that time.[38,147,148] Some studies have also indicated that the extent to which recovery occurs may also be associated with specific characteristics of patients.[149,150] For example, cohorts with different characteristics including age, comorbidities, and preoperative mental health scores may occupy different postoperative recovery trajectories, and in this regard, may self-select for different rehabilitation programs. Because the potential for improvement for most patients exists after total joint replacement, concerted efforts should be made to identify patients who are on a lower trajectory to facilitate their movement from that to a higher trajectory through additional physical, social, or mental health support.[151]

Measuring outcomes

A critical element of monitoring care is the ability to measure its impact.[152,153] Outcome measures have always been at the forefront of practice although this has changed considerably in orthopedics from surgeon-focused[154,155] to patient-reported outcome measures.[156] This change recognizes the discrepancy between surgeon and patient-reported outcome measures and the importance that these have in determining how treatments should be measured and recommended.[157] There are roles for both. Where surgeon-focused outcomes report on morbidity, mortality, and prosthetic survival, which is a measure of safety and efficacy of devices and practices, patient-reported outcome measures report what is important to patients from their perspective. In moving toward patient-reported outcome measures, studies have reported similar reliabilities between surgeon and patient-reported outcome measures[158] and others have suggested that patient-reported outcomes are less time-intensive.[159]

As reimbursement for surgical care has been linked with patient outcomes in the larger economies, e.g., United States (Patient Protection and Affordable Care Act PPACA) and the United Kingdom (2012 Health and Social Care Act), patient-reported outcome measures will become more important in guiding decisions as to the appropriateness of total joint replacement. Numerous scales exist but only a few have been validated for disease-specific or joint replacement treatment.[156] One of the most widely validated patient self-administered scoring systems for use in osteoarthritis is the Western Ontario and McMaster Universities arthritis Index (WOMAC),[160,161] which is also available in 60 languages. Although among the more popular, this survey comes with some limitations including that it has not been designed for specific joints and can be influenced by non-arthritis-related factors.[154] Moreover, the correlation with patient satisfaction and perceived quality of life have in some reports been only moderate.[162,163] The short form 36 (SF-36) questionnaire[164] and its later derivative the short form 12 (SF-12)[165] are general health status and quality of life surveys that are among the more commonly employed in osteoarthritis research.[166] While they have been shown to be valid and reliable,[167,168] there are limitations related to floor and ceiling effects, which may make it more applicable for measuring changes at the group rather than the individual level.[169]

Patient expectations and satisfaction

Several earlier studies have demonstrated the close link between patient expectation and satisfaction.[170−172] However, the lack of consistency in defining patient expectations has led to some controversy in others' findings.[173] Importantly, what appears to be a major driver for satisfaction is whether patients' expectations are realistic or not. In this regard, discordant expectations between patient and surgeon exist in one-third of cases,[174] patients are often overly optimistic and frequently underestimated time to recovery,[175] and patients often have higher expectations in activities not generally regarded as essential, for example, hiking and dancing.[176] It is becoming more important for facilitating improved outcomes to temper patients' expectations,[177] balancing them with appropriate surgical advice, and paying special attention to the discourse regarding surgical outcomes.[24,178] Patient satisfaction is becoming an important quality marker that reflects not only the meeting of patient expectations, but also the delivery of safe, efficient, and effective clinical care. In this regard, the move toward value-based care will align more with what patients value the most rather than simply how costs can be minimized.[179,180]

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Chapter 10

The interprofessional team, service delivery, and professional development

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The preceding chapters have explored the theoretical concepts and key evidence-based recommendations for delivering care to people with osteoarthritis. In this chapter, we describe considerations and strategies that health professionals can use to successfully deliver this care in their daily practice. We begin by outlining the essential principles underpinning contemporary osteoarthritis care—self-management, person-centered care, the chronic care model, and interprofessional and multidisciplinary care. We will then explore the different health factors and considerations outside of health that are necessary for successful care delivery and give practical examples of how to incorporate these into your clinical practice. Finally, we examine ways clinicians can remain informed of changes to the current recommended evidence-based osteoarthritis treatments.

Introduction

Coordinated, consistent, and tailored evidence-based care is necessary to ensure people with osteoarthritis receive the care they need, when they need it. However, contemporary care pathways are not just about providing treatment. Rather, they are about forging strong partnerships between people with osteoarthritis, health professionals, and other services to ensure individuals are empowered to take ownership of their health. There is also a rising awareness of the need to integrate factors outside of the traditional health focus, known as social determinants. Addressing social determinants ensures health issues are addressed within the context of people lives and not simply as "add-ons". This chapter will focus on the interaction between the health professional and the person with osteoarthritis and provide strategies for delivering evidence-based care within contemporary care frameworks.

Case study:

Stephen is a newly graduated physiotherapist working in a private physiotherapy clinic. Stephen has an appointment to see Katrina, who presents with knee osteoarthritis and a history of depression and social isolation due to her limited walking capacity (100m). Stephen has a good knowledge of the key recommended treatments for knee osteoarthritis; however, he is concerned about his poor knowledge and skills for managing depression. Stephen also lacks confidence in discussing the importance of weight loss and potential pharmacological options with Katrina. In this chapter, we will consider how Stephen can supplement his existing knowledge and utilize local health professionals, services, and resources to provide Katrina with evidence-based care suited to her needs.

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Principles underpinning successful delivery of care

Support for self-management of osteoarthritis

As discussed in the preceding chapters, exercise, physical activity, and weight loss, along with education and support for self-management, are advocated as the key treatments for osteoarthritis. But what is "support for self-management" and how does this fit into the broader scope of health care? Self-management is defined as patients having the tools, knowledge, and skills to manage the actual or perceived impact of their osteoarthritis, including where, when, and how to seek additional care, if needed.[1] Any decisions related to a person's health should be made by the patient,[2] thereby empowering the individual to better cope with their symptoms, treatments, physical and social consequences, and the lifestyle changes inherent in living with the condition.[3,4] Self-management sits between self-care (the everyday behaviors required to stay healthy) and symptom management (actions required to reduce osteoarthritis symptoms). Fig. 10.1 illustrates how self-management sits within this broader health context. Enabling patients to develop these skills has the twofold benefits of improving quality of life and reducing reliance on long-term health care.

Self-management may be directed solely by the individual or in partnership with a health professional. This relationship may also change and evolve over time. Regardless, self-management requires a proactive attitude from the person seeking care. Making informed decisions on lifestyle behaviors and different treatment options is potentially new to many people with osteoarthritis, and consequently, they may not possess the knowledge, competencies, or motivation to do so.

Health professionals can assist by equipping patients with these skills and providing additional support, advice, or encouragement as needed (also see Chapter 4). This requires health professionals to consider the person's lived experience and ensuring thought is given to their biological, psychological, social, and environmental circumstances, their health goals, and their previous experiences of care.[5] Taken together, these principles can help address many of the barriers to delivery and adherence to care as discussed in the preceding chapters.

In the following sections, we introduce three principles that underpin self-management and that health professionals should understand, namely:

i) Person-centered care,
ii) The Chronic Care Model, and
iii) Interprofessional and multidisciplinary care pathways.

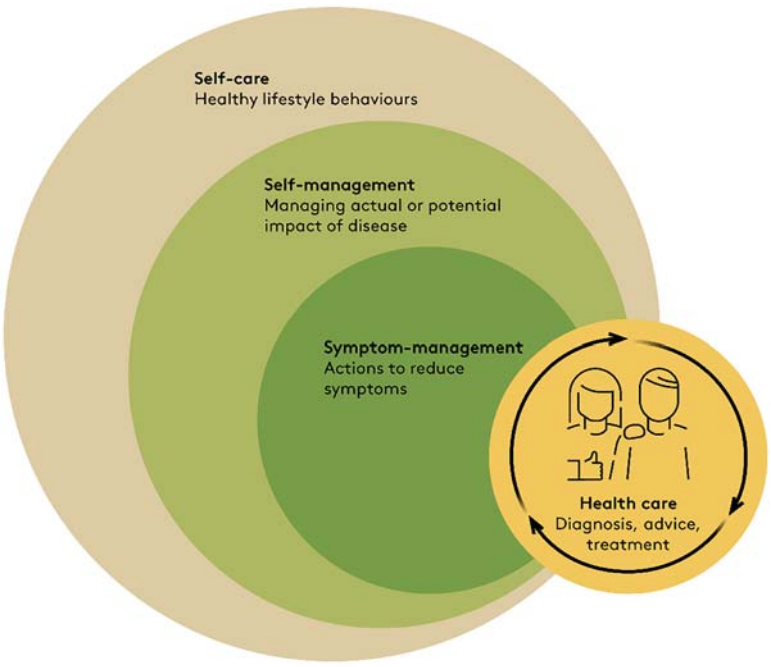

FIGURE 10.1 Self-management of osteoarthritis. Enabling support for self-management is a key recommended treatment for osteoarthritis. Self-management is ensuring people with osteoarthritis have *the tools, knowledge, and skills to manage the impacts of their condition. Self-management* sits between the everyday behaviors required to stay healthy (self-care) and the actions required to reduce osteoarthritis symptoms. *From Kongsted A, Ris I, Kjaer P, Hartvigsen J. Self-management at the core of back pain care: 10 key points for clinicians.* Braz J Phys Ther. *2021;25(4):396–406 with permission.*

Person-centered care

One of the major challenges facing many health professionals is how to move away from "treating" people to inspiring them to develop the skills needed for self-management. Lifestyle interventions can be difficult to implement, and the behavioral changes needed are hard to maintain. Enacting a person-centered care approach, where any treatment or advice is tailored to the needs, capacity, and preferences of the individual, can result in patients having more ownership of their care. Studies have shown that patients are more able to change their behavior if they have input in the decision-making process and are supported to take on that leading role.[6–8] A detailed discussion on the principles of person-centered care can be found in Chapter 1.

The Chronic Care Model

As the preceding chapters have illustrated, osteoarthritis is a complex, chronic condition, and patients often benefit from interactions with a variety of health professionals, services, and organizations. High-quality multifaceted care can be delivered in many ways and should always be person-centered. When considering different ways of delivering high-quality, person-centered osteoarthritis care, the Chronic Care Model[9] (Fig. 10.2) can provide a helpful overarching framework for healthcare design.

The Chronic Care Model[9,10] is a widely adopted framework used to enhance person-centered care for people with chronic conditions. The model aims to "improve health, enhance patient experiences, reducing health costs, and improve the work life of health professionals." The model's focus is on ensuring system and community factors are considered in addition to clinician-level factors, thus encouraging productive interactions across the whole pathway of care. The premise of the model is that productive interactions between health professionals, people with osteoarthritis, and their wider community result in improved outcomes (e.g., better health status, quality of life, and patient satisfaction).

A key component of the chronic care model is the "prepared, proactive practice team" (Fig. 10.2), which is essential to empower people with osteoarthritis to self-manage their condition.[9,10] Developing a prepared, proactive practice team can be achieved through the adoption of interprofessional or multidisciplinary models to deliver care.

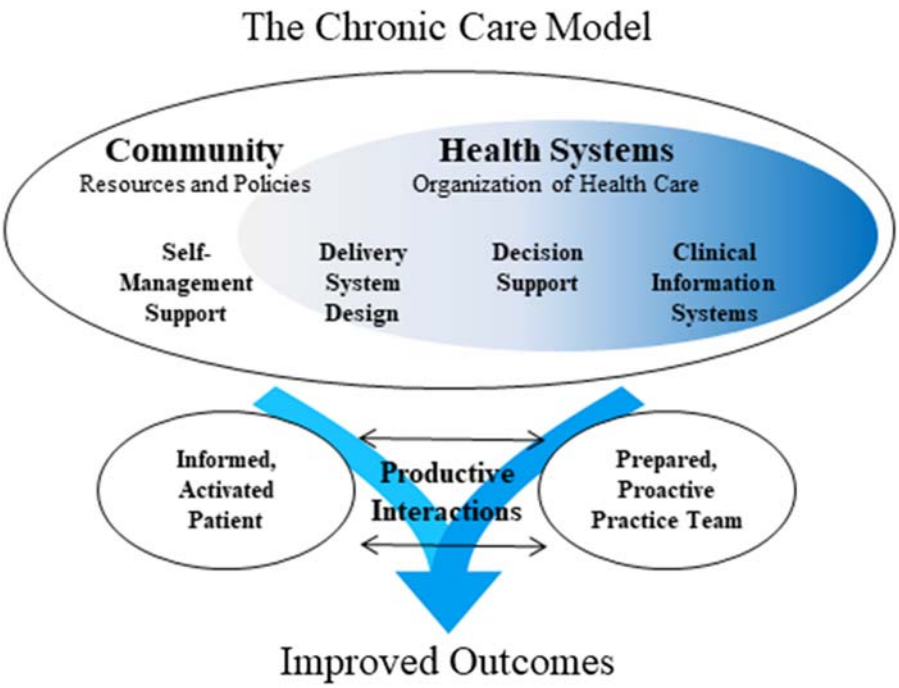

FIGURE 10.2 Chronic Care Model. The chronic care model[9,10] is a widely used framework used to provide person-centered care to people with chronic conditions. The model's focus is on system and community factors to encourage productive interactions across the whole pathway of care. *Adapted from Bonomi AE, Wagner EH, Glasgow RE, VonKorff M. Assessment of chronic illness care (ACIC): a practical tool to measure quality improvement.* Health Serv Res. *2002;37(3):791–820 with permission.*

Interprofessional and multidisciplinary care

Interprofessional or interdisciplinary care is where a group or team of health professionals from different professional backgrounds collaborate to offer care, guidance, and support to people seeking care, their family, carers, and broader social networks.[11] Interprofessional team-based care has been defined as that delivered by *intentionally* created, usually small, teams who have a collective identity and shared responsibility for an individual or group of patients.[11] Characteristics of good interprofessional teams[12] are shown in Table 10.1 and include shared goals, clarity of roles, effective communication, and shared decision-making.[13] Common examples are rapid response teams and palliative care teams. Internationally, there are successful examples of using interprofessional teams to deliver osteoarthritis care, often through osteoarthritis management programs (Fig. 10.9). The Australian Osteoarthritis Chronic Care Program (OACCP)[14,15] is one example. A key feature of these programs is the role of a "coordinator" who facilitates the patient's interaction with the health professionals throughout their involvement (Fig. 10.3). This coordinator role can be performed by any health professional.

Multidisciplinary care refers to *less structured* collaborations between health professionals.[11] Similar to interprofessional care, multidisciplinary care draws on the knowledge from different disciplines to deliver evidence-based care. However, care may not be coordinated by a central professional, rather care may be facilitated by a general practitioner (GP) or the person with osteoarthritis themselves (Fig. 10.4).

The strength of interprofessional care is that all necessary health professionals can be actively involved in delivering consistent and coordinated care from initial diagnosis, through choice and delivery of treatments, monitoring of aftercare and evaluation outcomes,[16,17] and across different healthcare setting (e.g., primary care, outpatient clinics, community-based care). However, not all people with osteoarthritis require interprofessional care. Some patients may only require clinical input from a small number of health professionals or for a short period (e.g., managing an osteoarthritis flare-up). It may also be infeasible to deliver interprofessional care in certain settings[17] Thus multidisciplinary or single clinician care can sometimes be the more efficient and cost-effective option.

TABLE 10.1 Characteristics of a good interprofessional team.

Themes	Description
1. Leadership and management	Having a clear leader of the team, with clear direction and management; democratic; shared power; support/supervision; personal development aligned with line management; leader who acts and listens.
2. Communication	Individuals with communication skills; ensuring that there are appropriate systems to promote communication within the team.
3. Personal rewards, training and development	Learning; training and development; training and career development opportunities; incorporates individual rewards and opportunity, morale and motivation.
4. Appropriate resources and procedures	Structures (for example, team meetings, organizational factors, team members working from the same location). Ensuring that appropriate procedures are in place to uphold the vision of the service (for example, communication systems, appropriate referral criteria and so on).
5. Appropriate skill mix	Sufficient/appropriate skills, competencies, practitioner mix, balance of personalities; ability to make the most of other team members' backgrounds; having a full complement of staff, timely replacement/cover for empty or absent posts.
6. Climate	Team culture of trust, valuing contributions, nurturing consensus; need to create an interprofessional atmosphere.
7. Individual characteristics	Knowledge, experience, initiative, knowing strengths and weaknesses, listening skills, reflexive practice; desire to work on the same goals.
8. Clarity of vision	Having a clear set of values that drive the direction of the service and the care provided. Portraying a uniform and consistent external image.
9. Quality and outcomes of care	Patient-centered focus, outcomes and satisfaction, encouraging feedback, capturing and recording evidence of the effectiveness of care and using that as part of a feedback cycle to improve care.
10. Respecting and understanding roles	Sharing power, joint working, autonomy.

From Nancarrow SA, Booth A, Ariss S, Smith T, Enderby P, Roots A. Ten principles of good interdisciplinary team work. *Hum Resour Health.* 2013;11:19. https://creativecommons.org/licenses/by/2.0/.

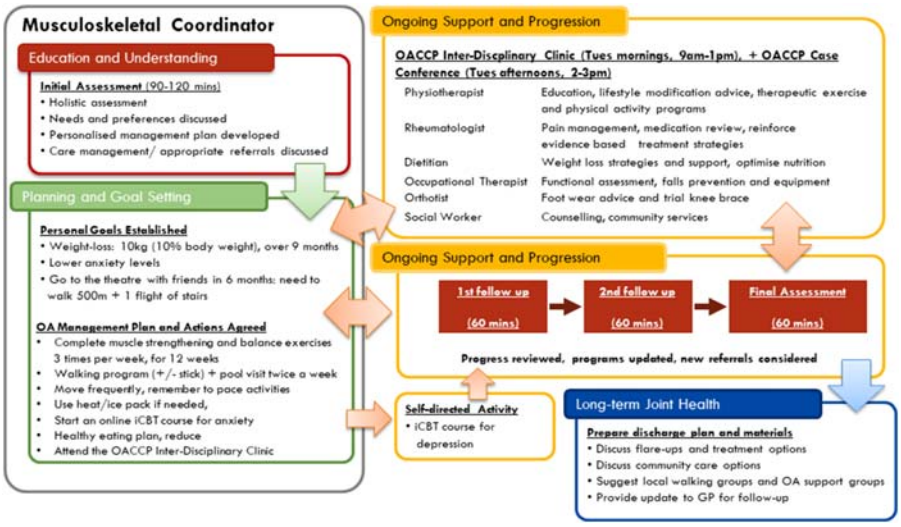

FIGURE 10.3 Example of a patient's journey through an osteoarthritis management program. The Australian-based Osteoarthritis Chronic Care Program (OACCP)[15] is an example of an interprofessional osteoarthritis management program. The patient's journey through the program is coordinated by a Musculoskeletal Coordinator, with coordinated input from an interprofessional team of health professions. The patient may also elect to undertake self-directed activities as part of their program or afterward. This example shows how Katrina may be managed by the interdisciplinary team if she undertakes this type of program.

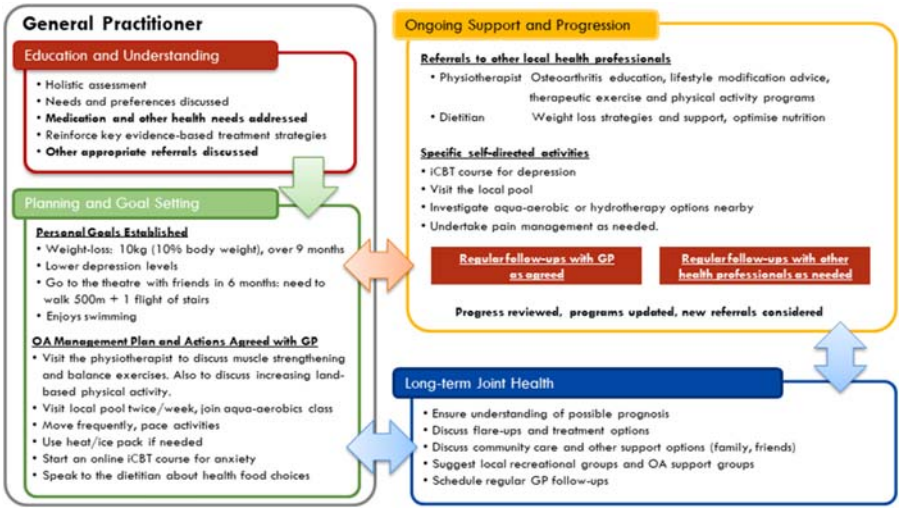

FIGURE 10.4 Example of a patient's journey through a primary care pathway. This figure illustrates how Katrina's care may be managed if she presents to primary care. In this example, Katrina's GP is coordinating her care. The GP will coordinate the medical aspects of care (e.g., medication review, comorbidity management) and will utilize a mix of referrals to other health professionals, self-directed activities, and community support to achieve the multidisciplinary care required to meet Katrina's needs. The GP will ensure regular follow-up is incorporated into the care management plan.

Exploring health and nonhealth considerations for delivering care

There is no one "best" model for delivering successful osteoarthritis care. Osteoarthritis management can be delivered through many different care pathways and by different health professionals. Care can be delivered in primary, secondary, tertiary, or private health settings, through community and government, or by private organizations such as insurance companies. It can be delivered face to face, through virtual care settings (i.e., telehealth, eHealth), in a group format, or via individual sessions. Regardless of the care setting, the fundamental components of delivering care should remain consistent, but adapted to suit local needs. The following section will reflect on the essential components of care delivery for osteoarthritis and provide suggestions on how they can be adapted to suit local needs. Specifically:

i. The healthcare team: Who should be delivering osteoarthritis care?
ii. Delivering and coordinating care: What are the core components of delivering successful care?
iii. Thinking beyond healthcare: Social determinants of health considerations, and
iv. Adapting care pathways for different settings.

The healthcare team

Who should be delivering osteoarthritis care?

As care is usually sought to address complaints due to pain and decreased daily functioning, GPs, family medicine doctors, nurses, or other primary care health professionals (e.g., physiotherapist) are usually the first point of contact. In many instances, the first-contact health professional will be able to coordinate all the patient's needs, however, in more complex cases, patients may need to be referred to other health professionals with greater expertise in a particular field.

Fig. 10.5 provides some examples of health professionals that commonly deliver osteoarthritis care and the types of services they provide. However, osteoarthritis care is not the domain of a "select" group of professions, and many other professions are often involved. For example, muscle strengthening and balance, promoting cardiorespiratory fitness, and combating inactivity can be addressed by a physiotherapist, while exercise physiologists can also help improve activity levels, combat inactivity, and manage other cardiometabolic conditions (e.g., diabetes, cardiovascular disease) via exercise. Occupational therapists can provide training and assistive devices to improve daily functioning, fall prevention, and assess the application of specific splints for hand OA. Similarly, podiatrists can assist with foot problems, shoes and shoe inserts/orthotics. Rheumatologists, GPs, nurses, pharmacists, and other medical specialists (e.g., sports physicians) can advise on medical aspects, including medications to manage pain and inflammation, and management of comorbidities. Psychologists or social workers can make an important contribution for addressing psychosocial issues or referrals to community or government services. In cases of severe OA, an orthopedic surgeon may be appropriate to consult on suitability for a joint replacement.

The role of the health professionals in delivering osteoarthritis care

The role of the health professional in facilitating successful person-centered care cannot be underestimated. Success is dependent upon well-trained professionals with a genuine knowledge of the patient and with well-developed skills in communicating and listening to patient's concerns to work with the patient to find and address the patient's personal aims (see Chapter 1). Interested and committed professionals with a positive attitude that builds trust and partnerships go a long way to the success of a program.

One barrier to delivering successful person-centered care is that health professionals often experience difficulties working outside their traditional care pathways. Inflexible professional attitudes can be a barrier whereby consciously or unconsciously, they slip back into "prescribing care" or they lack the interest, knowledge, or commitment to deliver contemporary care. The skills needed to implement behavior change strategies, for example (see Chapter 4), are very different to delivering a biomedical care approach, and ingrained professional attitudes are often difficult to change. Similarly, to achieve good results, professionals must have sufficient time and funding to fully understand the patient's needs and incorporate them into treatment planning and follow-up.[18,19]

Professional training and education are essential to delivering successful osteoarthritis care. Optimizing the person-centered approach to osteoarthritis management is not easy; however, it can be learned. There are various training courses on person-centered care available through universities and health professional societies/networks. For example, the

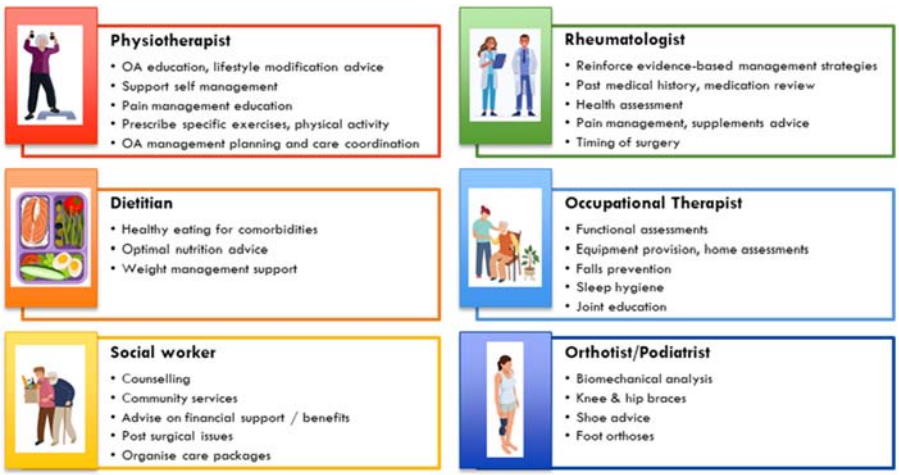

FIGURE 10.5 Examples of health professionals that commonly manage people with osteoarthritis. Many different health professionals can provide osteoarthritis care. This figure illustrates some of the health professionals that commonly deliver care and the types of services they provide. However, depending on the health setting, there are many other professionals that provide evidence-based osteoarthritis care including, but not limited to, GPs and family physicians, nurses, sports physicians, chiropractors, osteopaths and other musculoskeletal specialists.

Canadian Medical Education Directives for Specialists (CanMEDS)[20] is a competence framework covering the different roles that professionals have in relation to osteoarthritis patients. CanMEDS stipulates that the professional should be an expert in the field of osteoarthritis, a good communicator, be able to collaborate, reflect and investigate, promote the health of the osteoarthritis patient, organize care, and know the quality of one's own action to judge.[21] These competencies involve knowledge, skills, values, and attitudes in collaboration with other professionals, patients, social networks, and other important stakeholders that make interventions effective and efficient.[20] Ultimately, it is about enhancing the quality of managing osteoarthritis care for people with complex care needs and improving their participation within a more effective care system.

Clinical practice point: Although addressing pain and functional limitations are necessary components of care, when delivered in isolation, these strategies are unlikely to change the behaviors[22] essential for ensuring self-management of OA. So instead of providing a "quick fix," ask what you can do to prevent these health problems from occurring or getting worse in the long term.[23]

When should we on-refer patients to other professionals?

As introduced earlier in this chapter, optimal patient care may require referral to other health professionals at some stage in their care pathway. However, research has shown that referrals to other professionals or services are often performed poorly.[18] Knowing when and where to refer patients is a key skill for all clinicians delivering osteoarthritis care. Box 10.1 presents a list of factors the health professional should consider before on-referral to other professionals or services.

Referrals to other health professionals typically occur when a problem lies outside the health professionals' area of expertise or scope of practice, to address comorbidities or other specific requirements. People with osteoarthritis may also benefit from referral to other community, government, or industry-based support services that are outside the health system. For example, sporting and recreational clubs, community transport services, or services provided by insurance companies. Table 10.2 provides more examples of referral pathways for supported care. There is also a growing list of evidence-based online programs that patients can complete in their own time and without having to travel. They may or may not have contact with a clinician in these programs. Examples of different referral pathways will be discussed in the following sections.

Case study:

During the consultation, Stephen discussed with Katrina her personal goals and what activities were important and feasible for her to undertake (Fig. 10.3). One of Katrina's goals was to improve her nutrition and weight management. Katrina thought she would benefit from speaking to a dietitian about her weight-management plan. Stephen gave Katrina a 3-day food diary to track her current food intake and some general advice about healthy eating. He also showed Katrina some online resources from a credible and independent source to get started. Stephen helped Katrina set up an appointment with a local dietitian he knew had expertise in osteoarthritis.

Katrina also decided she was ready to address her poor psychological health. Stephen discussed several options with Katrina, including seeing a Clinical Psychologist or Counselor and undertaking an Internet-delivered Cognitive Behavioral Therapy (iCBT) course. Katrina advised that she preferred to undertake an iCBT course that she could complete in her own time, rather than attend a face-to-face visit. Stephen provided

Continued

BOX 10.1 Considerations for on-referral

- Is the person with osteoarthritis likely to benefit from the services being referred to?
- Does the timing of this referral meet the patient's needs?
- Has the person with osteoarthritis confirmed this referral as a priority and supports their goals?
- Has the person with osteoarthritis agreed to this course of action?
- Can the person with osteoarthritis access the service?
- Does the service have expertise in osteoarthritis or other musculoskeletal health care?
- Is the service provided in line with current osteoarthritis clinical guidelines?

TABLE 10.2 Complex osteoarthritis care and clinical reasoning considerations. This table provides considerations and suggestions of how to support comprehensive osteoarthritis management and care coordination. The table is best interpreted reading left to right noting relevant considerations per patient presentation, different treatment options, and referral pathways, which should be discussed and reviewed with the patient.

Person-centered care considerations	Clinical assessment	Treatment domain	Independent self-management options	Pathways for supported care
Personal preferences: - Attitudes - Thoughts, perceptions - Previous experiences - Beliefs - Self-efficacy, confidence - Treatment delivery and preference (i.e., in-person, online, independent, 1:1 or group class) **Readiness for change:** - Personalized goals - Shared decision-making - Agreed in treatment plan - Timing of treatments - Ongoing review and evaluation of program - Self-management support - Addressed drivers and barriers to care - interest in referrals to other services or provider **Psychological well-being** **Physical limitations** **Musculoskeletal pain** **Socioeconomic** - Education - Employment - Financial status/income - Insurance - Social class **Geographic** - Living location - Neighborhood - Parks and open space **Access** - Home environment - Health services (public vs. private)	**Physical activity and exercise**			
	Sedentariness (not meeting WHO physical activity guidelines[24]) ***Focal muscle weakness*** ***PROMs scores:*** For pain, function and health-related quality-of-life. (e.g., scores for KOOS ADL subscale items A1- A17). ***Functional performance tests*** e.g., Timed-up-and-go, 40m fast-paced walk, 30s sit-to-stand test. ***Pain interference measures*** - Visual Analogue scale (VAS) - Pain behaviors - Influence of mood, thoughts and sleep on pain presentation - Musculoskeletal assessment (i.e., allodynia, areas of pain) ***Comorbidity management*** - Musculoskeletal conditions (low back pain) or chronic pain, - Cardiovascular conditions, Metabolic Syndrome (obesity, diabetes and CVD), - Depression - Respiratory conditions, e.g., obstructive sleep apnoea, asthma ***Falls*** - TUG >13.75s = high risk of falls, - Joint instability/giving-way or collapse	**Structured exercise:** - Strengthening - Cardiovascular - Flexibility - Balance - Neuromotor - Mind-body	**Home exercise program** Education — discuss benefits, misinformation and pain education, e.g., "it is safe to move" … "not all pain = damage".	**Referrals to:** - Physiotherapy - Exercise physiology - Osteoarthritis exercise program - Hydrotherapy - Falls prevention classes
		Physical activity - Incidental activity - Advise to move frequently	Shopping, gardening, housework, walk to the mailbox, play with grandchildren	**Consider:** - Community services. e.g., transport, cleaners or healthy meal deliveries - Social support
		Sport and recreation activities **Pain education** **Medication review**	Walking, tennis, golf, swimming, hiking, skiing, mind-body (Tai chi or yoga), cycling, dancing. - Education and advice about pain and impact on osteoarthritis management recommendations.	**Consider:** - Community groups (e.g., sports clubs, walking groups, gymnasiums), - Encourage social support (e.g., walking with a friend or neighbor) **Medical referrals** - GP - Rheumatologist - Clinical nurse - Pain specialist - Pain MDT clinic
	Nutrition and weight-management			

- Local recreational facilities - Internet access - eHealth literacy - Social support - Quality of healthcare - Quality of therapeutic relationship - Transport/parking - Time availability - Financial position - Local services- local community organizations - Sporting organizations **Knowledge, health literacy and education:** - Health beliefs - Learning preferences (visual, written, oral) **Sociocultural factors** - Personal values - Family - Lifestyle factors - Support systems - History of trauma (e.g., refugee, abuse) - Relationships - Faith and religious setting - Cultural background (CALD) - Interpreters - Language **Personal safety**	***Above healthy weight*** - BMI ≥25 if under 65 years, or - BMI ≥27 if over 65 years ***Waist circumference*** i.e., for Caucasian adults - Females >80 cm - Males >94 cm ***Specific tools:*** That considers metabolic, physical and psychosocial factors to determine risk and optimal treatment. e.g., Edmonton Obesity staging system (EOSS) ***Subjective history considerations*** Diet history, including - Dietary allergies, - Preferences (i.e., vegan), - Previous weight loss/gain treatment success or failures, Emotional eating, physical hunger, mindless eating, knowledge deficit, fatigue/ sedentary behavior, emotional and psychological barriers	**Weight management interventions** *Dietary interventions:* - Low fat - Low-carbohydrate - Low calorie diet - Very low-calorie diet (+/− meal replacements) - Mediterranean diet - Intermittent fasting - anti-inflammatory diet - Fiber rich diet - Pre-made meal services - Commercial programs *Healthy lifestyle treatments to be used with dietary interventions:* e.g., exercise, sleep, mood, thoughts and habits. *Pharmacotherapy:* If weight loss through lifestyle interventions alone is unsuccessful or to assist weight maintenance. *Surgery:* For complex patients with severe obesity-related comorbidity. e.g., bariatric surgery (see Chapter 6)	- Dietary plan, - Education and advice, - Educational materials (booklets, videos, websites, phone applications). - General healthy eating (minimized discretionary foods, including alcohol). - Self-monitoring progress (food diary, activity tracker)	**Referrals to:** Dietetics - Nutrition advice - Multidisciplinary weight loss clinics - Endocrinology - Immunology - Clinical psychologist - Commercial weight loss programs - Online weight loss programs - Drug and alcohol centers **Consider:** - Behavior change support/- social networks (including SMART goal setting and monitoring).
	Under healthy weight - BMI <18.5 if < 65 years	Nutrient-dense foods, meal supplements	Dietary plan, education and advice.	**Referrals to:** - Dietetics/Nutrition - Multidisciplinary clinics - Endocrinology - Clinical psychology - Consider social networks
	Comorbidity management - Obesity - Type I/II diabetes - Stroke or cardiac event within the last 6 months - Unstable cardiovascular condition - Hyperlipidemia - Osteoporosis - Renal conditions - Inflammatory bowel disease	***Specific dietary requirements for comorbid conditions:*** - Diabetes requiring insulin and oral medications - Fluid intake restrictions - Medications that have adverse effects such as weight gain i.e., steroids (Prednisolone), antidepressants (some SSRIs)	Dietary plan, education and advice	**Referrals to:** - GP - Specific medical specialty and clinics - Dietetics **Consider:** - Behavior change support - Consider social networks

Continued

TABLE 10.2 Complex osteoarthritis care and clinical reasoning considerations. This table provides considerations and suggestions of how to support comprehensive osteoarthritis management and care coordination. The table is best interpreted reading left to right noting relevant considerations per patient presentation, different treatment options, and referral pathways, which should be discussed and reviewed with the patient.—cont'd

Person-centered care considerations	Clinical assessment	Treatment domain	Independent self-management options	Pathways for supported care
	- Gastrointestinal conditions (diverticulitis, irritable bowel syndrome) - Eating disorders - Malnutrition - Cancer, depression			
	Mood and sleep			
	PROMs for: ***Psychological health*** *Quick screening tools,* e.g.,: - Patient health Questionnaire-2 (PHQ-2),[25] - PROMIS29[26] for anxiety and depression. *Detailed screening tools,* e.g.,: - Depression anxiety Stress scale 21 (DASS-21)[27] - The patient health Questionnaire-9 (PHQ-9)[25] ***Sleep disturbances, e.g.:*** - Insomnia Severity Index[28] - Pittsburgh sleep quality Index (PSQI)[29] - Sleep apnoea 'STOP-Bang Questionnaire'[30] ***Comorbidity management*** - *Mood,* e.g.,: Depression, anxiety, stress, other psychological disorders, substance abuse - *Sleep disorders,* e.g.,: Obstructive sleep apnoea (OSA), insomnia, snoring, restless legs syndrome, narcolepsy ***Pain interference measures*** - Pain level, e.g., Visual Analogue scale (VAS) - Pain behaviors	**Cognitive behavioral therapy (CBT), e.g.:** - Thought management - Relaxation - Problem solving - Pain management **Counseling** **Meditation** **Sleep interventions, e.g.:** - Sleep hygiene - CBT - Sleep restriction therapy (insomnia) **Pharmacotherapy** **Healthy lifestyle interventions to improve sleep:** - Physical activity and exercise	**Education and advice** e.g., the benefits of managing mood and sleep, and the interactive effects these domains have on the experience of pain and osteoarthritis. **Independent mood and sleep management strategies** - Meditation, - Visualization - Breathing and relaxation techniques - Educational materials (e.g., books, booklets, videos, websites, phone applications). **Self-monitoring progress** using a diary and journaling	**Referrals to:** - GP - Specialists' doctors - Clinical Psychologist - Psychiatrist - Social worker - Mental health service - Hospital - Social networks **Consider:** **Cognitive behavioral therapy (CBT):** Face-to-face or internet delivered for: - Mood (anxiety, depression) - Insomnia, sleep and fatigue. - Pain coping

	- Influence of mood, thoughts and sleep on pain presentation - Musculoskeletal assessment (i.e., allodynia, areas of pain) ***Subjective history*** - Pain catastrophizing, - Fear of movement - Low self-efficacy. - Social support, risk of isolation - Poor sleep quality or fatigue			
	Activities of daily living			
	Difficulties with activities of daily living (ADLs) and personal care. e.g., difficulty with: - Raising from chair - Bending to the floor - Getting in and out of the car - Putting on socks/shoes - Rising from the bed - Taking off socks/shoes - Getting in/off toilet - Light domestic duties - Showering - Getting dressed - Cooking - Gardening ***Focal muscle weakness*** ***Pain interference*** - Visual Analogue scale (VAS) - Pain behaviors - Musculoskeletal assessment ***PROMs for pain, function and health-related quality-of-life.*** e.g.,: - KOOS/HOOS ADL subscale.[31] (Fig. 10.8) - Oxford knee[32]/hip[33] score ***Functional performance tests***[34] e.g., Timed-up-and-go, 40 m fast paced walk test, 30 s sit stand test. ***Falls*** - TUG >13.75s = high risk of falls, - Joint instability/giving-way or collapse ***Comorbidity management***	**Physical activity and exercise** **Falls education and balance exercises** **Pain science education** **CBT** **Home assessment for home modifications, education and equipment provision** *Assistive devices and equipment* e.g.,: - Over toilet seat/chair - Shower stool - Extended reacher - Shoehorn - Sock slider - Installation of rails/ramps or lifts - Kitchen & cooking aids **Walking aids, frames and gait training** **Orthotic devices** e.g., Foot orthoses (FO), knee or hip braces **Personal Alarms** (e.g., Vita call) ***Medication review***	Education, lifestyle modification advice, pacing and energy conservation strategies Educational materials (booklets, videos, websites, phone applications). Purchasing appropriate equipment, assistive devices, footwear and aids. Home exercise program	**Referrals to:** - GP - Specialists such as a Geriatrician - Endocrinologist - Rheumatologist - Occupational therapist (OT) - OT Home visit - Exercise physiologist - Physiotherapist - Social worker - Orthotist/Podiatrist - Pharmacist - Registered nurse - Pain specialists - Pain management program/ MDT clinics **Consider:** - Group exercise classes - Community groups and social networks, e.g., walking groups, social clubs, friends - Community services. e.g., transport, cleaners & meal deliveries - Nongovernment organizations - Government support i.e., Aged care services

Continued

TABLE 10.2 Complex osteoarthritis care and clinical reasoning considerations. This table provides considerations and suggestions of how to support comprehensive osteoarthritis management and care coordination. The table is best interpreted reading left to right noting relevant considerations per patient presentation, different treatment options, and referral pathways, which should be discussed and reviewed with the patient.—cont'd

Person-centered care considerations	Clinical assessment	Treatment domain	Independent self-management options	Pathways for supported care
	- Musculoskeletal conditions (low back pain) or chronic pain, - Cardiovascular conditions, Metabolic Syndrome (obesity, diabetes and CVD), - Depression respiratory conditions, e.g., obstructive sleep apnoea, asthma			
	Social support			
	Subjective history: - Home alone with coping issues - Relationship grievances - Social supports - Isolation - Cognitive difficulties - Financial difficulties - Services (government vs. private) - Carer responsibilities - Access to support services (e.g., transport/parking, financial) ***Person reported outcome measures for psychological health.*** e.g., ***Quick screening tools***: - Patient health Questionnaire-2 (PHQ-2)[25] - PROMIS29 domains for anxiety and depression[26] ***Detailed Screening tools:*** - Depression anxiety Stress scale 21 (DASS-21)[27] - The patient health Questionnaire-9 (PHQ-9)[25]	**Counseling** **Cognitive behavioral strategies (CBT)** **Community services** available (private or government subsidized) **Recreational services** **Faith, religious and community groups** **Volunteering**	Education, advice and provision of support Educational resources (booklets, videos, websites, phone applications). Independent coping strategies I.e. talking to a friend, participating in enjoyable activities (music/arts/dance), gardening, meditation and relaxation etc …	**Referrals to:** - GP - Specialists doctors - Clinical Psychologist - Psychiatrist - Social worker - Mental health services **Consider:** - Social networks - Support groups - Community organizations - Recreational associations - Government organizations - Indigenous services, e.g., Aboriginal Liaison services - Nongovernment organizations - Internet delivered services e.g., CBT programs

ADL, Activities of Daily Living, *CVD*, cardiovascular disease, *KOOS*, Knee Osteoarthritis Outcome Score, *PROMs*, Patient-Reported Outcome Measures, *TUG*, timed up and go, *WHO*, World Health Organization.

Case study:—cont'd
Katrina with suggestions for evidence-based iCBT courses. Katrina and Stephen agreed they would continue to evaluate Katrina's mood at future seasons and monitor how she was managing.

Delivering and coordinating osteoarthritis care

Comprehensive management of people presenting with osteoarthritis and related comorbidities can be challenging to manage and coordinate in a clinical setting. As a complex and chronic condition, the clinician may be required to facilitate conflicting patient priorities and needs and often at multiple time points. For clinicians new to osteoarthritis management, we consider the essential steps to delivering care within four phases, which are illustrated in Fig. 10.6. The four phases of care delivery are:

i. Education and understanding,
ii. Planning and goal setting,

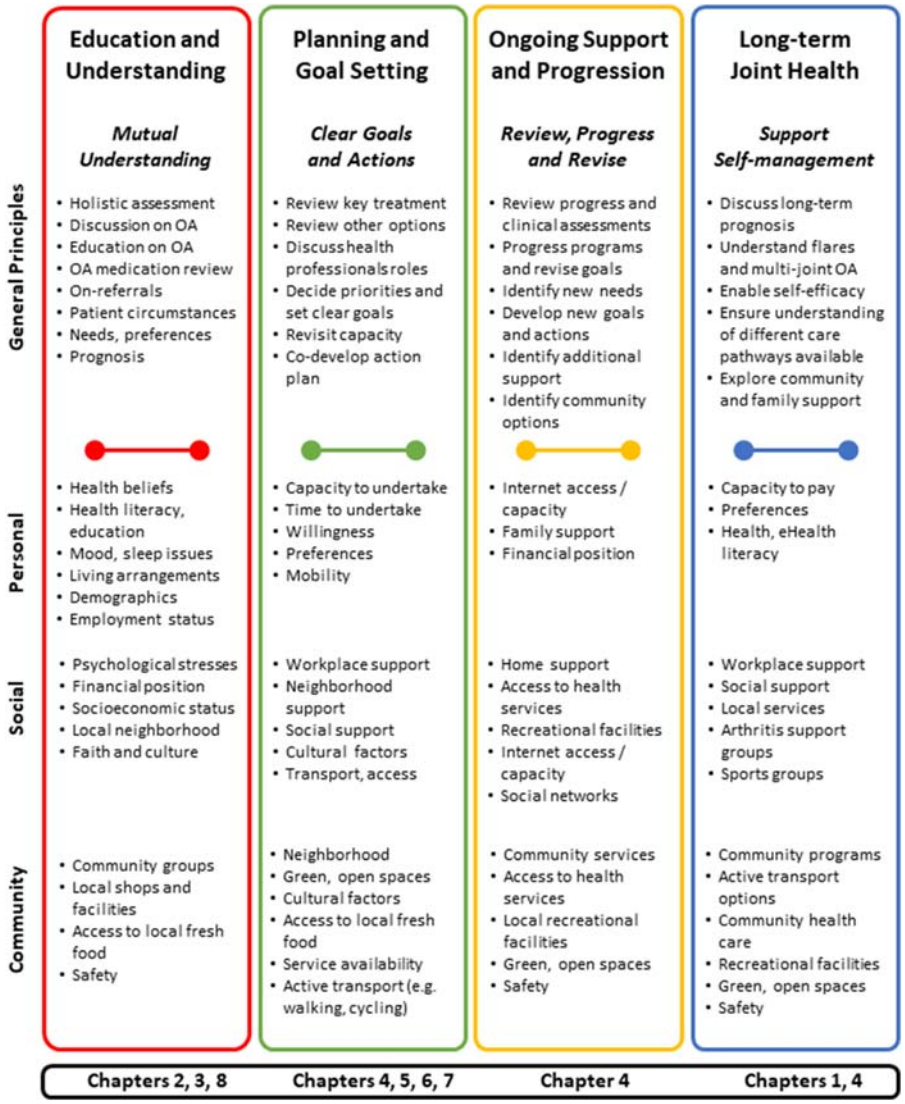

FIGURE 10.6 Essential components of delivering and coordinating osteoarthritis care. This figure shows four phases of delivering and managing osteoarthritis care. Within each phase, we have outlined the general principles of care, as well as other personal, social, and community factors that could be considered to ensure care is provided within a broader context. The different components of care delivery may not necessarily fit neatly into each phase but may need to be modified to suit the circumstances.

iii. Ongoing support and treatment progression, and
iv. Supporting long-term joint health.

It is important to remember the different components of care delivery may not necessarily fit neatly into each phase—rather they may be overlapping, split, or occur at multiple time points. The process may also need to be modified to suit your clinical and organizational circumstances.

Phase i. Education and understanding

This first phase is an introductory dialogue between the health professional and the person seeking care, which aims to develop a mutual understanding of the issues being experienced and the potential options for care. Recommended actions and considerations that should be undertaken in this phase include:

Person-centered care considerations

- Discussions around personal preferences and priorities for care, readiness for change, psychological well-being, physical limitations, musculoskeletal pain, and knowledge of their condition. Social determinants of health, such as health literacy, socioeconomic factors, geography, access to care, and sociocultural factors should also be discussed. Table 10.2 and Table 10.4 outline the breadth of social determinant factors that may be relevant to providing care.

Clinical assessments

- Holistic assessment: an assessment of the person seeking care and their related comorbidities should be undertaken using a biopsychosocial approach. Assessments may include person-reported outcome measures, objective measures, and functional performance tests. Table 10.2 provides examples of clinical assessment measures that could be used.
- Education: Ensure provision of comprehensive osteoarthritis education that addresses misinformation and fears around osteoarthritis and lifestyle modification advice. Provision of resources in a variety of formats (i.e., written, visual, auditory, and/or electronic based) can be provided for the person to review and navigate independently, in their own time.
- Prognosis: It is important that the person seeking care receives education about their prognosis for osteoarthritis. This allows an opportunity to discuss their risk factors, clinical presentation, and address any misinformation or myths that a joint replacement for osteoarthritis is inevitable. These topics have been discussed in detail in Chapter 9.

Clinical practice point: Successful care is dependent upon professionals' skilfulness in listening "in a different way" to patients, confirming, documenting, and repeatedly acknowledging the person's narrative. Seeing the patient as a person who is active and a capable or equal partner has been cited as a common facilitator to improving care.

Phase ii. Planning and goal setting

The second phase is a mutual care planning discussion, leading to setting of clear goals and development of management plans, and mutually agreed actions (Chapters 1 and 4). This phase is iterative and continual and may occur at several times in a person's care pathway. Recommended actions for this phase include:

Treatment domains

- Discussions around the evidence-based treatment options available. These may include increasing physical activity and exercise, improved nutrition, weight management, mood, medication management, and sleep. Discussions around support for activities of daily living or social support may also occur.
- Take a shared decision-making approach when discussing and prioritizing treatment options. All patients should be offered the core treatments (where applicable) and supplemented with other options if and when appropriate. Discussions around a "Menu of Osteoarthritis Care Options" is often a good way to engage with patients in the decision-making process. An example Menu of Care Options is shown in Fig. 10.7.

FIGURE 10.7 The menu of osteoarthritis care options. There are many ways to help improve osteoarthritis symptoms and to support people to manage them. A menu of care options, like the example here, may help you discuss these options with your patients, and choose one or two priorities to work on. For example, you may ask your patient to tick the categories they would most like to work on.

Independent self-management options

- Codevelop an osteoarthritis self-management plan, where the patients feel motivated and confident to implement the treatment strategies independently, and it meets their needs, personalized goals, and individual circumstances.

Phase iii. Ongoing support and treatment progression

Osteoarthritis care is an ongoing process. This phase provides ongoing support and treatment progression for the person seeking care. This may involve progression of programs (e.g., strengthening, physical activity) or revision of care plans and actions to meet new goals and priorities. The planning and goal setting activities outlined in phase ii may need to be repeated at multiple time points, depending on the complexity and needs of the person.

As a health professional, actions in this phase may require referrals to support care or represent a shift to less supported therapies (e.g., online programs, self-managed programs). To facilitate this transition, it is valuable to develop knowledge of what local services are available, and how these services can be accessed. Tips for developing these networks are presented in Box 10.2.

Phase iv. Long-term joint health

Ultimately, the aim of health professionals is to support people with osteoarthritis to develop their self-efficacy to manage their condition. This does not mean the patient is totally self-reliant, but instead it ensures the patient understands when, where, and how to seek additional help if required. This may require the clinicians to have a discussion with the person around:

- how comorbidities and any associated management strategies may impact on their joint health,

BOX 10.2 Establishing local networks

Establish pathways for supported care

- Establish strong relationships with health professionals and create referral pathways to improve access of people to appropriate health professionals, services, and support holistic management. Strategies for the clinician may involve creating a directory of local services, referral pathways for different comorbidities and optimizing use of government subsidies and/or private health insurance as appropriate.
- Referrals can be made through interprofessional care coordination if you are fortunate to practice within a discrete osteoarthritis management program, or through multidisciplinary referral pathways, or a combination of both depending on the needs and goals of your patient.
- Where there are no formal arrangements to support interprofessional teams, health services and organizations can still utilize interprofessional collaborative practice principles by utilizing local health professionals and services. They may also adopt newer virtual care delivery systems, also known as online services, telehealth or e-health services.
- It may also be useful to develop local pathways for timely orthopedic review and surgical escalation, if needed.

Establish pathways for less-supported care

- Establish strong relationships with other community, government, or industry-based services and create pathways for less-supported care. For example, people seeking care can be referred to local gyms or sporting/recreational clubs, pilates/yoga/Tai Chi groups, or walking groups. A list of evidence-based online programs for people may also be an option for people with mild symptoms or lack of time to see healthcare professionals.

- understanding osteoarthritis flare management, changing symptoms over time, and when to seek care,
- education about local osteoarthritis resources and services they could utilize, and
- understand how family and social networks can support, or hinder, their self-management.

At this point it is important the health professional gauges a persons' self-efficacy and be able to transfer required knowledge, in a way suited to the person's level of health literacy. Development of a discharge planning check list to ensure the patient is confident with their personalized management plan and self-management strategies can help with this process.

Clinical Practice Points: Tools and resources to support complex osteoarthritis care

There are many tools and resources that can be considered to support care for people with complex osteoarthritis needs. Tables 10.2 and 10.3 provide examples of different situations, care options, tools, resources, and services that could be considered as part of a care pathway. We have provided examples of how these may work when delivered through an interdisciplinary team (Fig. 10.3) or through primary care, as managed by a GP (Fig. 10.4).

Table 10.2 is designed to highlight the variable nature and complexities of different patient presentations that you are likely to see in a clinical setting and emphasizes the need for a personalized approach. The table is best interpreted reading left to right noting relevant considerations per patient presentation, different treatment options and referral pathways, which should be discussed and reviewed with the patient.

Table 10.3 provides an example of a patient-centered consultation that could be undertaken with a person presenting with osteoarthritis. The table also provides suggestions for discussion points taken from behavior change theory to help empower your patient to self-manage their condition.

The tables are not designed to replace clinical reasoning nor the value of good communication and health coaching skills such as problem-solving with your patients to achieve their goals. There may be several areas of concerns and clinical indicators identified; however, it may only be clinically appropriate to address one or more areas that are important to your patient using a menu of care options to create person-centered goals and an osteoarthritis management plan. It should also be noted that not all osteoarthritis recommendations can be implemented in a linear approach and the person's priorities may change over time, so careful review and evaluation of the osteoarthritis management plan are crucial to support long-term care.

TABLE 10.3 An example of how to undertake an initial patient-centered consultation. This table provides the key points to consider when undertaking the first phases of a person-centered consultation (see Fig. 10.6 – phases i and ii). The right-hand column also provides examples of how to introduce and discuss the different components with the patient, using the principles of behavior change.

Stage	Key points	Example wording using behavior change principles
Phase i Education and understanding	Set the scene • greet the person, give your name and program name. • remind the person of the service aims. • explain your role, who you are, and what you can do for them	• "the aim of this program is to help you understand what is going on in your knee". • "I can give you some recommendations on what you can do to improve your symptoms and function, so that you can have the best possible outcome and continue to do the activities most important to you". • "It's my job to support you to achieve the best outcomes and address any questions you may have about your conditions or how to optimise your health". • "I will highlight the important things you are currently doing to manage your osteoarthritis. There might be other areas we can review and address that will further support your care".
	Clarify the person's role and expectations of the program, and define success	• "your role is to be honest with me about your expectations and concerns, and to ask me any questions you might have." • "It's very helpful if you let me know what you are having a hard time doing, and if there any goals you would like to achieve and what you are willing/not willing to do." • "being honest and transparent about your preferences will help me to trouble shoot the best options available to you."
	Check the person's understanding of their osteoarthritis: • knowledge and understanding of clinical issues. • health literacy points • knowledge and understanding of why these issues may be a potential problem for them • what could they do to minimize the impact of osteoarthritis on their life?	• "have you received or read any information about osteoarthritis?" • "what is your understanding of osteoarthritis and what is happening to your knee/hip/hand?" • "Do you have any questions about what osteoarthritis is or how it develops?" • "Do you know the common risk factors for osteoarthritis?" • "what do you remember about what your GP or health professional explained about osteoarthritis? What advice or recommendations did they give you about how to manage your osteoarthritis?" • "what is your understanding of this diagnosis of osteoarthritis?" • "what does this diagnosis mean for you? How it might impact on your life over time?" • "what are you currently doing to manage your knee symptoms? What have you previously tried in the past?"
	Discuss any critical information relevant to the discussion and tactfully address any misinformation or misunderstandings.	• "do you know the common prognosis for people who have hip/knee osteoarthritis?" • "do you know what you can do to improve your pain and function?" • "do you know what treatments are available to help you manage osteoarthritis?"
Undertake a holistic assessment		

Continued

TABLE 10.3 An example of how to undertake an initial patient-centered consultation. This table provides the key points to consider when undertaking the first phases of a person-centered consultation (see Fig. 10.6 – phases i and ii). The right-hand column also provides examples of how to introduce and discuss the different components with the patient, using the principles of behavior change.—cont'd

Stage	Key points	Example wording using behavior change principles
Phase ii Planning and goal setting	Go through the possible treatments - using the menu of care options (see Fig. 10.7): • briefly outline the rationale for each self-management category • ensure patient knowledge and understanding • assess/acknowledge current actions and fill in gaps or answer questions • establish why acting on these recommendations might be beneficial	• "this is a menu of care options. It outlines the possible treatments you could undertake to help support the management of osteoarthritis." • "you have mentioned a number of these topics. Do you know which treatments have the greatest effect on knee symptoms?" • "if you were able to act in each of these main areas over time, how do you think that might impact on you and the things that are important to you?"
	Prioritize and choose areas to work on with the patient • collaboratively prioritize broad program categories (e.g., weight-management) • prevent the patient from becoming overwhelmed • reinforce the notion of steady and sustainable progress versus 'all or nothing', action attempts.	• "the aim for today is to establish what you are already doing to manage your knee symptoms and to prioritize what else you could do." • "We'll discuss how you can set these priorities in a way you can manage, to get the best health outcomes for you." • "there are lots of options here. We know that it would be difficult for you to do all of these at once. We'll discuss a couple of options that you would be happy to focus on."
	Determine priority goals and actions • provide evidence-based knowledge and clinical opinion to help the patient decide a course of action (if appropriate) • reinforce that the choice is ultimately the patient's	• "there are clear evidence-based guidelines on what is recommended to manage osteoarthritis and the most important areas to focus on first, is this something that you would be prepared to discuss?" • "based on your clinical consultation, I would recommend [insert recommendations] as a priority, because [explain rationale]. But ultimately, it is up to you what you would like to do, and if you'd like to proceed." • "what are your thoughts about that? Does this sound achievable?"
	Develop a self-management plan • summarize priorities and clarify tasks to be undertaken • document readiness and priority decisions in a management plan.	• "what activities do you think you would get the most benefit from working on?" • "how would you like to prioritize the broad areas that we discussed? It's okay to have the same priority for more than one broad area." • "are there any areas here that you are not willing to address today?"
	Check the person's confidence and willingness to proceed, and provide reassurance and support.	• "before we go on, how confident do you feel overall about acting on these recommendations to improve your osteoarthritis management and health?" • "I am here to support you and trouble shoot any challenges to achieve your goals. • "remember that you don't need to attempt everything all at once." • "It's far more likely that you will succeed in creating new health habits if you do things a little bit at a time in a manageable way that doesn't push you too far out of your comfort zone."

Thinking beyond health care—integrating care into everyday life

What are social determinants of health?

For both the person with osteoarthritis and health professionals, there is often a lack of understanding of how to incorporate osteoarthritis care into people's lives, especially behavioral and lifestyle changes (Chapters 4, 5 and 6). Deciding on a particular course of action may not be feasible if the patient does not have the time, funds, support, or health literacy to undertake it. Similarly, limited access to allied health services or support services, often due to geographical location or socioeconomic factors, is a major barrier to care.[35] Consequently, incorporating infeasible or inappropriate actions into the management plan can result in frustration and poor adherence to the treatment.[36]

To address this challenge, there are other factors that should be considered when codeveloping goals and management plans with patients. For example, how and where people live have a greater impact on their health than the quality of their medical care.[37] Many of these factors, also known as the social determinants of health, arise from people's interaction with nonhealth sectors such as education, work, social relationships, and the built or natural environment.[38] These factors can be considered both in terms of how people live[39] and also the settings and places they use in daily life.[40] Table 10.4 provides a brief overview of social determinant factors that should be considered when discussing and planning care. Appropriate consideration of patient's individual circumstances early in the care delivery process is essential to the patient-centered approach to care and as it enables appropriate management strategies to be identified and implemented early.[38,41,42] Addressing the negative influences of social determinants is also essential to ensuring equality in care delivery.[43]

Strategies to address different social determinant considerations in osteoarthritis care are seldom addressed in clinical guidelines or covered in health professional training and education.[44] Greater consideration of psychosocial factors (e.g., social considerations, mood) is becoming more widely recognized as essential component of care (e.g.,[45]); however, most social determinant considerations are poorly integrated into care pathways.[46] This topic would fill a textbook on its own; however, we have introduced some of the major concepts below. Tables 10.2 and 10.3 provide further examples of how to incorporate social determinant considerations into osteoarthritis care pathways, and Fig. 10.6 illustrates where social determinant factors could be considered in the different phases of care delivery. Further reading on this topic can be found in Ref.[42,47–49]

Concepts underpinning social determinant considerations for osteoarthritis care

Social gradient in health: People in lower socioeconomic positions experience worse health regardless of the economic wealth of the country.[50] This is known as the social gradient in health and is also relevant to people with osteoarthritis.[46,51,52] Vulnerable populations, people with lower education or poor health literacy, who are unemployed or on a low income, have no life partner, or poor mental health are at higher risk for developing osteoarthritis and multimorbidity than

TABLE 10.4 Social determinants. Examples of social determinants of health, context, and settings.

Social determinant	Contextual considerations relevant to the social determinant[39]	Examples of settings and places[40]
Individual and socioeconomic	Income, education, occupation, social class, sex/gender, race/ethnicity, health literacy	Workplaces, home, healthcare, educational
Material circumstances	Living and working environment, food availability	Workplaces, neighborhoods,
Behavioral and biological contexts	Lifestyle factors (e.g., diet, exercise)	Green spaces, sports facilities, neighborhoods, online
Social-environmental and psychosocial factors	Psychosocial stressors, lack of social support, stressful living conditions, coping styles	Home, workplaces, online settings, virtual clinics
Social cohesion	Social relationships, social support	Faith and religious settings, community facilities, sporting organizations
Socio-economic and political contexts	Public, social and economic policies; governance; cultural and societal values; epidemiological conditions	Healthy cities, health services, community-based organizations

From Bowden et al. Realizing health and wellbeing outcomes for people with osteoarthritis beyond service delivery. *Clin Geriat Med* 2022; 38(2):433-48 with permission.

people without the condition.[53,54] A lower socioeconomic position has been linked to poor access to rehabilitation services, lower healthcare utilization, and lower rates of receiving recommended care.[55,56]

Culturally and linguistically diverse populations: Cultural and linguistically diverse populations are also a major consideration for health professionals in many countries. Often people who are from culturally or linguistically diverse backgrounds, especially new arrivals to a country, also have lower socioeconomic positions and poor health literacy. Further, health services are not always designed to meet their needs. Importantly, many high-income countries, including Australia, New Zealand, Canada, and the United States, have vulnerable first-nations populations reporting a high prevalence of osteoarthritis,[57] and a huge burden of other chronic conditions such as cardiovascular disease and diabetes.[58] Many of these people also live in rural and remote areas, with poor health service provision, and traditionally, little government support.[58] Internationally there are increasing calls for services that can be adapted to different cultural contexts and delivered with sensitivity to their diversity of needs.[59–61] Interpreter services and provision of information in different languages is one step to improving care and health literacy in these populations. Other strategies suggested include providing peer assistance programs, cultural or religion specific activities, and additional assistance to navigate the health system.[52,59,62] Codesign and codelivery of osteoarthritis programs and services with the local communities that use them are also essential.[63]

Health Literacy and eHealth: Low health literacy and poor digital health are essential considerations to achieving good outcomes from osteoarthritis care[64] (Box 10.3). Having low or marginal health literacy not only affects the daily management of people with osteoarthritis but diminishes efforts to prevent health problems from developing or progressing. Addressing low health literacy is hence currently viewed as a highly important public health issue and a key factor in health promotion efforts to attain a healthier society, in general, as well as a healthier outcome for all, even in the face of one or more disabilities.[65] People with lower self-reported health literacy are reportedly less receptive to health education and less likely to use disease prevention services or successfully manage their chronic conditions.[66] This population was also less likely to use search engines to find information online, but more likely to get health information from social networking sites or use a health-related apps.[67] Various strategies have been suggested to address low health literacy and make health information accessible, useful, and understandable to the entire population.[67] These include the use of visual aids and the elimination of jargon.[67] The inclusion of digital options into health care, such as social media and health websites, may also enhance engagement with different treatment options.[68] However, efforts need to be made to ensure the online platform is intuitive and accessible, adapted to meet local needs, and regularly updated.[68]

Occupational and work considerations*:* Occupation and work considerations relate to many osteoarthritis outcomes and should be explored. There is growing evidence that occupational exposures are associated with the development and progression of osteoarthritis,[41,70–72] and in some instances can be linked to increased all-cause mortality, depression, anxiety, and poor-quality sleep.[71] In addition to the type of work, support from the workplace is also an important consideration. In high-income countries, lack of support and work flexibility from employers and work colleagues has been highlighted as a barrier to care by people with osteoarthritis.[73] Lack of support may lead to changes in employment,[48] and is cited as a major reason to being unemployed, or taking early retirement.[74,75] This is particularly problematic for younger people who want or need to work.[48] Workplace support for osteoarthritis may be more challenging in low- and middle-income countries,[51] therefore discussions on ways to manage the situation may be warranted.

Socioenvironmental and social cohesion considerations: Socioenvironmental and social cohesion are major considerations for planning and delivering care. Family, social, and community participation are often negatively impacted by osteoarthritis, resulting in decreased independence and lower quality of life.[48,53,54,60] Limited social participation, social isolation, and loneliness can also be a significant social consequence of having osteoarthritis and have been linked to worse

BOX 10.3 Health and e-Health literacy

Health literacy: the personal, cognitive, and social skills needed for individuals to gain access to, understand, and use information in ways that promote and maintain good health.[64] It also covers the ability to successfully negotiate the health environment. This poses a challenge to many older adults, especially if they manage one or more complex chronic health conditions.

eHealth or digital health literacy: is closely related to health literacy but specifically concerns the use of digital technology for managing health, namely "the ability to seek, find, understand, and appraise health information from electronic sources and to apply the knowledge gained to addressing or solving a health problem."[69]

mental and physical health[76] Strategies to improve identification and use of local social and community networks and strengthen existing personal relationships should be undertaken for people at risk of poor social outcomes.[77]

Built environments and local neighborhoods: There are strong connections between the built environment, social determinants, and osteoarthritis outcomes. The "built environment" comprises all spaces where people live, work, and socialize, and the way people move between those spaces.[78] It includes all elements of spaces that are modified by humans, including streets, houses, commercial spaces, green and open spaces, and similar.[42] Opportunities to use local neighborhoods to enhance osteoarthritis care should be explored during the initial planning and goal setting phase. Examples may include opportunities for increasing physical activity such as recreational walking or active transport (e.g., walking or cycling to work). Getting people out and about in their neighborhoods can also facilitate greater social interactions, which is important for fostering mental health resilience and preventing loneliness.[49]

Case study:

Stephen completed an initial consultation with Katrina using a biopsychosocial approach. After reviewing Table 10.2, Stephen noted the following considerations for care:

Person-Centered Considerations: expectations "surgery is inevitable," previous treatment "failed physiotherapy when she was younger," poor psychological well-being, access is limited due to physical limitations (exercise tolerance = 100m and difficulty with stairs). Requirements for close parking spaces and rest breaks.

Clinical assessments (per domain):

1. Physical Activity and Exercise: Person-Reported Outcome Measures scored low on the Knee Injury and Osteoarthritis Outcome Score (KOOS)[31] (0 = worst 100 = best). Suboptimal physical activity according to WHO physical activity guidelines, muscle weakness (quadriceps and gluteal muscles), scored low on functional performance tests (40MWT = 45sec, TUG = 11.3sec), and she presented with pain interference (VAS 7/10 and allodynia on musculoskeletal assessment).
2. Nutrition and weight management: BMI 33 kg/m^2, waist circumference 108 cm, reported behavioral eating. Does not meet nutritional requirements.
3. Mood and sleep: Person-Reported Outcome Measures, scored high on the DASS21[27] for depression, comorbidities (above a healthy weight, depression and sleep apnoea using CPAP machine), fear of movement, low self-efficacy, poor sleep quality (waking up not refreshed and complaining of fatigue).
4. Activities of Daily Living (see Fig. 10.8): Difficulty with stairs and standing from a chair, Person-Reported Outcome Measures on KOOS as above (refer to KOOS ADL subscale), muscle weakness, pain interference, functional performance tests as above.

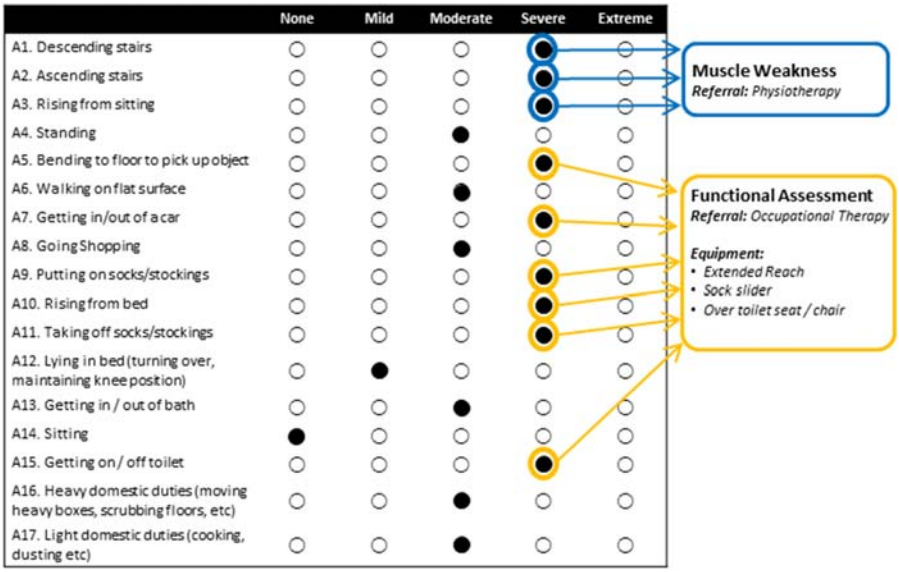

FIGURE 10.8 Using the Knee Injury and Osteoarthritis Outcome Score (KOOS) – Activities of Daily Living (ADL) subscale to inform clinical reasoning. Katrina completed the KOOS questionnaire.[31] This figure shows a snapshot of one of the five domains covered in the KOOS and how the raw scores could be used in a clinical setting. Stephen used the raw scores from the KOOS ADL subscale to help inform his clinical decision-making, based on Katrina's functional problems. From these scores, Stephen suggested to Katrina she would benefit from undertaking some muscle strengthening as part of her physiotherapy program. Stephen also suggested to Katrina that an Occupational Therapist could discuss different exercises and equipment options that could help her improve her everyday activities. The KOOS ADL subscale question is "What difficulty have you experienced in your knee in the last week?"

Pathways of care and adapting them to suit different settings

As emphasized previously, all osteoarthritis care pathways should ideally incorporate the key evidence-based treatments, tailored to the needs of the individual. Care delivery should provide support for people with complex presentations, enable interprofessional or multidisciplinary input when required, and be delivered consistently between the different health professionals delivering care. Additional services that provide lifestyle support or other assistance to enable self-management and long-term behavioral changes are also essential. However, delivery of this care in the real world requires a pragmatic approach. So, while the care delivery should be similar in "what" is delivered, "how" the care is delivered can be adapted to the size and organizational structure of the clinical environment. In this section, we will introduce examples of existing pathways of care and discuss considerations for adapting them to different care settings.

Osteoarthritis Management Programs: An osteoarthritis management program (OAMP) is an evidence-based, person-centered osteoarthritis care program, designed to deliver interprofessional care. They can take many forms; however, the significant traits of an OAMP[79] are a tailored care program provided as a package of care with longitudinal reassessment and progression; and that comprises two or more of the key recommended components of care as standard, namely education for self-management, exercise and physical activity, and weight loss (Fig. 10.9). An OAMP should also have a range of options for evidence-based adjunctive treatments as required. A strength of the OAMP is the ability to deliver the tailored, interprofessional care needed for OA, while adapting to different patient volumes.[80] However, these interprofessional programs can be staff and resource-intensive to run and may require significant support from the government, insurance companies, or the local health services. The Australian Osteoarthritis Chronic Care Program,[14] the Joint Implementation for Guidelines for Osteoarthritis in Western Europe (JIGSAW-E),[81] and the Joint Health Program[82] in the United States are examples.

Clinic-based programs: There are several care pathways led by specific health professionals, often through private clinics or individual hospital outpatient departments. The Good Life with Osteoarthritis: Denmark (GLA:D,

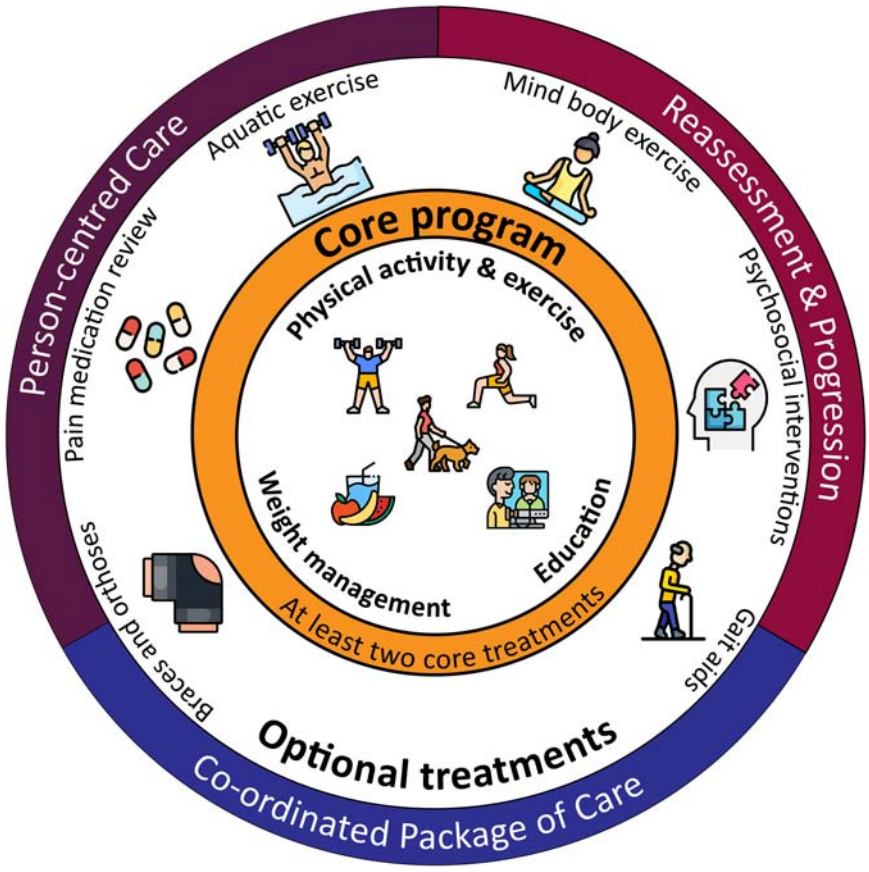

FIGURE 10.9 Osteoarthritis management programs: An osteoarthritis management program, also known as an OAMP, is an evidence-based, person-centered osteoarthritis care program, designed to deliver interprofessional care. An OAMP is defined as a tailored package of care, delivered with longitudinal reassessment and progression; and that offers at least two of the key recommended components of care as standard (e.g., education for self-management, exercise and physical activity, and weight loss). The OAMP may also provide additional options for adjunctive therapies participants can undertake in addition to the core treatments. *From Kobayashi et al. A Framework to Guide the Development of Health Care Professional Education and Training in Best Evidence Osteoarthritis Care. Geriatr Med 2022;38(2), 361–384, with permission.*

international),[83] Better Management of Patients with Osteoarthritis (BOA), and the Active with Osteoarthritis (AktivA) programs, for example, are physiotherapy-led programs offering a range of education and exercise and physical activity. They do not routinely refer for orthoses, weight management, or pharmacologic treatment or joint replacement surgery. Many of these programs provide training courses for clinician's interested in osteoarthritis management. Another example is the UK ESCAPE-pain program,[84] a group rehabilitation program for people with chronic knee and hip pain.

Online programs: There is a rise in the availability of online care options for osteoarthritis. These may be useful for clinicians who work individually, in small or less resourced settings, or for patients who prefer an online option. Join2-move[85] from the Netherlands provides eight modules dedicated to osteoarthritis education, improving physical activity and decreasing pain with structured goal setting. The ESCAPE-pain and BOA (i.e., *Joint Academy*[86]) programs also have associated eHealth delivery option.

Enhancing osteoarthritis care in lower-resourced settings

Health professionals who work in lower-resourced settings, such as those in low- and middle-income countries or in rural and remote area clinics, may not have easy access to other health professionals or services to help deliver care.[87] They are also likely to be in primary care, and osteoarthritis is not their primary scope of practice. Consequently, they may face greater barriers to delivering care than those working in high-resourced settings. Fig. 10.10 provides examples of barriers to delivering care that have been identified by clinicians working in lower-resourced settings. The following section introduces strategies that can be used to enhance care and encourage interprofessional or multidisciplinary care in these settings.[87].

Upskill local health professionals through high-quality, evidence-based education and training: Provision of high-quality education and training for health professionals responsible for treating osteoarthritis in these settings is essential to improving the delivery of care.[88] Providing education and training on how to diagnose, monitor, and manage osteoarthritis can empower and enable primary health professionals in these lower-resourced settings to provide the key evidenced-based treatments. It can also help primary healthcare professionals understand when to refer patients to specialists or allied health.

In some circumstances, it may be necessary for a single clinician to deliver "multidisciplinary" osteoarthritis care due to a lack of other services or health professionals to refer to. This can be common in underresourced or rural and remote areas. Experienced health professionals may be able to take on an "extended scope of practice" by upskilling in professional activities outside their traditional roles. For example, nurse practitioners working in remote settings may be the sole health professional available and would need to support care for a wide range of conditions.

Embrace remotely delivered services and technology: There may not be a local health professional who can deliver the care or intervention required. However, health professionals or their patients may be able access this care remotely. Harnessing eHealth technologies can be an effective and sustainable way to implement interprofessional models of care.[89] It is also important to acknowledge infrastructure barriers that exist in lower-resourced settings such as high-speed internet and costs for data, which are essential in eHealth-based interprofessional models of care.

Leverage existing chronic disease management services available: In some settings, chronic disease management services for other conditions such as diabetes and cardiovascular disease may already exist. These services often have an established multidisciplinary team of primary health professionals, with expertise in many of the comorbidities common to osteoarthritis.

Accessing existing resources for patient and healthcare professional education: There are many educational resources for patients and health professionals freely available online or by contacting the relevant organization (Chapter 4). It is important to note that patient education is most effective when combined with exercise therapy.[90]

Incorporating evidence-based care into your clinical practice

Current evidence-based care includes lifestyle, psychosocial, mind-body, pharmacologic, and surgical modalities targeted at relieving pain, improving joint function, improving daily functioning, societal participation, and modifying risk factors for osteoarthritis progression. Not only is it an ethical responsibility to provide the best care but working to the principles of evidence-based care improves practice by managing osteoarthritis based on the latest research. However, evidence-based care is continually changing and evolving as new research evidence comes to light. Identifying and implementing scientific evidence can be challenging for health professionals, particularly those who work alone, do not have easy access to

FIGURE 10.10 Barriers to delivering care in lower-resourced settings: Clinician's working in lower-resourced settings such as rural and remote practices or low- and middle-income countries may face greater barriers to care than those working in higher-resourced settings. The figure below shows examples of these barriers, but many others may exist in your clinical setting. *From Eyles et al. Implementation of best-evidence osteoarthritis care: perspectives on challenges for, and opportunities from, low and middle-income countries. Front. Rehabil. Sci. 2022;2, with permission.Copyright © 2022 Eyles, Sharma, Telles, Namane, Hunter and Bowden.*

research content, or those who do not have experience in research methodology. This section will discuss how you can remain informed of changes to the current recommended evidence-based osteoarthritis treatments and incorporate them into your clinical practice.

To understand how evidence-based care can help to improve practice, two basic principles are important:

1. recognition that scientific evidence alone is insufficient to guide decision-making (Box 10.4) and;
2. a hierarchy of evidence exists to help guide your decisions of available sources of information.

BOX 10.4 Evidence-based care in osteoarthritis

Evidence-based care in osteoarthritis can be defined as "a formalized process of care where osteoarthritis is managed in the best way".[91,92] This can involve an amalgamation of:

- healthcare professionals identifying, searching for, and interpreting the results of best scientific evidence; and
- using their clinical expertise and experience to make decisions on care; and
- considering patient's preferences and values, as well as the context within which the decisions are being made.

Using the evidence pyramid (levels of evidence) in evidence-based care

In research, there are seven levels of evidence, which can guide decision-making for anyone who needs to identify the best scientific evidence to inform management and care. This is often presented as an evidence pyramid or table, with the research with the strongest quality and evidence at the top, and those of lesser strength at the bottom[93,94] (see Fig. 10.11). Health professionals managing people with osteoarthritis should aspire to use the types of evidence at the peak of the pyramid, namely clinical practice guidelines, meta-analyses and systematic reviews, and high-quality randomized controlled trials.

It is up to the health professional to use the Evidence Pyramid to determine whether studies are of high quality. In accordance with the principles of evidence-based care, management of an individual osteoarthritis patient cannot be applied based on population-based research alone. After evaluating the strength of the evidence and determining its relevance, a decision can be made to discuss the outcome of the study with the individual patient. Discussions with expert colleagues may be also required, where findings of the research and the outcomes of the treatments are shared.

Clinical practice point: Remember to make sure any information or resource used is current and from a credible source. Ask yourself:

1. Who is the author of the information?
2. Who published the information, and where was it published?
3. What information does the resource include?
4. When was the information published or last updated?
5. Why did the author create the source?
6. Does the author or publisher have a conflict of interest in the recommendations?

Top tier evidence to guide decision-making

- ***Clinical guidelines:*** Clinical practice guidelines should be the first source of treatment recommendations. There are many international clinical guidelines readily available that provide up to date information on best-practice management of osteoarthritis. These guidelines are typically produced by leading health professional or research organizations.[45,95,96] Other countries or professional organizations may have their own, which may better suit local needs. Guidelines are more readily available for knee and hip osteoarthritis, but guidelines for hand osteoarthritis[97] are also available. It is important to note that the key first-line interventions recommendations of education for self-management, exercise and physical activity, and weight management are consistent between all clinical guidelines.

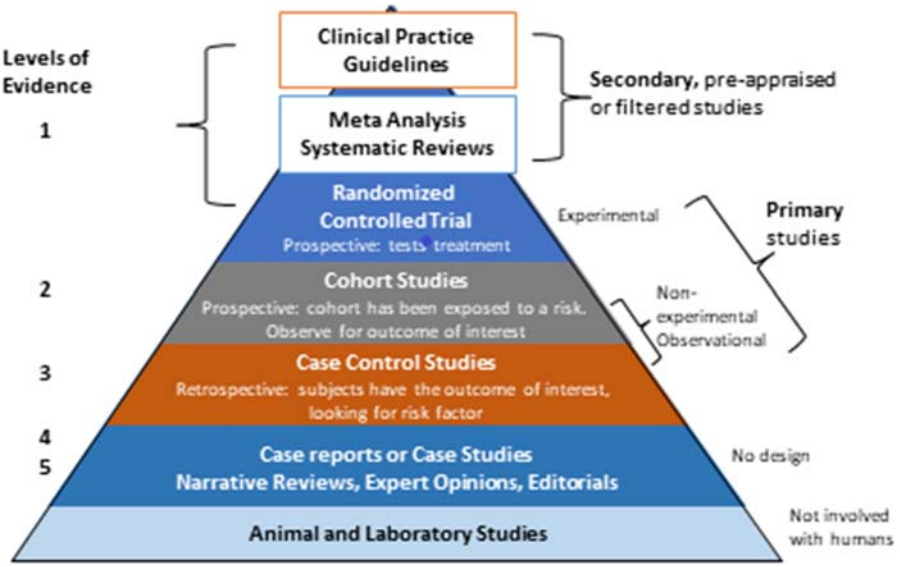

FIGURE 10.11 Evidence pyramid and levels of evidence. The evidence pyramid can be used by health professionals to guide decisions on the quality of the research before adopting new findings into their clinical practice. Evidence at the top of the pyramid has the strongest quality, while those at the bottom have weak evidence. After evaluating the strength of the evidence and determining its relevance, a decision can be made to discuss the outcome of the study with the individual patient. Discussions with expert colleagues may be also required, where findings of the research and the outcomes of the treatments are shared. *From Forrest JL, Miller SA. EBDM in Action: Developing Competence in EB Practice. EbdLibrary; 2016; Forrest JL, Miller SA. with permission.*

However, advice concerning other adjunctive therapies may differ. Take care to ensure you are using the most current guidelines, and those most relevant to your country and scope of practice.

- ***Meta-analyses and systematic reviews, and high-quality randomized controlled trials:*** Most clinical guidelines are updated regularly; however, new research may be published between revisions and other top sources of information such as systematic reviews and high quality randomized controlled trials may need to be considered. Meta-analyses and systematic reviews are syntheses of evidence and are also good sources of information to help inform clinical decision-making. The Cochrane Library and PEDro (Physiotherapy Evidence database) are useful databases for healthcare professionals to identify high-quality evidence that uses rigorous research methods.

Other reliable sources of information

There are many other reliable sources of information and collaboration forums available to healthcare professionals on treating and managing osteoarthritis. Some examples include:

- ***Research updates:*** Updates and expert commentary on current research findings are often published by professional bodies (e.g., General Practice, Rheumatology, Physiotherapy), scientific journals (e.g., UpToDate), or consumer organizations (e.g., Arthritis Australia, Arthritis Foundation, vs. Arthritis). Alerts can be setup in scientific databases or services such as Google Scholar to alert you when new research has been published.
- ***Discussion groups:*** International discussion groups are open to healthcare professionals managing and working with people with osteoarthritis. The Osteoarthritis Research Society International (OARSI) hosts several discussion groups on special interests throughout the year, led by experts in osteoarthritis research. Recent Discussion Groups included rehabilitation, hand osteoarthritis, foot and ankle osteoarthritis, prevention, and spinal osteoarthritis. The OARSI Joint Effort Initiative[98] is a Discussion Group focusing on the international implementation of osteoarthritis management programs, and who have published several papers in this area.[21,79,87]
- ***Online repositories:*** Healthcare professionals can access the latest information on osteoarthritis through online repositories, often established by osteoarthritis research centers. For example, versus Arthritis (United Kingdom),[99] Arthritis Australia's "MyJointPain",[100] Osteoarthritis Action Alliance (United States),[101] and the Arthritis Foundation (United States)[102] have resources to help healthcare professionals with interpreting guidelines, implementing evidence-based care, and understanding common topics related to osteoarthritis. All sites have a dedicated link for healthcare professionals.
- ***Podcasts:*** In the wake of the COVID-19 pandemic, Joint Action has released a series of podcasts, inviting osteoarthritis researchers, clinicians, and experts to discuss specific topics related to the latest research, as well as osteoarthritis management, treatment, and care.
- ***Professional development:*** Professional development opportunities are often provided by professional societies, the different osteoarthritis programs, consumer organizations, and similar. They may be offered as short courses, online modules, or webinars. Look out for opportunities in your area.
- ***Communities of practice:*** A community of practice (CoP) is a group of professionals who share a common concern, set of problems, or interest in a topic, and who come together to fulfill both individual and group goals. This group of professionals often focus on sharing best practices and creating new knowledge to advance a domain of professional practice. They can be at local, national, or international scales. An important aspect of sharing knowledge is the interaction on an ongoing basis. Traditionally a community of practice relies on face-to-face meetings in case of local or national activities. However, from an international perspective, using a web-based collaborative environment to communicate, connect, and conduct community activities might be the best approach.
- ***Peer mentoring:*** Peer mentoring can be used to support professionals deliver evidence-based care. This can be achieved by receiving individual mentoring from others with greater expertise or by attending a peer mentoring workshop.
- ***Dissemination of knowledge and information sharing***: Knowledge can be gained and shared in other forums, such as peer-reviewed journals and conferences. Some organizations may provide osteoarthritis resources for clinicians, have regular journals clubs to discuss new research, have a monthly newsletter or regular email correspondence.

In closing…

In this chapter, we have discussed how health professionals can deliver evidence-based care to the person with osteoarthritis, within a contemporary care framework. We have seen the importance of using the principles of person-centered

care, the chronic care model, interprofessional and multidisciplinary care, and how different health and nonhealth considerations can shape the care provided. We have discussed the principles underlying successful delivery of care and provided a framework for clinicians to consider when engaging with people seeking care. Finally, we have provided suggestions on how to keep up to date with changes in recommendations to ensure you are providing the most current evidence-based care in your clinical practice.

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OSTEOARTHRITIS HEALTH PROFESSIONAL TRAINING MANUAL

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Healthcare provided to patients with osteoarthritis (OA) is frequently inappropriate and of low value. There is an urgent need to improve the health professional's knowledge in managing patients with osteoarthritis.

Osteoarthritis Health Professional Training Manual synthesizes 70 specific capabilities, across 13 broad areas, into 10 chapters which address the current gaps in knowledge, skills and confidence to deliver evidence-based OA care consistent with international guidelines and facilitate effective translation to clinical practice for health professionals.

Written for health care professionals, that meet patients with osteoarthritis in the clinic, like general practitioners, physiotherapists, rheumatologists, orthopaedic surgeons, and health professionals in-training. It is also for basic researchers who want an update on clinical aspects of OA.

Key Features

- Provides a comprehensive training program for health professionals on delivering high-value OA care
- Presents core knowledge and practical insights applicable in everyday patient scenarios
- Written by leading international experts in the field of OA

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