Chapter 16
Knee Osteoarthritis

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Abbreviations

APM	Arthroscopic partial meniscectomy
COX	Cyclooxygenase
MRI	Magnetic resonance imaging
NSAID	Nonsteroidal anti-inflammatory medication
OA	Osteoarthritis

Key Points
- Weight control and exercise are foundational management principles for knee OA
- Medications are directed at symptom control
- Total knee replacement is an effective, cost-effective intervention for advanced disease

Introduction

Osteoarthritis of the knee is characterized by pain, functional loss, and damage to cartilage, bone, meniscus, and other structures (Fig. 16.1).

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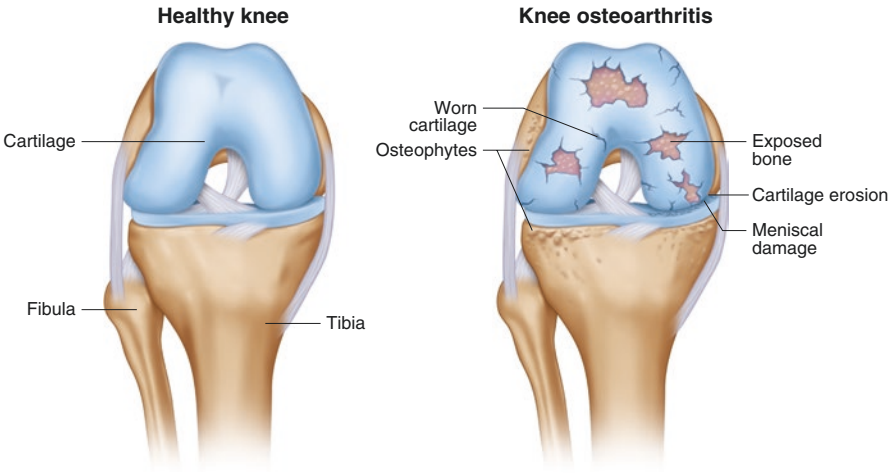

Fig. 16.1 A healthy knee and a knee with osteoarthritis, showing cartilage damage, osteophytes, and meniscal damage

Epidemiology

Osteoarthritis affects over 30 million Americans. The knee is among the mostly commonly involved joints, with symptomatic OA of the knee affecting over 14 million Americans and tens of millions more worldwide. OA is a costly condition. Over 600,000 persons in the US undergo total knee replacement, at a cost exceeding $12 billion. As with many chronic conditions, the indirect costs of lost productivity are even greater than the direct medical costs of osteoarthritis.

There are several important risk factors for knee osteoarthritis. The most powerful is age. While knee OA is uncommon in persons less than 40 years old, symptomatic radiographic knee OA occurs in over 15% of persons aged 65 or greater. With age, chondrocytes lose their capacity to produce the rich matrix of highly negatively charged macromolecules that enable cartilage to imbibe and retain fluid and bear load. Genetic factors also influence the loss of chondrocyte function. Obesity confers risk of OA both because of the excess biomechanical load borne by the knees of obese persons and due to metabolic factors associated with obesity. Prior injury is another powerful risk factor. Individuals who have sustained anterior cruciate ligament tears with concomitant meniscal tear by age 25, for example, face a lifetime risk of developing symptomatic, radiographic knee OA of around 30%. Longstanding occupational exposure to repetitive squatting confers risk, as does abnormal knee alignment (varus or excess valgus). Several medical conditions also may predispose to OA including hemochromatosis.

Clinical Presentation

History

The patient with osteoarthritis of the knee generally presents with gradual onset of knee pain with activity. Those with predominantly medial compartment disease typically perceive pain medially, and those with lateral compartment disease, laterally. It is possible, however, for patients with unicompartmental disease to feel pain on the contralateral side. Many patients will also have a global distribution of pain about the knee, reflecting concomitant involvement of the patella femoral and one or both tibiofemoral compartments. Pain rarely occurs at rest and is usually relieved by sitting or lying down. A complaint of stiffness is common and often associated with limited motion or an effusion. The quality of the pain varies; some patients describe it as sharp and others dull. Patients may notice intermittent swelling. Patients may also notice clicking, catching, popping, or a feeling that the knee is giving way. While these symptoms should alert the physician to the possible presence of a symptomatic meniscal tear, they may also arise from osteoarthritis per se (perhaps due to irregularities in the chondral surface of the osteoarthritic knee).

Patients may notice a gradual lack of knee flexion and extension. Stair climbing is frequently difficult for persons with knee OA, particularly those with involvement of the patellofemoral joint. Patients tend to seek care when they lose the capacity to perform valued activities, such as taking a walk with friends or climbing a flight of stairs in their house. Asking patients about their walking distance, the number of flights they can climb, and other functional activities that are relevant to their weekly routines is a useful way of assessing whether patients are improving or worsening. A number of patient reported outcome measures are available and are collected in clinical practice in some settings.

Physical Examination

Patients with knee OA often have an antalgic gait, in which they limp in attempt to place as little load across the knee as possible, for the shortest period of time. It is useful to observe knee alignment in the coronal plane. The normal alignment of the lower tibia compared to the thigh is about four degrees of valgus. Greater extent of valgus (tibia oriented excessively to toward the lateral side) overloads the lateral tibiofemoral compartment, while varus malalignment overloads the medial compartment. Patients with varus knees and more advanced OA may manifest a varus thrust with walking, in which the varus deformity is accentuated briefly as the patient pushes off in gait. Symptomatic patients tend to reduce weight bearing on the affected knee. As a result the examiner can often appreciate atrophy of the quadriceps (measured best 3 cm above the patella, as the vastus medialis obliquus is the most vulnerable muscle).

Tenderness is common over the medial or lateral joint line, depending on which compartment(s) are involved. Those with patellofemoral involvement often have pain with crepitus on manual compression of the patella against the femoral trochlea. Patients occasionally have palpable effusions; these are generally small and cool. Patients with effusions will sometimes have popliteal fullness on exam as well as pain, reflecting a popliteal cyst (Baker's cyst), which is a posterior outpouching of the synovium into the popliteal space. While range of motion tends to be preserved in early osteoarthritis, further in the course patients may develop limitations in flexion and extension.

Differential Diagnosis and Suggested Diagnostic Testing

Differential Diagnosis

The differential diagnosis of knee OA is broad. The chief challenge is not so much to determine whether the patient has knee OA but rather to discern whether knee OA is the principal source of the patient's symptoms or whether symptoms arise from one of several associated conditions. *Anserine bursitis* is a common source of pain in patients with knee OA. The anserine bursa is located at the insertion of the medial hamstring muscles into the tibia, just inferomedial to the tibial tubercle. Patients with *inflammatory arthritis* generally have warm effusions and often have involvement of other joints and prominent morning stiffness. *Infection* can generally be excluded on the basis of the more indolent presentation of osteoarthritis and the lack of warmth, substantial swelling, systemic symptoms, or monotonic worsening. A *strain of the medial collateral ligament* may mimic medial compartment osteoarthritis and can be identified by stressing the medial collateral ligament. *Patellofemoral dysfunction* due to malaligned patellar tracking tends to cause more diffuse anterior knee pain and can usually be provoked by patellofemoral compression. It is difficult to distinguish patellar dysfunction due to maltracking from patellofemoral OA; in fact, the two problems often overlap. (For more, see the chapter on patellofemoral syndromes in this text).

Meniscal tear is a frequent concomitant of knee osteoarthritis. Over 80% of patients with established osteoarthritis of the knee have meniscal tear on MRI. It is difficult to determine whether these tears are *symptomatic*. Popping, clicking, and catching sensations alert the physician to the possibility of meniscal tear, but these symptoms are nonspecific and may arise from osteoarthritis per se. The McMurray maneuver has modest diagnostic value. The examiner flexes and extends the knee using torque on the joint to stress the medial and then the lateral compartment. The test is designed to elicit a painful clicking sensation due to the direct irritation of the torn meniscus by loading and each tibiofemoral compartment through an arc of motion.

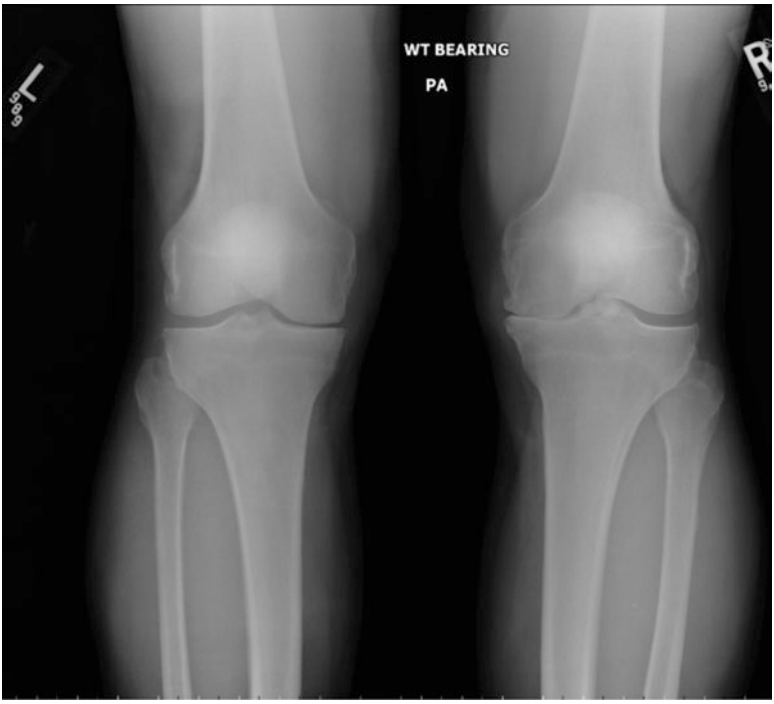

Fig. 16.2 Bilateral osteoarthritis with complete joint space loss and osteophyte formation medially on right; moderate to severe joint space loss on left

Diagnostic Testing

The diagnosis of knee OA can generally be made on the basis of characteristic history and physical examination findings, with no need for radiographs, advanced imaging, or blood tests. Radiographs obtained with the patient standing demonstrate the extent of joint space loss and osteophyte formation and are useful for assessing the severity of knee OA (Fig. 16.2). Flexed weight-bearing views are useful for assessing the extent of lateral compartment loss. Knee MRI is not necessary to diagnose knee OA but is sometimes used to evaluate for other problems that may mimic or accompany knee OA, such as meniscal tear. MRI should be ordered with caution in this setting, since over one third of all adults have meniscal tears and well over half of adults with knee OA have meniscal tears on MRI. MRI also provides detailed evaluation of OA features besides joint space loss and oteophytes, such as bone marrow lesions, synovitis, and effusion. Bone marrow lesions are subchondral areas of fluid signal on MRI. They are thought to arise from overload of subchondral bone (due, e.g., to destruction of the articular cartilage and/or meniscus, both of which bear load that is directly transmitted to subchondral bone when these tissues fail).

Nonoperative Management

Exercise and Core Lifestyle Changes

Substantial evidence documents that regular walking, knee strengthening, weight loss (for obese patients), and stretching to preserve a normal range of knee motion are all helpful in reducing pain and functional limitations in persons with knee OA. Consequently, the management of knee osteoarthritis should begin with patient education and engagement in self-care to initiate and sustain these lifestyle modifications. Physical activity and weight loss are notoriously difficult lifestyle changes for many patients. Programs and strategies are available to patients in the community to help persons with OA make these lifestyle commitments. Referral to a physical therapist is often useful so that patients can learn appropriate exercise techniques for strengthening, stretching, and improving neuromotor control of the lower extremity.

Medications

There is no validated and commercially available disease-modifying drug capable of arresting the process of joint destruction in persons with OA. In the absence of disease modification, treatment focuses on symptom relief and preservation of functional status. Acetaminophen is generally the first line of therapy. It is quite safe unless patients have liver dysfunction, but its analgesic effects are weak. Nonsteroidal inflammatory drugs (NSAIDs) are more potent but carry more toxicity, particularly in older patients and those with cardiac, renal, and gastrointestinal comorbidities. Thus, these drugs need to be used carefully, if at all, in patients with these comorbid conditions. Gastroprotective agents (e.g., proton pump inhibitors and H-2 blockers) reduce the frequency of gastrointestinal events in NSAID users. Several NSAIDs are also available in topical form (e.g., diclofenac). The topical formulations have similar efficacy to oral NSAIDs with less toxicity. Traditional NSAIDs such as ibuprofen and naproxen are predominantly cyclooxygenase 1 (COX-1) inhibitors. Predominant COX-2 inhibitors (such as celecoxib) do not inhibit platelets and thus are good options for patients with bleeding disorders or who are taking anticoagulants. The COX-2 inhibitors do increase risk of hypertension and cardiovascular events and thus should be used with care in patients with cardiovascular comorbidity.

Patients with pain that does not respond to any of these measures are often prescribed opiates. This prescribing practice is controversial. On the one hand, patients have limited options for addressing their pain. On the other, opiates carry risks of somnolence, respiratory suppression, falls, cardiac events, tolerance, addiction, and diversion of pills into the community. Physicians and their patients should discuss the risks and benefits of opiates carefully in this setting. Patients with chronic pain

due to OA may benefit from duloxitene—an atypical antidepressant—or gabapentin, an antiepileptic that has been useful for neuropathic pain. Many physicians will suggest duloxitene or gabapentin for patients with features of centralized pain, such as amplification of pain severity and broadening of pain location.

Intra-articular Injections

Intra-articular corticosteroid injections have been shown to be safe and effective, though transient in their effect. Some patients benefit from a strategy of two or three injections annually. This is particularly useful for patients who wish to delay or avoid TKA. Injections of hyaluronate and related products—viscosupplementation—involve greater costs than steroid injections, but the effect appears to persist longer. The guidelines of various authoritative societies are mixed with respect to viscosupplementation.

Indications for Surgery

Patients with knee OA who have not responded to nonoperative therapy may wish to consider surgical options. High-quality randomized controlled trial data document that arthroscopic surgery is no better than a sham control or than a physical therapy program in reducing pain due to significant knee OA. Thus, there is no role for arthroscopic surgery in the management of knee osteoarthritis, per se.

On the other hand, if patients have suspected meniscal tear in association with their osteoarthritis, arthroscopy can be considered. This issue is covered in greater detail in the chapter on meniscal tear. Several large trials have been completed on the efficacy of arthroscopic partial meniscectomy in patients with knee OA. One trial documented a clear advantage for surgery; another showed that surgery is no more efficacious than a sham arthroscopic partial meniscectomy. In two other trials, surgery showed no advantage over a PT-based regimen in the intention to treat analyses but better outcomes in the as-treated analyses. Experts have generally interpreted this evidence as supporting a strategy of initial rigorous physical therapy with an emphasis on strengthening, with consideration of surgery for patients who have not responded and who recognize that the efficacy of surgery in this setting is somewhat uncertain.

For the patient with symptomatic unicompartmental osteoarthritis despite trials of nonoperative therapy, several surgical options can be considered including osteotomy, unicompartmental knee arthroplasty, and total knee arthroplasty. Osteotomy usually involves doing a tibial opening wedge for medial varus arthritis and a femoral lateral opening or medial closing for the patient with lateral compartment OA. For the patient with unilateral medial compartment OA, the osteotomy is designed to shift load bearing to the lateral compartments. Similarly, for the patient

with lateral compartment OA, the osteotomy is designed to shift load medially. This procedure tends to be particularly well suited to younger patients (e.g., those in their 40s) with a good range of motion. If these patients were to receive a total knee arthroplasty, it would carry a high risk of failing in the patient's lifetime, requiring one or more revisions. Osteotomy is done infrequently in the US—just 1 for every 300 total knee arthroplasties. It is performed more frequently in Australia and Europe. Patients and referring physicians interested in considering osteotomy should inquire about surgeons who have expertise with this operation.

Unicompartmental knee arthroplasty (UKA) is another reasonable option for patients with unicompartmental knee OA. It is typically used in two settings. First, as with osteotomy, unicondylar arthroplasty has a role in younger, active patients because revision of a unicompartmental knee replacement involves less loss of bone than revision of a total knee arthroplasty. UKA patients report that their knee feels more normal than those with total knee replacements. In older patients with unicompartmental involvement, UKA is sometimes used because the procedure involves less bone resection and reaming and therefore has a lower risk of cardiovascular compromise due to fat embolism.

Total knee replacement (TKR) is performed on over 600,000 persons with advanced knee osteoarthritis annually in the US. The principal indications include evidence of advanced OA on radiographs, pain-related loss of functional activities that are important to patients, and absence of comorbidities that would make the procedure unsafe or the rehabilitation unsuccessful. Thus patients with unstable coronary disease, advanced heart failure, or advanced neuromuscular diseases are not appropriate candidates.

In TKR, the tibial plateaus are resected and a tibial plate is inserted. The femoral condyles are similarly sacrificed and femoral implants inserted (Fig. 16.3). In most implant systems, these components are made of metal alloys, and they are separated by a polyethylene liner that rests on the tibial plate. Many surgeons routinely also resurface the patella. Both UKR and TKR are technically demanding procedures, and poor surgical technique is the most common mode of implant failure. The incidence of complications and poor functional outcome is lower if the surgery is done by an experienced, high-volume surgeon in a high-volume center.

Expected Outcomes of Surgery

Approximately 80–85% of patients experience marked pain relief following TKA. The remainder has less complete pain relief, and a few patients actually feel worse or are frankly dissatisfied. There is considerable research focused on why 15–20% of patients continue to have persistence of pain after TKR. It appears that postoperative pain in these patients may be due to problems other than the index knee, such as contralateral knee or hip arthritis. Also, these patients may have psychological traits associated with persistence of pain, including catastrophizing and depression.

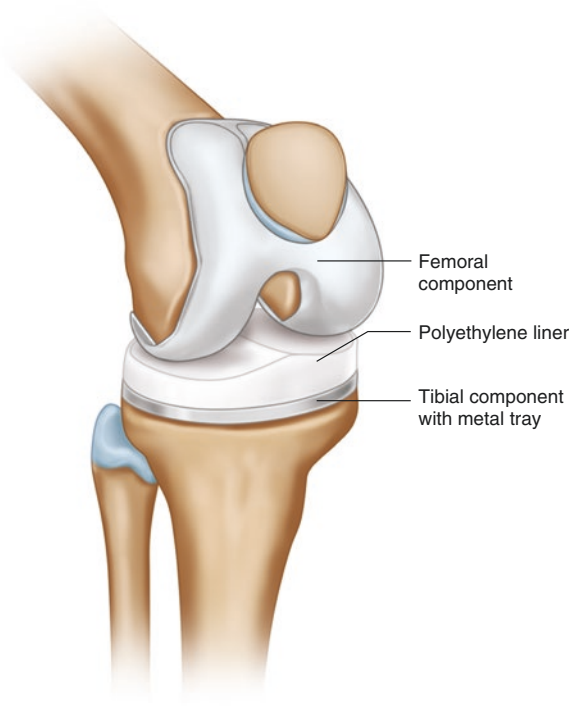

Fig. 16.3 Total knee replacement with femoral, tibial, and patellar components

Risks of complications depend upon the patient's general health. On average about 3–4% of patients have serious complications in the first 3 months after surgery including death, cardiac events, deep vein thrombosis or pulmonary embolus, pneumonia, or prosthetic infection. Over the longer term, infection remains a rare but worrisome risk and failure of the implant necessitating revision occurs at a rate of about 0.5% per year.

The outcomes of unicompartmental arthroplasty are similar to those of total knee arthroplasty. In most reports the risk of revision is somewhat higher for UKA than for TKA and the likelihood of symptomatic improvement similar. Osteotomy is less well studied but tends to have somewhat less complete pain relief than TKA. Patients undergoing osteotomy may ultimately develop OA on the weight-bearing side and at that point may progress to total knee replacement. The strategy guiding the use of osteotomy is to delay the need for TKA until the patient has reached his or her late 50s or 60s and faces a lower lifetime risk of TKA failure, which would necessitate revision.

Table 16.1 shows a summary of presentation and management of knee osteoarthritis.

Table 16.1. Summary of presentation and management of knee osteoarthritis

Presentation	Diagnostic testing	Conservative management	Indications for surgery	Operative management
Use-related pain and loss of valued activities	Diagnosis made by history and physical exam	Walking, quad strengthening, stretching	Persistent use-related pain and loss of valued activities despite conservative Rx	No role for arthroscopy in treating knee OA
Joint line tenderness	Radiographs to assess severity	Weight loss (if obese)		Role of arthroscopic surgery for OA with symptomatic meniscal tear evolving; requires careful discussion with physician
	MRI occasionally useful to exclude other entities	Analgesia (acetaminophen, NSAIDs, topical NSAIDs)	Patient understands and accepts short and long term risks	Osteotomy or unicondylar arthroplasty if unicompartmental OA
Occasional effusions		Intra-articular injection	Acceptable surgical risk	Total knee arthroplasty

OA osteoarthritis; *MRI* magnetic resonance imagining, *NSAIDs* nonsteroidal anti-inflammatory drugs

Suggested Reading

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