



Osteoarthritis

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Overview

Osteoarthritis can affect any synovial joint, and it is characterised by an abnormal response to tissue injury in cellular and extracellular pathways, including activation of the inflammatory response via the innate immune system.

21.1 Definition

Osteoarthritis can affect any synovial joint, where it may involve all the tissues in the joint. It is characterised by an abnormal response to tissue injury in cellular and extracellular pathways, including activation of the inflammatory response via the innate immune system. The resulting abnormalities in tissue metabolism lead to anatomical and physiologic derangements (described below). These changes result in osteoarthritis.

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21.2 Epidemiology

Osteoarthritis is the most common form of arthritis in the world. It affects 10–15% of the adult population, or about 250 million people worldwide. It causes significant morbidity. Over the last half century, the proportion of the population affected by osteoarthritis in developed countries has more than doubled, related to increases in life expectancy and steadily increasing body mass index (BMI). The incidence and prevalence of osteoarthritis have historically been lower in low-income compared to high-income countries although it is likely to change with the ever-ageing and increasingly obese international population.

21.3 Risk Factors

Osteoarthritis is a heterogeneous condition, with both modifiable and non-modifiable risk factors implicated in its pathogenesis. The relative importance of each risk factor differs in an individual and the affected joint.

Age is strongly associated with osteoarthritis, with 10–13% of adults affected by the age of 60. The incidence of osteoarthritis increases with age, with the prevalence of symptomatic osteoarthritis (of the knees, hands or hips) in the mid-80s being estimated to be 45–55% in the United States.

Females are more likely to experience osteoarthritis particularly after the age of 50, although prior to that OA is more common to men. Where present in women, OA may have a more severe trajectory, with worse pain and functional deficits than men. Given the sexually dimorphic distribution of OA, a hormonal component to the pathogenesis has been proposed. Although there is evidence for endogenous hormones and the menopause to be associated with new diagnoses of OA, the role of exogenous hormones is less clear.

There is likely to be a **genetic component**, with a positive family history of osteoarthritis conferring increased risk. Having a grandparent, parent or sibling with OA presents increased risk of generalised OA, spinal OA, hip OA and hand OA (generalised and hand OA being most implicated). Multiple genetic markers have been postulated, although none individually pose significantly increased risk.

Overweight/obesity increases the risk of osteoarthritis most strongly at the knee, but also to a lesser degree at the hips and hands. The effect of obesity is likely due to a combination of mechanical and systemic factors related to meta-inflammation.

Previous joint injury increases the risk of OA. Injury to the anterior cruciate ligament injury in the late teens and 20s has been shown to be associated with developing symptomatic and radiological knee OA within 7–15 years. Both mechanical and inflammatory factors have been implicated. Joint injury increases the risk of OA to the affected joint.

Occupational factors/strain, including lifting, significant labour-related work and farm work, in particular, has been associated with increased risk of developing osteoarthritis, particularly of the knee and hips.

21.4 Pathogenesis

Osteoarthritis can affect any synovial joint, ultimately involving all tissues within the joint, resulting in joint failure. The underlying mecha-

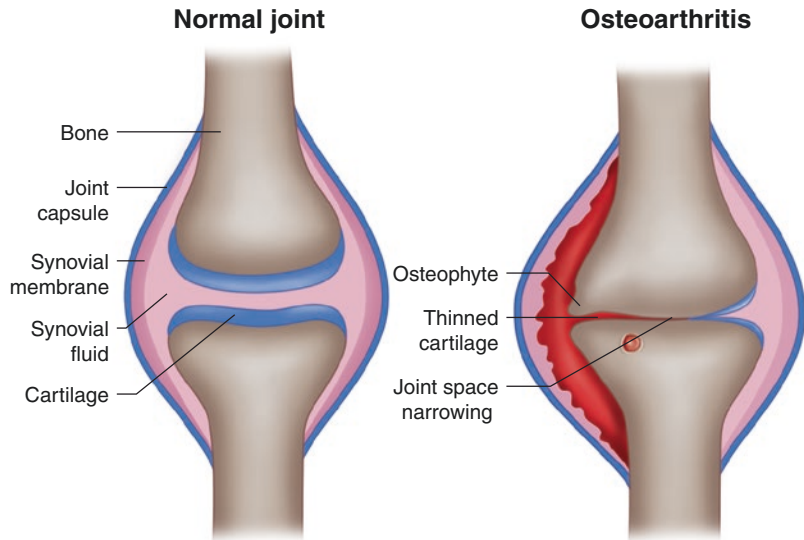
nisms by which its risk factors work have not been fully elucidated. Despite the varied initial insults, the pathological findings are similar in all joints affected by osteoarthritis.

Articular hyaline cartilage has been viewed as the target tissue of OA. Initially, cartilage swells due to increased hydration associated with glycosaminoglycan loss, with anabolic changes. With the resultant changes to tissue composition, collagen type II breakdown occurs, leading to cartilage compression and increased tissue pressure, with catabolic effects becoming more prominent, with inflammatory change and cartilage degradation. The hyaline cartilage fibrillates and develops fissures, resulting in erosions and subsequent cartilage loss.

Bone changes are notable from early in disease. Increased subchondral bone turnover is seen in early disease, associated with the extension of blood vessels into the previously avascular cartilage. These subchondral changes are associated with the development of bone marrow lesions, seen on MRI. Bone marrow lesions are evidence of the tight link between bone and cartilage metabolism in OA, as their presence is associated with increased cartilage loss. Both metabolic and mechanical factors contribute to bone changes in osteoarthritis, with progressive disease associated with increased joint size, manifesting clinically as bony hypertrophy and radiographically as subchondral bone sclerosis, subchondral cyst and osteophytes. Increased severity of OA has been defined by the formation and growth of osteophytes, the growth of which is affected by metabolic and biomechanical factors.

Synovial inflammation, seen as synovitis with or without effusion, is often present in osteoarthritis, despite it being viewed as a non-inflammatory condition. Synovial inflammation may be seen in early osteoarthritis, characterised by lining cell hyperplasia, fibrosis and increased vascularity. The inflammatory cells that are present predominantly originate from synovial macrophages, with a contribution from synoviocytes and chondrocytes. Traditionally, OA is not considered an inflammatory arthritis; less aggressive synovitis is often present than is seen in rheumatoid arthritis.

Fig. 21.1 Typical changes seen in osteoarthritis. On the left-hand side of the joint, structures are normal



Meniscal and ligamentous pathology is often present in OA. The pathological changes seen in these tissues are similar to those seen in cartilage with disruption of the matrix, fibrillation, calcification tissue, cell death and ligamentous tears being common. At the knee, meniscal degeneration is often present.

Muscle adjacent to joints affected by OA is often wasted. Joint pain causes muscle inhibition and wasting. However, there is some evidence that it may precede incident OA, with muscle loss resulting in poor joint mechanics, predisposing to loading injury and OA development.

Some of the changes seen in OA are demonstrated in Fig. 21.1.

21.5 Classifications of OA

OA may be classified as primary, where it occurs with no clear precipitant identifiable, or secondary, where its presence relates to another factor. Secondary causes of OA include significant joint injury or instrumentation, obesity, previous sepsis of the joint, metabolic defects (haemochromatosis and Wilson's disease), avascular necrosis of subchondral bone or response to other forms of arthritis that damage the joint initiating the pathogenesis of OA.

Osteoarthritis has also been classified according to the distribution of affected joints, as either local or generalised osteoarthritis. In local arthritis, a single joint is involved. In generalised osteoarthritis, usually hands, particularly first CMC and DIP joints are affected in association with knee OA.

21.6 Clinical Features of OA

The clinical features of osteoarthritis include use-related pain, limited (<30 min) morning stiffness, short duration of gel phenomenon (<5 min), muscle wasting and loss of function. Joint pain tends to wax and wane, with periods of pain, which may last for hours to weeks, interspersed with less severe symptoms. Some features are common to any affected joint, including pain that is worse on movement and in the evening, joint-line tenderness, bony deformity, instability, crepitus, limited movement and function. Joint-specific manifestations are as follows.

Hand OA may be associated with difficulty completing activities of daily living, loss of fine motor skills and pain that is worse on movement. On examination, the following features are seen: wasting of the intrinsic muscles of the hand, osteophyte formation presenting clinically as Heberden's

Fig. 21.2 The typical changes seen in hand OA. Note the presence of Heberden's and Bouchard's nodes



(distal interphalangeal joints) and Bouchard's nodes (proximal interphalangeal joints), base-of-thumb involvement and carpometacarpal joint involvement. Figure 21.2 demonstrates these changes.

Knee OA is characterised by pain that is worse particularly at the end of the day and on movement, crepitus, a sensation of instability and giving way. On examination, findings may include valgus or varus deformity, antalgic gait and quadriceps muscle wasting. The joint line may be tender, with bony expansion, soft tissue swelling, joint effusion and swelling in the popliteal fossa (Baker's cyst).

Hip OA results in inguinal, buttock or knee pain, related to innervation of the hip by the femoral and sciatic nerves. An antalgic gait and shortening of affected limb may be observed, with pain on internal rotation of affected hip and loss of hip flexion.

21.7 Diagnosis

For a diagnosis of osteoarthritis to be made, the presence of the following clinical features are often sufficient:

- Joint pain exacerbated by movement
- Age greater than 45 years of age
- Morning stiffness less than 30 min
- No other systemic inflammatory features are present

Investigations may be needed to exclude other conditions.

The radiological changes in OA reflect the pathological changes—joint space narrowing, osteophyte formation, subchondral cysts and bony sclerosis. Some joint-specific changes are presented in Table 21.1.

Table 21.1 Some specific features of osteoarthritis of various joints seen on X-ray and MRI

Imaging modality	Changes seen
X-ray	<ul style="list-style-type: none"> • Hand: Involvement of carpometacarpal joints, base of thumb, proximal and distal interphalangeal joints. Involvement of the second and third metacarpophalangeal joints raises the possibility of haemochromatosis • Hip: Cam and pincer deformity, dysplasia of the femoral head (Fig. 21.3a) • Knee: Narrowing of the patella-femoral (on skyline view) and patella-tibial joint space, and valgus and varus deformity, may be seen depending on the specific compartment involved (Fig. 21.3b)
MRI	Bone expansion, cartilage loss with thinning and cartilage defects, meniscal tear, effusion, synovitis, subchondral bone marrow lesions and subchondral bone cysts

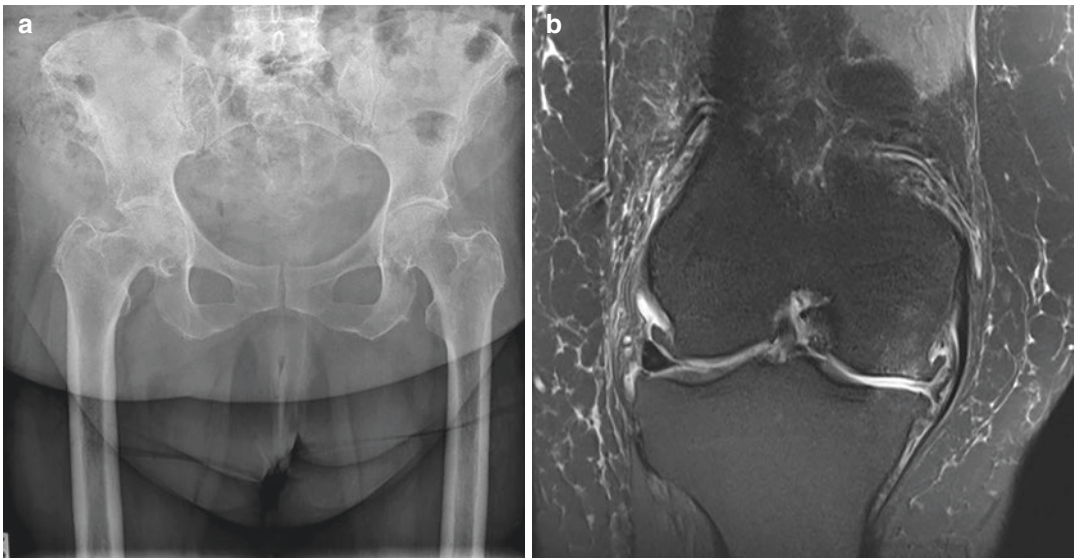


Fig. 21.3 (a) A plain X-ray of bilateral hips, demonstrating severe osteoarthritis of the right hip, with loss of joint space, subchondral sclerosis and osteophytes. (b) A knee

MRI demonstrating changes seen in OA. Note the cartilage thinning, osteophytes, subchondral bone oedema and a synovial effusion

21.8 Management

Optimal management of osteoarthritis is holistic and may require multidisciplinary interventions. It requires a caring therapeutic approach, as patients often feel as if their condition is hopeless. Patients want and need to understand their condition, its prognosis, self-management and prevention. The fundamental components of care relate to weight management and physical activity and/or exercise: these are the only two factors that have been shown to reduce progression. Patients' highest priority is pain control. To achieve the above, the Osteoarthritis Research Society International (OARSI) has recently developed new management guidelines.

21.9 Non-pharmacological Management

Exercise and weight management (with weight loss in those who are overweight) are key. Land- and water-based exercise with or without weight loss has been demonstrated to be of benefit in reducing OA-related pain. Land-based exercise has short-intermediate-term improvements in pain scores even when ceased. However, any weight loss has been shown to reduce the progression of OA. Approximately 5 kg of weight loss reduces the risk of developing knee OA in one study. In contrast, weight gain has been shown to increase pain, reinforcing the need to promote weight maintenance.

When weight loss and exercise are inadequate, involvement of a physiotherapist to improve muscle strength and minimise pain may be considered. Cognitive behavioural therapy has been shown to have some efficacy at addressing associated depression and/or complex pain syndromes in patients afflicted with OA.

Gait aids can also be used in the management of osteoarthritic pain pending more definitive management. Use of a single-point stick for example on the contralateral side in unilateral osteoarthritis of the knee/hip has been shown to reduce pain.

21.10 Pharmacological Management

First-line pharmacological therapy includes topical therapy with non-steroidal anti-inflammatories (NSAIDs) and capsaicin, which can be used as needed. Topical NSAIDs' adverse effects are minimal (local skin reactions), and these medications are absorbed minimally into the systemic circulation and are thus safer than their oral counterparts.

Second-line agents which can be used additionally include oral non-selective NSAIDs (with proton pump inhibitors) and paracetamol as needed. However, consideration must be made to the patient's comorbidities. If the patient has hepatic impairment, regular paracetamol would then be discouraged; patients with Barrett's oesophagus, gastritis and peptic ulcer disease may be better suited to COX-2-specific inhibitors (e.g. celecoxib). Patients with significant renal and/or cardiovascular disease should not be placed on oral NSAIDs for risk of acute deterioration.

Specifically for knee OA, glucocorticoid (IAGC) or hyaluronan (IAHA) can be injected into the joint, although these offer modest short-term therapeutic benefit at best. Note that intra-articular glucocorticoid may result in ele-

vated blood sugar levels in patients with impaired glucose metabolism or diabetes mellitus, which may require additional care.

In patients with overlying depression, complex pain syndromes (with allodynia or spreading of pain) or other significant comorbidities which preclude the use of oral NSAIDs, duloxetine may be considered.

As there is no long-term evidence of benefit from opiates, and their use has significant adverse consequences, their use should be strongly discouraged. Although the use of complementary medicines is widespread, used by more than approximately 40% of patients, there is little strong data to support their use.

There is increasing interest in targeting patient subgroups to tailor therapies to those who are most likely to benefit. A recent example was the finding that turmeric (*Curcuma longa* extract) reduces knee pain in those with underlying synovitis identified via MRI or ultrasound. These results highlight the importance of targeted therapy, although this is still quite a novel area.

21.11 Surgical Management

End-stage joint disease in OA can be treated with joint replacement, particularly in the case of knee and hip OA. Care must be taken in selecting the timing for joint replacement as they have a limited duration of function, and results for revision surgery are poor compared to primary joint replacement. This may be considered if non-pharmacological management is not improving function appropriately and there is ongoing patient dissatisfaction and reduction in quality of life. Care should be taken to assess and treat pain sensitisation and affective disorders prior to considering surgery, as both of these increase the likelihood of poor joint replacement outcomes.

Take-Home Message

- Osteoarthritis is a common condition which is becoming more prevalent in increasingly aged and obese world population.
- The clinical picture is often enough to make the diagnosis; radiological imaging is not always required.
- The typical pathological/radiological features seen in osteoarthritis are osteophytosis, joint space narrowing, subchondral sclerosis and subchondral cyst formation.
- Weight management, physical activity and exercise and analgesic form the foundation of care for osteoarthritis.
- The management of osteoarthritis requires a caring therapeutic relationship with the patients, as it has the potential to affect all facets of their life.

Summary

Osteoarthritis is the most common form of arthritis in the world. It affects 10–15% of the adult population, or about 250 million people worldwide. Osteoarthritis can affect any synovial joint, where it may involve all the tissues in the joint, ultimately resulting in joint failure. It is characterised by an abnormal response to tissue injury in cellular and extracellular pathways, including activation of the inflammatory response via the innate immune system. The resulting abnormalities in tissue metabolism lead to anatomical and physiologic derangements. Osteoarthritis is a heterogeneous condition, with both modifiable and non-modifiable risk factors implicated in its pathogenesis. The underlying mechanisms by which its risk factors work have not been fully elucidated. OA may be classified as primary, where it occurs with no clear precipitant identifiable, or secondary, where its presence relates to another factor. The clinical features of osteoarthritis include use-related pain, limited (<30 min) morning stiffness, short durations of gel phenomenon (<5 min), muscle wasting and loss of function. The radiological changes in OA reflect the

pathological changes—joint space narrowing, osteophyte formation, subchondral cysts and bony sclerosis. Optimal management of osteoarthritis is holistic and may require multidisciplinary interventions. Exercise and weight management (with weight loss in those who are overweight) are key. First-line pharmacological therapy includes topical therapy with non-steroidal anti-inflammatories (NSAIDs), which can be used as needed. End-stage joint disease in OA can be treated with joint replacement, particularly in the case of knee and hip OA.

Questions

Multiple correct answers are possible. Answers available in the book back matter.

1. What are the main modifiable and non-modifiable risk factors implicated in osteoarthritis?
 - (a) Modifiable: body weight, joint injury, occupation strain, alcohol consumption; non-modifiable: age, female gender, family history/genetics, menopause
 - (b) Only modifiable: body weight, joint injury, occupation strain, alcohol consumption
 - (c) Only non-modifiable: age, female gender, family history/genetics, menopause
 - (d) Modifiable: age, gender, joint injury, occupation strain, alcohol consumption; non-modifiable: smoking, family history/genetics, menopause
2. What are the main clinical features that differentiate osteoarthritis from other arthropathies?
 - (a) OA is characterised by pain worse after joint use, <0.5 h of morning stiffness, <5 min of gel phenomenon, muscle wasting and loss of function. On examination, there will be joint-line tenderness, bony deformity and limited range of motion
 - (b) OA is characterised by pain worse after joint use, <0.5 h of night stiffness, <5 min of gel phenomenon, muscle wasting and loss of function. On examination, there will be joint-line tenderness, bony deformity and limited range of motion

- (c) OA is characterised by night pain worse after joint use. On examination, there will be limited range of motion without joint deformities
- (d) OA is characterised by pain present during the whole day. On examination, there will be joint-line tenderness, bony deformity and limited range of motion
3. What are the radiological features seen on plain film that characterise osteoarthritis?
- (a) Osteophytosis, joint space narrowing, subchondral sclerosis and subchondral cyst formation
- (b) Osteoporosis, joint space narrowing and subchondral cyst formation
- (c) Osteoporosis, joint space widening, subchondral sclerosis and subchondral cyst formation
- (d) Joint space widening and subchondral cyst formation
4. What are the main management principles when treating patients with osteoarthritis?
- (a) Via a multidisciplinary approach, minimising pain, maximising and preserving function, engagement with activities of daily living, exercise and weight maintenance
- (b) Via a symptomatic approach, with NSAIDs
- (c) Via a surgical approach. Joint replacement surgery is indicated in each case of osteoarthrosis
- (d) Ice therapy, rest and immobilisation
5. What is the role of opioid therapy in osteoarthritis?
- (a) No role for opioid treatment outside of acute periods perioperatively post-joint replacement
- (b) Opioids are useful in the early stages of the disease
- (c) Opioids should be considered as first-line therapy
- (d) Opioids are maintained 3 months after surgery

Further Reading

- Bannuru RR, Osani MC, Vaysbrot EE, Arden NK, Bennell K, Bierma-Zeinstra SMA, et al. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. *Osteoarthr Cartil.* 2019;27(11):1578–89.
- Ciccitini FM, Wluka AE. Not just loading and age: the dynamics of osteoarthritis, obesity and inflammation. *Med J Aust.* 2016;204(2):47.
- Hannon CP, Bayer S, Murawski CD, Canata GL, Clanton TO, Haverkamp D, Lee JW, O'Malley MJ, Yinghui H, Stone JW. International consensus group on cartilage repair of the ankle. Debridement, Curettage, and Bone Marrow Stimulation: Proceedings of the International Consensus Meeting on Cartilage Repair of the Ankle. *Foot Ankle Int.* 2018;39(1_suppl):16S–22S. <https://doi.org/10.1177/1071100718779392>. Erratum in: *Foot Ankle Int.* 2021;42(2):248. PMID: 30215307.