OSTEOARTHRITIS

1. **AIMS**

On completion of this chapter, you should be able to correctly diagnose osteoarthritis and formulate a treatment plan for osteoarthritis of the hip, knee, hand, foot, shoulder and spine.

2. **LEARNING OBJECTIVES**

- Understanding the pathophysiology of Osteoarthritis
- Diagnosing Osteoarthritis on clinical, radiological and laboratory grounds
- Treating Osteoarthritis of the different common locations.

3. **INTRODUCTION**

Osteoarthritis is a chronic disorder of synovial joints characterized by softening and disintegration of the articular cartilage. Mechanical stresses (impact loading more than friction) combined with a varying ability, largely genetically determined, to withstand these stresses, result in osteoarthritis. It is not primarily an inflammatory disorder, but reactive phenomena such as osteoblastic activity in the subchondral bone leading to sclerosis of subchondral bone, new growth of cartilage and bone at the joint margins (osteophyte) and capsular fibrosis, can be found.

The knees, hips, certain joints of the hands and apophysial joints of the spine are most of the spine are most commonly involved. Clinical features include joint pain on use (mechanical pain), varying in intensity from minimal to severe, as well as stiffness after inactivity (‘gelling’).
4. **NORMAL CARTILAGE PHYSIOLOGY AND PATHOPHYSIOLOGY IN OSTEOARTHRITIS**

Articular cartilage (a specialised hyaline cartilage) covers the ends of the long bones providing the smooth gliding surface of the joint. It is lubricated by synovial fluid.

Cartilage is made up of cells (the chondrocytes) that produce the extracellular material (the matrix). The matrix consists of sheets of collagen fibres with large proteoglycan molecules lying between these fibres. The collagen fibres run vertically from the bone upwards towards the surface of the joint, where they change direction and then run parallel with the surface of the cartilage.

Cartilage consists of:
- condrocytes (the cells)
- collagen fibres
- proteoglycan molecules

The proteoglycans are large molecules composed of a very long central chain of hyaluronic acid with numerous side chains attached along its length. These side chains consist of a central protein core with chondroitin sulphate and keratan sulphate molecules linked to it. Proteoglycan molecules are negatively charged and as such are highly hygroscopic (attract water). These long molecules lie between the collagen fibres. As they attract water they swell, putting the collagen fibres under tension. It is this tension that gives cartilage its characteristic tensile properties. When load is applied to cartilage some of the water is ‘squeezed’ out, which immediately increases the negative ionic charge in the proteoglycan molecules and results in a greater hygroscopic force to attract water back again once the load has been lifted. These biomechanical properties of cartilage are dependent upon an intact collagen and proteoglycan system.

Any factor damaging the collagen, proteoglycans or the chondrocytes will result in cartilage breakdown and osteoarthritis. Abnormal loading of cartilage e.g. a varus deformity of a knee will, with time, lead to breakdown of the overloaded cartilage in the medial compartment of the knee. Disease processes e.g. infection or rheumatoid
arthritis, can also irreparably damage cartilage with secondary osteoarthritis developing at a later stage.

5. **MACROSCOPIC CHANGES IN OSTEOARTHRITIS**

The first visible damage to cartilage is softening and swelling. This is caused by rupture of collagen fibres, with the proteoglycans absorbing more water and the cartilage swelling up. At this stage the cartilage is considerably weakened.

The second stage is fibrillation. Fine flakes of superficial cartilage become loosened and flake off. Cracks appear in the cartilage and eventually run through the full thickness of the cartilage.

The third stage is continued erosion of the cartilage with the ultimate loss of the full thickness of the cartilage. When the cartilage has been lost, the exposed bone becomes very hard with a polished appearance and eventually looks like ivory, hence the term eburnation of bone.

Small effusions form in the joint. This fluid is forced through the clefts (cracks) and into the underlying bone to form subchondral cysts that can be seen on X-ray.

The osteoblasts of bone underlying the damaged cartilage are stimulated to produce new bone, which clinically presents as subchondral sclerosis on X-ray. New bone growth is also stimulated around the edge of the joint, forming a lip of bone called an osteophyte.

Macroscopic changes:
- softening and swelling
- fibrillation
- full thickness cracks
- eburnation
- subchondral cysts
- subchondral sclerosis
- osteophyte formation
6. **CLASSIFICATION**

Osteoarthritis classification according to the etiology:

- Primary or idiopathic where no known cause can be found, although genetic factors are important. The distribution of joint involvement may be localised or generalised.
- Secondary where a definite cause can be found e.g. an old fracture through the joint or a disease damaging the cartilage.

7. **EPIDEMIOLOGY**

Osteoarthritis is the most common disorder of joints in people over the age of 65 years. Although many people show radiographic evidence of the disease, this correlates poorly with the presence of symptoms. There is a rapid increase in the radiographic evidence of osteoarthritis after 40 years.

The disease usually presents in middle age or beyond, with women affected more than men (except for the hip joint). The most common joints involved are the hips, knees, facet joints of the spine and certain small joints of the hands and feet.

N.B. There is a poor correlation between clinical symptoms and radiographic findings.

8. **INDIVIDUAL RISK FACTORS FOR THE DEVELOPMENT OF OSTEOARTHRITIS**

1. Obesity. Obesity is strongly associated with osteoarthritis in the knee and to a lesser degree in the hip.

2. Family history/heredity. The polyarticular forms have a hereditary component, especially osteoarthritis of the small joints of the hands.
3. Trauma. Trauma to a joint with injury to the cartilage is associated with a high incidence of osteoarthritis later.

4. Hypermobility: Ligamentous laxity predisposes to osteoarthritis.

5. Joint shape abnormalities. Slight degrees of acetabular dysplasia account for some hip osteoarthritis. This also applies to the knee.

6. Occupation and Sport. Excessive and repeated loading of a joint predisposes the joint to osteoarthritis.

   Risk factors:
   - obesity
   - heredity
   - trauma
   - hypermobility
   - abnormal joint shape
   - occupation

9. **CLINICAL FEATURES**

9.1 Onset

The onset is usually slow. The patient at first notices an ache in the involved joint, often immediately after use. Occasionally the onset is acute, usually after mild trauma. In these patients the disease has been present for some time but the clinical symptoms were precipitated by the mild trauma. There is a gradual and intermittent increase in the severity of the symptoms over a period of months to years. However, in some patients, even with considerable radiographic changes of osteoarthritis, there is little or no pain.
9.2 Pain and tenderness

Pain is the most important symptom of osteoarthritis. The pain may be diffuse or sharp and stabbing, but is associated with use of the joint. Later in the course of the disease 50% have pain at rest and 30% get pain at night. Pain in the soft tissues around the joint is also common. The muscles surrounding the joint may be painful and are often weak. Strengthening these muscles can relieve much of this pain.

9.3 Movement abnormalities

Besides pain, most osteoarthritis patients complain of stiffness in the involved joints after periods of inactivity. This is also called ‘gelling’ and passes over within minutes of using the joint again. Coarse crepitations can be felt as the joint moves, due to the roughened surfaces moving over each other. In advanced osteoarthritis the crepitations may be heard as well as felt. With advanced disease the range of movement of the joint is reduced. This is due to thickening of the capsule together with bony changes within the joint.

9.4 Deformities

Soft tissue swellings due to mild synovitis and effusions are seen, particularly in advanced disease. Osteophytes are deposits of bone around the rim of the involved joint. The cartilage loss leads to pseudolaxity of the joint, with the excessive forces on the periosteum at the joint margin stimulating new bone formation. This is best seen as the bony hard nodules of the distal and proximal interphalangeal joints of the hands in osteoarthritis (Heberden and Bouchard nodes respectively). In advanced disease the destroyed joints become deformed with various angulations. The degree of functional loss and disability depends on which joint is involved.
10. **RADIOLOGIC FEATURES OF OSTEOARTHRITIS**

Cartilage is not visible on X-ray and leaves a space between the bone ends. Narrowing of this space indicates loss of cartilage. A white sclerotic area in the subchondral bone is typical of osteoarthritis. Cysts may be seen in the bone underneath the cartilage. These are due to synovial fluid penetrating through cracks in the cartilage. Osteophytes appear as bony ridges around the rim of the joint.

X-Ray Features:
- cartilage loss
- subchondral sclerosis
- cysts
- osteophyte

11. **LABORATORY INVESTIGATIONS IN OSTEOARTHRITIS**

Routine laboratory tests are normal.

12. **BASIC PRINCIPALS OF TREATMENT**

There is no ‘specific’ therapy but a wide variety of treatments are available for osteoarthritis sufferers. Treatment covers a number of goals including the following:

1. Prevention
2. Therapy for established disease
   - Education
   - Exercise programme

Other nonpharmacologic modalities, eg. braces, special shoes, mobility aids, taping of the patella.
Pharmalogical modalities:
- Simple analgesics (paracetamol/ low dose ibuprofen)
- NSAID’s in full doses
- Intra-articular corticosteroids
- Topical treatment eg. anti-inflammatory creams

Surgical modalities:
- Tidal lavage (knee)
- Debridement
- Osteotomy (knee)
- Joint replacement

Therapy for established disease:
- education
- aids and braces
- simple analgesics
- NSAID’s
- intra-articular steroids
- topical creams
- surgical procedures

13. **OSTEOARTHRITIS OF THE HIP JOINT**

Osteoarthritis of the hip has a chronic, variable course. It frequently, but not invariably, leads to severe pain and disability..

Three different patterns of hip joint involvement occur. The most common is involvement of the supero-lateral part of the joint in 60% of cases. It is this part of the joint that is the main area of contact on weight bearing and as such would carry the greatest stresses. Medial pole disease occurs in 25% and concentric involvement of the whole joint occurs in the other 15% of patients.
Patterns of joint involvement:
- 60% superolateral pole
- 25% medial pole
- 10% concentric

Some patients form heavy bony osteophytes around the rim of the joint (hypertrophic osteoarthritis), with marked loss of movement of the joint. Although stiffness and loss of mobility are prominent, pain tends to occur later in the course of the disease, probably due to reduced movement causing less friction. Other patients develop only small osteophytes – the so-called atrophic type. The joint retains good movement but pain is experienced early and is severe. Why some people develop large osteophyte and others not, is unknown.

**Clinical features**

The symptoms usually develop slowly with a few cases starting abruptly, often caused by minor trauma on the diseased but as yet asymptomatic hip. The course of the disease is unpredictable. A small minority have a rapid progressive disease over a period of months, but most have years of varying degrees of discomfort.

Pain varies from a dull ache to a sharp stabbing pain, usually related to movement of the joint and especially with weight bearing. In very advanced disease, pain can be continuous and at night. The pain may be felt in the buttock, groin, thigh, lateral side of the hip or referred to the knee.

N.B. In patients with knee pain, the hip must always be examined!

Loss of hip abduction and internal rotation, and pain at the end of the available range of movement are noticed first. Later all hip movements are limited. Functional problems include difficulty in pulling on socks or shoes and cutting the toe nails (due to decreased flexion and external rotation of the hip).

Loss of abduction and internal rotation is an early physical sign.
Treatment

Education of the patient is of paramount importance. The patient must be informed as to how advanced the disease is. The slow progress of the disease must be explained, but if the patient is already experiencing a lot of pain the question of surgical replacement of the hip must be discussed. The high success rate of the operation must be emphasised. Overweight patients must be strongly encouraged to loose weight. Obesity accelerates the progression of the disease and causes more pain. If the patient later requires a hip replacement, obesity may be a contraindication to surgery.

Education is of paramount importance.

Many patients are afraid to use the hip for fear of further “wearing it out”. However, there is some evidence that a LACK of use leads to a progression of the disease. Thus moderate movement of the joint is beneficial, but prolonged loading or heavy activity will cause further damage with more pain and should be avoided. Regular and moderate exercises, that maintain a full range of movement without loading the joint, are beneficial, eg. swimming and cycling. Contact sports as well as high impact sports, such as running, must be avoided. As a general rule, if an activity causes pain, it should be stopped. Moderate exercise, particularly in the early stages of the disease, is often accompanied by striking reductions in pain. There is strong evidence that maintaining a full range of joint motion, as well as strong muscles around the affected joint, can slow the disease progression and considerably relieve pain.

There is some evidence that lack of exercise leads to a progression of the disease.
EXERCISE AIMS

AVOID:
- Prolonged loading
- Activities that cause pain
- Contact sports
- High impact sports e.g. running

ENCOURAGE:
- Full range low impact movements e.g. swimming, cycling

Shoes and sticks. Patients are more comfortable in a shoe with good shock absorbing features e.g. running shoes. A walking stick held in the opposite hand reduces the load on the hip by 20-30%. Dressing aids to help putting on shoes and socks, and a reaching stick (or long handled barbeque tongs!) to pick objects up from the floor can help to alleviate many of the functional difficulties osteoarthritis patients experience.

Simple analgesics such as paracetamol or low dose ibuprofen should be used initially and only “as needed”. If this is insufficient, regular dosing with a more potent anti-inflammatory can be tried. Some, but not all, will get relief. N.B. Indomethacin should be avoided in hip osteoarthritis as it has been shown to lead to more rapid progression of the disease.

Start with simple analgesics
Add NSAID’s if needed
Do not use indomethacin

Hip replacement surgery has dramatically changed the outcome of this disease. Complications are few but nevertheless significant. Infection and loosening of the prosthesis occur in a small percentage of cases, but are very serious. The prostheses also have a limited life span. Pain (night pain in particular) is regarded as the main indication for surgery.
A general rule is that surgery is indicated if the patient cannot work, sleep, walk or have any leisure activities because of their hip disease.

Complications:
- Infection
- Loosening
- Life span of the materials

14. **OSTEOARTHRITIS OF THE KNEE JOINT**

**Anatomy and biomechanics**

The knee joint consist of three compartments, the medial and lateral tibiofemoral compartments and the patellofemoral compartment. Each of these compartments can be affected individually or in combination by osteoarthritis. Isolated medial compartment, or medial plus patellofemoral compartment arthritis, are the most common.

The 3 compartments involved:
- Medical
- Lateral
- Patellofemoral

In the standing position weight bearing passes through the centre of the tibiofemoral area. With activity the medial compartment takes the greatest load. In knee flexion the patella (and in particular the lateral facet of the patella) is compressed against the femoral condyles, placing great loads on this part of the knee joint. Meniscectomy or knee ligament injuries alter load transmission and are major predisposing causes of “secondary” osteoarthritis of the knee.
Clinical features

Two major groups are seen, the first being younger people (mostly men) with disease limited to one knee. This is often related to a previous injury, in particular removal of the meniscus. The second group of patients are middle-aged females, usually obese. They often have osteoarthritis at sites other than just the knee.

The main complaint is pain on walking and on ascending or descending stairs. Tenderness along the joint line is common and coarse crepitations can be felt when the knee moves (except in early disease). Wasting of the quadriceps muscle is almost the rule. Small effusions may be present at any stage of the disease. Disease of the medical compartment with resultant loss of cartilage in that compartment leads with time to varus (inward) angulation. Lateral compartment disease is the least common of the three types and will lead to an outward (valgus) deformity of the knee.

Two groups associated with knee osteoarthritis:
- Younger people with one knee often from previous trauma
- Middle aged obese females, with osteoarthritis often also at other sites

With patellofemoral disease crepitus around the patella can be felt. Pain occurs with climbing or descending stairs, when the diseased patella is compressed against the femoral condyles by the contraction of the quadriceps muscle.

Patellofemoral osteoarthritis is particularly common in women.

The course of the disease is usually slow, taking years from the time of the patient noticing the first twinges of pain to the crippling stage. Even when osteoarthritis is well established, the patient can remain both clinically and radiographically relatively stable for many years. Acute flare-ups are often associated with mild trauma. Reasons for the disease to progress again after the stable phase are not known, but overuse, mild trauma and obesity are important.

N.B. Obesity is an important factor in the progression of the disease
Treatment

This, as in hip osteoarthritis, entails fully explaining the disease and its variable course. Overweight patients must lose weight, as there is a very strong correlation with body mass and the rate of progression of the disease. Should joint replacement be needed, complications are more likely in the overweight patient.

Strengthening exercises of the quadriceps muscles are of particular importance. A walking programme should be encouraged to improve the muscle strength of the legs, as well as general fitness.

NB: A proper strengthening programme is associated with a significant decrease in pain and improvement in function.

Points of importance:
- Explanation
- Obesity
- Exercises

A walking stick and shock absorbing shoes e.g. running shoes, are of help to the symptomatic patient. A lightweight knee brace helps some with lateral tibiofemoral instability. Taping of the patella to realign the posterior patellar surface on the intercondylar notch can give relief of patellofemoral osteoarthritis pain.

Aspirating an effusion and injection a long acting corticosteroid can be of benefit in the early stages of the disease, especially when there are signs of inflammation of the joint.

In the early stages of the disease, tidal lavage of the knee can give relief by removing the debris and inflammatory mediators from the knee. A wedge osteotomy can be considered for patients with unilateral compartment disease with malalignment. This realigns the joint with more weightbearing on the other uninvolved compartment and postpones a knee replacement, often for many years.
For the patient with continuous pain, night pain or pain on walking despite adequate medication and exercises, a knee replacement should be considered.

15. **OSTEOARTHRITIS OF THE FOOT**

The 1st metatarso-phalangeal joint of the big toe is the main site of osteoarthritis in the forefoot. It is common in ballerinas and in women with bunions. There is osteophyte formation that limit the movement of the joint, hence the name hallux rigidus or stiff big toe. Treatment involves soft, padded shoes, analgesics / NSAID’s and surgery in treatment of resistant cases.

16. **OSTEOARTHRITIS OF THE SPINE**

Osteoarthritis of the facet (apophysial) joints of the spine is different from degeneration of the intervertebral discs, but the two conditions are closely linked, with the one capable of causing the other. The osteoarthritis changes in the facet joints are identical to those seen in other joints. Radiographic changes in the spine are extremely common over the age of 40 years and there is very little correlation between radiographic findings and the presence of back pain.

Back pain, aggravated by prolonged sitting or standing and made worse by movement, is typical of facet joint osteoarthritis.

Treatment consists of exercises to maintain mobility and muscle strength. This also helps to relieve the muscle spasm often seen. Resistant muscle spasm is treated by local injection with lignocaine or bupivacaine into the trigger points in the muscle. Analgesics, and if they are ineffective, anti-inflammatories, are used for the pain. A soft brace (corset) can also decrease some of the discomfort.

N.B. It is of critical importance to avoid any unnecessary strain on the back e.g. bending, lifting and twisting activities.
OSTEOARTHRITIS OF THE HAND AND WRIST

Osteoarthritis of the hands is far more common in women than men and typically starts around the menopause.

The joints involved are:
- The distal interphalangeal (DIP) joints
- The proximal interphalangeal (PIP) joints
- The carpo-metacarpal joint at the base of the thumb.

The hallmark of osteoarthritis of the fingers is the so called Heberden nodes at the DIP joints and the Bouchard nodes at the PIP joints. These are osteophytes forming hard bony swellings around the rim of the joint. Later in the disease instability develops and functional problems occur due to loss of fine finger movements. Considerable pain can be felt during the 50’s. Usually there is stabilisation in the 60’s and a relatively pain free period in the 70’s, although there might be significant joint deformity and functional problems at this stage. Occasionally the arthritis begins very abruptly and can be mistaken for rheumatoid arthritis, except that rheumatoid arthritis does not involve the DIP joints.

N.B. There is little place for surgery for osteoarthritis of the proximal and distal interphalangeal joints. Cosmetic surgery for the nodules should not be done.

The natural history of osteoarthritis of the fingers:
- Pain during the 50’s
- Stabilisation during the 60’s
- A relatively pain free 70’s but with deformity and functional impairment

Osteoarthritis at the base of the thumb (the carpometacarpal joint) is common. Pain is first felt with gripping objects and with twisting actions. The pain gradually gets worse, ultimately making it almost impossible to do anything involving a gripping action with the involved hand.
Treatment involves educating the patient to avoid excessive strain on the joints e.g. gripping objects tightly, opening bottles, holding heavy objects etc. The occupational therapist can be of great help in giving functional aids, eg jar openers and tap openers, and providing splints, eg. for the thumb base. Mild analgesics e.g. paracetamol and the anti-inflammatory drugs should be used first. If this is ineffective, intra-articular cortvosteroid injections can give dramatic, but often only temporary, relief. If intra-articular steroids have not given satisfactory pain relief, surgery should be considered. This is highly successful.

Over loading the thumb with tight gripping actions will aggravate the symptoms.

18. **CONCLUSION**

Although osteoarthritis is a chronic disease that is currently incurable, it is not untreatable. An optimistic outlook and a rational individualized treatment plan should be adopted for every patient who suffers from osteoarthritis.

19. **SELF EVALUATION QUESTIONS**

1. Discuss the ultrastructural and macroscopic changes observed in osteoarthritis, as well as the pathophysiology leading to each of these changes.

2. A patient presents with pain in the knee. Describe the clinical presentation (symptoms and signs) and the radiologic findings that would lead you to diagnose osteoarthritis of the knee.

3. Give a short summary of your treatment plan for osteoarthritis of the:

   - Hip
   - Knee
   - First metatarsophalangeal joint
   - Facet joints of the spine
20. REFERENCES


