

Common Knee Conditions

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Introduction

Bipedalism has placed great demands on the middle articulation of the human lower limb. The **knee** has to serve both as a stable pillar enabling erect stance...and as a rapidly moving articulation allowing us to run at speed.

It will not come as a surprise to know that the knee is the joint most commonly injured in sport. In terms of sheer numbers and economics, it is also the most important joint to develop osteoarthritis.

At some point, one in five adults and one in twenty children will present as patients with knee pain.

A survey of sporting injuries undertaken over 10 years noted that 40% were knee injuries. And the adverse consequence of such trauma was greater than that to other injured joints.

A British survey from 1995 suggests that at least 2% of those over 55yrs of age are candidates for knee replacement.

Data from the National Joint Registry indicates that well over 100,000 knee replacements are performed annually in the UK. That figure exceeds the number of hip replacements, a finding shared by surveys in the US and Australia.

My objective today is to provide insight into the presentation and management of four conditions which affect the knee. These are **meniscal tears, anterior knee pain, knee instability** and **arthritis**. I will cover each of these conditions on the basis of structure, symptoms, signs, scans and surgery.

Meniscal Tears

The menisci serve as mobile platforms for the femoral condyles. Inspection of the disarticulated knee reveals how loads transmitted through the femur are received by the tibia below. Half of the load is taken by the menisci. And carriage of these forces is enhanced by the ability of the menisci to stretch circumferentially when loaded.

As the knee bends, the medial meniscus combined with the cruciate ligaments and surface geometry keeps the medial femoral condyle rolling on a relatively fixed part of the medial tibial plateau. The lateral meniscus is more mobile and literally carries the lateral femoral condyle off the cliff-edge of the lateral tibial plateau in deep bend.

Typical symptoms of a meniscal tear are localised joint-line pain triggered by a twist or, in middle-aged patients, a rise from a squat. Pain is 'unpredictably intermittent', made worse by twisting on a planted foot, kicking with the in-step, getting in and out of a car and when the knees touch each other in bed at night. Some patients place a pillow between their knees to sleep comfortably.

A sensation of 'something slipping in the joint' is sometimes recounted. Whilst any locking caused by the medial meniscus happens at angles of around ten degrees, displaced lateral menisci cause lateral pain with knees locked in more than 30 degrees of flexion.

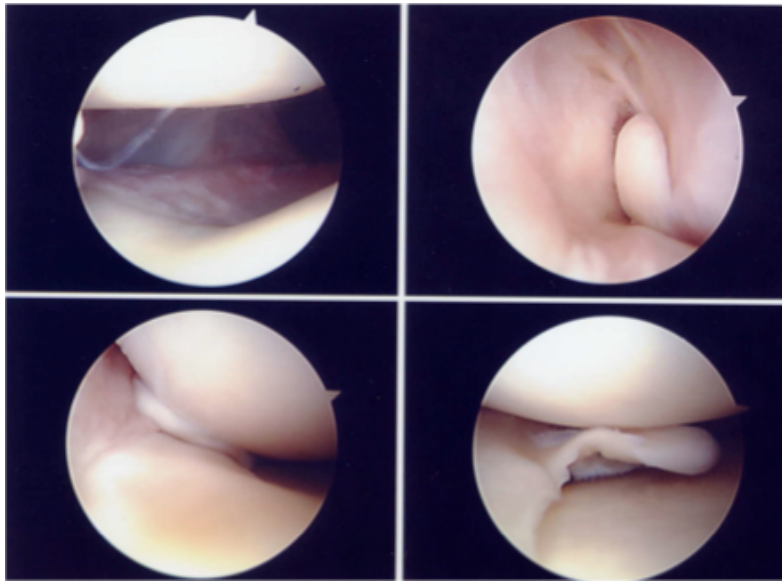
The archetypal patient with a meniscal tear is an active middle-aged male with grey hair. They point to the medial joint line as being the site of pain and there is local tenderness and rotational irritability. Rarely a palpable fluctuant swelling indicates a meniscal pseudocyst consequent to a degenerate tear. Following surgical resection, several return a few years later with a similar problem in the opposite knee

I rarely undertake meniscal surgery without an MRI scan. The images not only confirm the diagnosis but also predict outcome. I know that a horizontal fissure tear for example might well settle with non-operative intervention. Many such tears produce a one-way valve and the popliteal cyst popularised by Mr Baker, a London surgeon from the 1800s. A radial tear or a bucket-handle tear on the other hand is much more likely to cause mechanical disturbance including instability. And the other advantage of a pre-operative MRI is to exclude confounding

from chondral wear or conditions such as spontaneous osteonecrosis of the knee, a condition which often settles spontaneously.

Recent years have seen surgeons spend much time and money in stitching torn menisci. The exercise is not easy and there is a price to pay with potential for chondral damage. Each stitch costs more than £120. I have caused two nerve injuries to the saphenous nerve. Recent short tears to the bloody periphery of the meniscus have the best chance of healing. Suturing longstanding bucket-handle tears is often fruitless and imperfect...healing rarely happens except perhaps in the context of a co-existing cruciate ligament repair.

Beware a diagnosis of medial collateral injury involving fixed flexion. Whilst isolated medial ligament injuries often develop a fixed flexion deformity for several months, the diagnosis to exclude, by MRI, is a locked knee secondary to a bucket handle tear!



A surgeon's view of a torn meniscal cartilage. Note the flap tear in different positions.

Anterior knee pain

Pain at the front of the knee is a symptom not a diagnosis.

In some knee clinics about 40% of patients present with anterior knee pain. Symptoms include pain in the front of one or both knees, often in lax-jointed females with valgus lower limb alignment. Many have a sedentary lifestyle with associated lower back pain. Discomfort is worsened by fixed bent knee exercises such as squats and lunges. Patients like to stretch out and seek leg room. High heels potentiate pain. We know that strong quadriceps muscles correlate inversely with anterior knee pain. But regaining strength is best undertaken carefully with straight leg raises, hamstring stretches and avoidance of breast-stroke swimming and down-hill running.

The causes of anterior knee pain could be sub-divided into the 'obvious' (such as patella fractures, patella-femoral OA and Osgood-Schlatter's) or the 'obscure' (such as patella-femoral chondral flaps, plical impingement and fat pad pathology) Many 'obscure' causes are simply so because plain radiography is negative. Please remember to insist on 'skyline' patella views, without which patello-femoral disorders may be missed. Even with MRI, some of the 'obscure' conditions are overlooked.

Our appreciation of anterior knee pain and knee pain in general has been enhanced by arthroscopy, imaging and maverick experimentation.

The synovium is the most sensitive part of the knee joint and lines the softer and non-articulating parts. It is highly vascular and in the body anything vascular is also innervated.

Synovial folds form remarkably taut curtains within the knee. A supra-patella shelf (plica) exists proximal to the patella and is in my experience continuous invariably with a medial plica which can intervene between patella and medial femoral condyle. The same structure runs distally to cloak a pyramidal shaped and highly vascularized 'fat pad' culminating in a tight insertion onto the apex of the trochlear notch right in front of the cruciate ligaments.

There are two other 'fat pads' both of which are in the supra-patella region. The purpose of these entities is probably to cushion the patella as it rises and sinks in the trochlea groove. Nature abhors a vacuum and without the fat pads a chronic effusion would be likely.

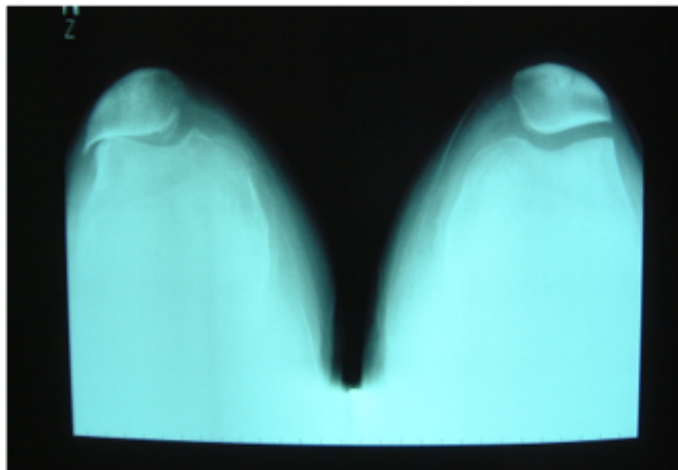
Beware the hip in patients with any knee pain! But be particularly wary of children with knee pain lacking signs in the knee. A slipped upper femoral epiphysis really should not be missed. In older patients, diffuse anterior knee pain overlapping with distal thigh pain is sometimes indicative of hip arthritis.

Maverick experimentation undertaken by a forthright American surgeon has done much to explain which parts of the knee are sensitive. Scott Dye persuaded a colleague to operate on his knee without anaesthetic. The investigators mapped out using pressure sensitive probes, the parts of the inside of the knee which were most sensitive. Articular cartilage was insensitive but the part which when touched hurt the orthopaedic surgeon most was...the synovium- covered infra-patella fat pad!

Signs in patients with anterior knee pain are best elucidated with them seated on the edge of the couch. The patellae are often laterally subluxed and slip further laterally with extension, a movement often accompanied with palpable and sometimes audible crepitus.

MRI scans are increasingly detailed. We can often see medial plicae, sometimes inflamed. And we can see increased signal from 'fat pad impingement'. Occasionally 'fractured fat pads' occur following trauma. And their resection arthroscopically can bring comfort to selected patients.

Perhaps many 'sprained knees' involve bleeds which inflame the synovium leading to local tenderness which resolves spontaneously. Conversely, it is my view that occult haemorrhage can irritate the entire synovial cavity and cause diffuse pain hampering diagnosis of localised tissue injury.



A 'skyline' x-ray view. Note bone on bone contact between kneecap and thigh bone on right knee confirming advanced knee-cap (patella) arthritis. A common cause of pain in the front of the knee.

Knee Instability

I believe that the knee is stabilised by muscles, ligaments and surface geometry, in that order of importance. But these factors are not independent of each other. A schematic diagram of the knee suggests that ligaments are backed up by muscle tendon units capable of actively supporting them where their actions are collinear. Further, some tendons have a footprint which spreads widely over the capsule of the knee and is capable of selective tensioning in ways we do not yet understand. Surface geometry determined by the menisci is also, consequent to direct contact, vulnerable to soft-tissue tensions: consider the anatomy of popliteus, the cruciate ligaments and the medial collateral ligament.

Though one tries, it is difficult to relate the mechanism of injuries on the sports field with exactly what has been injured. However, some patterns emerge. Instability going in a straight line, often without warning, may be due to quadriceps inhibition, without any gross anatomic derangement present. Conversely, instability upon twisting on a planted foot especially if accompanied by a sensation of some internal derangement, is suggestive of a ligament or meniscal injury or patella-femoral dislocation.

A sensation of 'popping' accompanied by pain, rapid swelling and instability, suggests haemarthrosis secondary to anterior cruciate ligament injury. Watch the patient's hands as they describe the deformity they recall to their knee during their injury. Gestures indicative of valgus displacement or twist are usual.

I would always recommend examination to check active knee extension: to miss detachment of the extensor mechanism has adverse consequences. If the examiner's thumb can rest on the shelf of the upper tibia, just medial to the patella, with the knee flexed at right angles, the posterior cruciate ligament is probably intact. Contrary to popular belief, careful clinical examination even early following injury can be useful. However, where there is concern, a very low threshold for imaging with MRI should exist.

In my opinion anterior cruciate ligament surgery should be recommended for those wishing to pursue an active lifestyle. But the patients must be aware that however flawless the surgery their knees will never be as good as prior to injury. A non-operative approach is dangerous in young people as experienced knee surgeons are familiar with a prognosis of recurrent injury involving chondral and meniscal pathology and eventual arthritis. In older people too I have seen displaced meniscal tears develop many years after anterior cruciate injury.

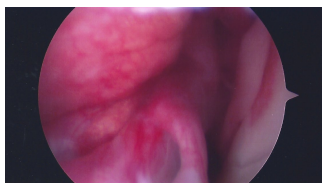
I prefer to use 'hamstring' tendon graft. By that I mean semitendinosus and gracilis (knee surgeons forget that the latter is not a 'hamstring'!) I use intra-operative fluoroscopy to guide tunnel drilling and minimise surgical error. Using such technology has enabled me to preserve the remnant ligament and associated vascularity better.

Pictures which follow show steps taken in performing a 'remnant preserving' anterior cruciate ligament reconstruction.

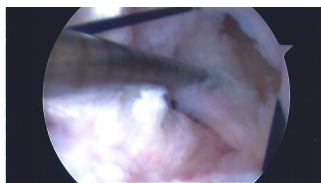
First image: View in theatre with x-ray guidance.

Second image shows shiny new graft passing through the torn remnant cruciate ligament.

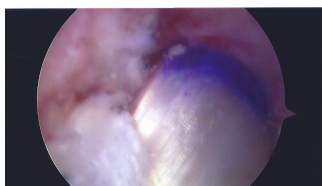
Third image shows titanium screws in thigh bone and shin bone holding graft in place.



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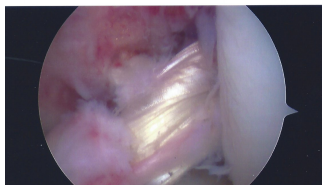
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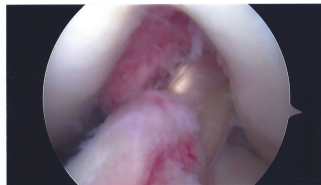
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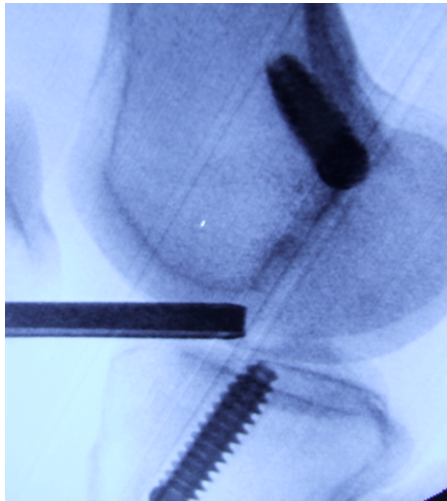
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Knee Arthritis

Arthritis of the knee is evident on radiographs of half of those in their fifties or older. Osteoarthritis is about dozen times commoner than rheumatoid arthritis. Patients with complete loss of articular cartilage in the weight-bearing tibio-femoral joint are most symptomatic. From cadaveric studies using pressure sensitive film, we know that great force is transmitted in normally aligned knees. 3.5Mega Pascals. That is equivalent to a stack of 3.5 million apples (weighing 100g each) stacked in a column of 1 sq metre!

We also know that valgus, varus or even fixed flexion deformity increases the force crossing the knee and is associated with accelerated progression of arthritis.

I use a standard proforma to quantify the severity of pain and dysfunction in my patients. The same form is used to monitor the results of surgery. Many scoring systems exist but it is the setting of thresholds that takes experience.

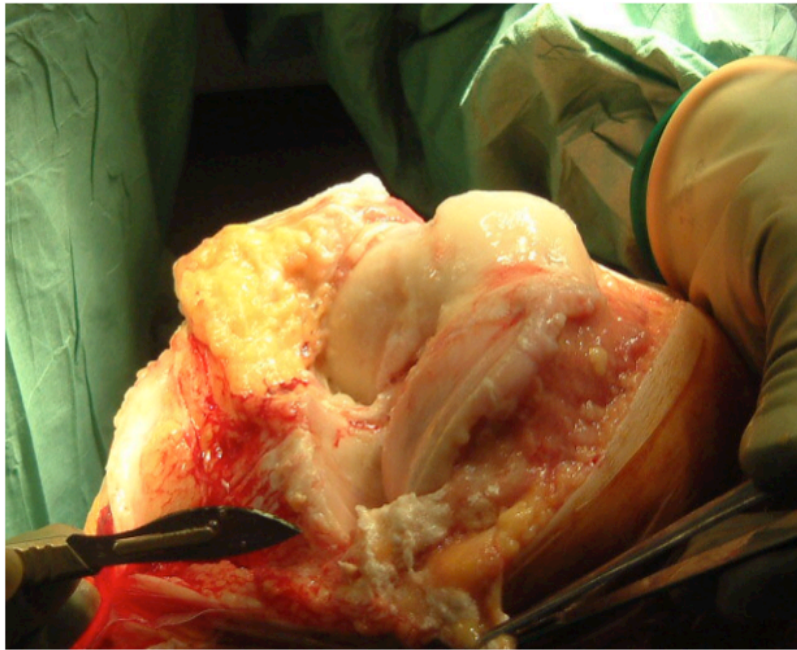
Of the symptoms that matter most, I would suggest night pain, pain despite the use of analgesia and, in the case of valgus knees, instability, as reasons to refer arthritic patients for consideration of major intervention. If patients present to surgeons with fixed deformities greater than 10-20 degrees then surgery, in my hands, involves greater bone resection during knee arthroplasty. Plain radiographs should show bone on bone contact on weight bearing films. If pain exists without such erosion, arthroplasty might not be suitable. Equally, another cause for pain is sometimes present including osteonecrosis or an unstable meniscal tear.

Patients with localised arthritis who wish to run, jump or ski are candidates for osteotomy. One cannot perform such activities with a joint made of metal and plastic. The last 10 years has seen resurgent interest in UK surgeons for undertaking osteotomy.

Knee 'replacement' is a misnomer. The joint is *not* replaced. 'Knee resurfacing' would be a better term. In my experience of undertaking more than a thousand such procedures, about half the articular cartilage in half the knees 'replaced', is normal. I have seen very good results undertaking partial 'replacements' and try to undertake such interventions rather than 'total knee replacements' where possible. Life expectancy has increased and surgeons must anticipate revision surgery in patient's lifetimes. The protection of bone stock for future intervention is vital.

In my practice, the two major advances in knee 'replacement' over the last 15 years include the avoidance of using cement to 'fix' prostheses to bone. I prefer to use devices coated with hydroxyapatite, a constituent of normal bone, now widely used in hip replacements and dental implants. Another advance has been the development of improved cutting jigs with better alignment and reproducible cutting methods. Computer navigated cutting is likely to become more refined. But I suspect that the arrival of an entirely robotic system is at least a decade away.

Images below show an arthritic knee as it appears when opened for a total knee replacement. Below that is an x-ray of a cementless total knee replacement (Genesis II HA Coated)



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