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The Patello-femoral Joint and Anterior Knee Pain

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What is the Patello-femoral Joint?

The knee joint is made of two main joints: the tibiofemoral and the patello-femoral joint. The **patella** or knee cap, is the bone in front of the knee which forms the link between the quadriceps muscles and the tibia at the tibial tuberosity. The quadriceps muscle on the front of the thigh generates the forces which result in a straightening or extension of the knee. The presence of the patella allows the muscle tendon to sweep around the anterior aspect of the knee and allow the knee to bend whilst maintaining a mechanical lever arm for the action of the quadriceps muscle. The compressive forces and sheer force on the articular surface of the patello femoral joint are therefore enormous. Whilst standing with the leg straight very little compressive force is produced however in walking bending or jumping the forces are very much higher. Whilst running or jumping down hills or a slope the forces have been estimated at 10 times body weight. To accommodate these extreme forces the articular cartilage of the patella is thicker than anywhere else in the body. The patella has a track where it articulates with the anterior aspect of the femur called the **trochlea** groove. It is held in this track by the anatomy of the joint surfaces, the compressive forces and the surrounding muscles and ligaments which form the knee joint capsule.



The anatomy and mechanics of patello-femoral joint.
(www.primalpictures.com)

Anterior Knee Pain

Anterior knee pain is a common complaint. That is all it is a complaint from a patient about pain in the front of the knee. It is often misnamed a “condition” or a syndrome. It is neither. The pain may result from a myriad of different conditions or problems which variously result in pain. Neither is it a syndrome in its own right as there are many different syndromes which may underlie the complaint. These terms are often used by practitioners in ignorance or an oversimplification of what is a complex, varied and difficult complaint from which to properly identify the cause. None the less the cause and condition underlying the complaint of anterior knee pain can now with the proper knowledge, expertise and investigation be identified.

However patients with patello-femoral pain represent a significant challenge to the GP’s, physiotherapists and orthopaedic surgeons. This clinical conundrum is often aptly named “The Black Hole of Orthopaedics”, implying that no single explanation or therapeutic approach has yet fully clarified this problem. This is simply due to the fact that there is not one condition which causes the problem but a myriad of different causes which are little understood. Indeed many GP’s, therapists and surgeons alike pay scant regard to the condition, suggesting that the patients have some innate psychological problem and pain sensitivity. It has also traditionally been erroneously suggested that adolescent patients all get better and therefore need no treatment.

Patients characteristically complain of anterior knee pain whilst descending stairs, sitting with the knee bent, running or jumping especially down hills or stairs. To understand this one has to understand the mechanics of the patello-femoral joint and pain transmission. These activities are ones which generate the greatest compressive forces across the patello-femoral joint. Pain in a joint is perceived when deformation of the subchondral bone plate occurs. This deformation is dependant on the point load across the joint and is reduced and protected by a functioning layer of articular cartilage. However in conditions such as chondromalacia or arthritis where the protective layer of articular cartilage is deficient, the cushioning effect is reduced, the deformation of the underlying bone is greater and the perceived pain also greater. In conditions where there is anatomical malalignment of the patello-femoral joint, certain areas of the patello-femoral joint are overloaded which may also understandably and predictably be associated with the complaint of pain. Predictably the pain is greatest during activities where the compressive forces are greatest. Thus in many cases understanding the nature of the patient’s complaint, examination of the anatomy and imaging by X-ray or MRI can commonly identify the underlying problem.

Chondromalacia

Another commonly misused term surrounding the complaint of anterior knee pain is Chondromalacia. This is not a syndrome or even a collection of conditions. A direct translation of Chondromalacia is the visual appearance of sick cartilage on the posterior aspect of the patella which articulates with the femoral trochlear. The condition may result in anterior knee pain, it may be the result of an accident such as a Motor Vehicle accident, anatomical mal-alignment of the patella, overuse in jumpers such as basketball players or idiopathic: of unknown origin.

The articular cartilage of the patella is the thickest of anywhere in the body. Whilst the patello-femoral joint is submitted to very high compressive forces the articular cartilage also experiences sheer forces at the same time. Produced as the patella slides up and down in the femoral trochlear with knee motion, it is thought that it is this sheer force which causes the surface of the articular cartilage to break down producing characteristic irregularities fronds and fissures in the articular cartilage surface. The condition can be very extensive and cover the majority of the patella or the damage may be deeper within the surface layer resulting in loss of the whole articular surface of the patella. Such degrees of damage are almost always associated with significant anterior knee pain.

Contributing factors:

General factors such as generalised muscle inflexibility and spasm often result in anterior knee pain. Conversely patients with generalised ligamentous laxity may have a high riding patella (patella alta), patello-femoral subluxation and maltracking (the patella does not track within the centre of the femoral trochlear groove on knee flexion and extension). All these conditions alter the mechanical position of the patella in its groove and may result in pain. Other anatomical factors like genu valgum (knock knees), abnormal twisting of the femur (femoral torsion), and flat (pronated) feet contribute to maltracking of the patella and the onset of the anterior knee pain. When the patella is not centred in the groove of the femur, there is an imbalance that results in increased pressures between articulating surfaces and subsequent accelerated wear and tear (patella malalignment). Most clinicians subscribe to the concept of patellar malalignment as a source of pain.

A blow to the anterior aspect of the knee commonly occurs in Motor Vehicle accidents and may result in the complaint of anterior knee pain. Once again this has many derivations. The blow can directly damage the articular surface, patella subluxation or dislocation may also result in articular cartilage damage. Damage may also occur to the soft tissues around the knee. These can include the synovial folds or plicae or the infra-patellar fat pad. Injury to these structures commonly gives rise to painful clicking, catching or locking of the joint. Alternately a direct blow to the inferior tip of the patella may initiate patellar tendonitis; a painful condition on activity where pain is experienced specifically around the insertion of the patellar tendon into the inferior pole of the patella.

Treatment of Anterior Knee Pain

Treatment can only be appropriate once a proper and specific diagnosis has been made. Although a provisional general category of anterior knee pain or patello-femoral pain can be made and may be useful initially to direct physiotherapy. This is not a proper diagnosis and if the symptoms persist, are restrictive or do not respond to initial non-surgical measures, then a proper examination, investigation and diagnosis is mandatory. A specialist with an interest in Anterior Knee Pain conditions may be necessary. This may be a physiotherapist with a special interest, as many orthopaedic surgeons have little insight or knowledge about the myriad of conditions resulting in anterior knee pain. Special patello-

femoral X-rays or MRI scans are often required. The process of finding an appropriate specialist may be frustrating for patients who find difficulty finding answers to their knee problems.

Often patients present for a second or third opinion having had a poor response from rehabilitation and non-surgical management. In these patients further physiotherapy is often inappropriate and assessment for surgery is undertaken at the outset once a proper diagnosis has been made. However in most cases in the early stages initial management should include non-surgical management. This includes a careful assessment and identification of the source of the problem, the anatomy and mechanics of the patella, knee and limb. This often includes podiatry and orthotics to control pes-planus or flat feet. Physiotherapy assessment, improvement of flexibility, strengthening and rehabilitation is necessary. Historically particularly in the UK this has involved strengthening the quadriceps muscle, in particular the vastus medialis obliquus muscle. This is often undertaken by resisted repetitive extension exercises. However this is often inappropriate in those patients with patello-femoral chondromalacia or arthritis where the symptoms are made worse by these exercises not better. Currently a more global approach to optimizing function of the lower-extremity kinematic chain is advocated. This can include:

1. Core stability control and strengthening.
2. Improving flexibility of the quadriceps hip extension and also the leg extensors of the hamstring muscles, calf, Achilles and plantar fascia.
3. Orthotics and attention to footwear and running shoes to help control the foot position in weight bearing and gait.
4. Controlling any maltracking or subluxation of the patella through specific strengthening exercises to the Vastus Medialis Obliquus (VMO).
5. General strengthening of the quadriceps, calf muscles and hamstrings around the knee.
6. Improving proprioception.

Orthotics and Supports

Orthotics are inserts into shoes to support the feet. This usually is for pes-planus or flat feet where the medial longitudinal arch needs support. Pes-planus may in itself cause pain under the medial arch of the foot. However more commonly it results in ankle pain after exercise, calf tightness and muscle strains. It can also be a factor in the onset and treatment of anterior knee pain. This is because the position of the foot during heel strike and the stance phase of gait controls the rotatory position of the ankle and tibia. In turn this translates into an effect of the position of the patella within its groove. Whilst use of orthotics may not immediately resolve anterior knee pain, where the foot position is significantly abnormal they are an essential part of the management scheme.

Knee supports generally provide a feeling of comfort, security and warmth to the knee. This applies to all types of knee support. In fact due to the biomechanics and forces around the knee it is very difficult for any brace to do any more than this. Indeed those neoprene soft knee supports are very effective however they are often combined with straps or metal hinges only secured on the sides of the neoprene in pockets. These are wholly ineffective at providing any additional support or stability. Patients often present with these braces and to their surprise they are advised to remove the metal side hinges.

Specific and effective braces have been designed for three purposes for knee problems. Patello-femoral instability, subluxation or dislocation, Anterior Cruciate Ligament Instability (ACL) and for patellar tendonitis. Those for ACL instability have a rigid proximal and distal fibreglass or metal support for the thigh and calf connected by two strong side hinges firmly fixed to the thigh and calf supports. These are strapped on with Velcro straps. These braces can control ACL instability when fitted and worn correctly. However they are only effective when worn and such patients usually opt for surgical ACL reconstruction.

Patellar tendonitis is one of the many conditions presenting with anterior knee pain. The pain is often associated with driving or walking or running down hills and is sited specifically at the inferior tip of the patella during and after activity. It is also known as jumpers knee. A Velcro strap or band placed across the patellar tendon just below the patella can help alleviate some of the pain associated with this condition.

Where the patella is not tracking centrally in its groove or in more significant degrees the patella subluxes (partial dislocation) or completely dislocates, the stability of the patella can be improved by a support specifically designed for this purpose. The design usually has a hole cut out for the prominence of the patella and side support on the lateral aspect of the patella to resist the tendency of the patella to move laterally in its groove. This support may be supplemented by Velcro straps around the thigh. These supports are commonly very effective whilst worn. This is helpful in controlling symptoms and allowing a return to activity. Additionally they are helpful as this improvement is helpful in the assessment of the patient and the specific problem. Often such patients can then be helped on a more permanent basis by surgical stabilisation of the patella.

Chondromalacia

Chondromalacia or chondromalacia patellae was the term introduced by Aleman in 1928. The word describes the visual appearance of damaged articular cartilage on the posterior articular surface of the patella. It is therefore incorrect to use the term as a syndrome or as a patient complaint. The complaint is anterior knee pain or crepitus (fine crunching) in the patello-femoral joint. The condition is not a syndrome but a specific diagnosis. The cause of chondromalacia may be multiple and complex. The most common cause is a malalignment or maltracking of the patella within its groove. The second most common cause would be as part of a degenerative wearing process. Direct trauma of a road traffic accident where the knee hits the dash board may also be a cause, as may repetitive trauma in runners, jumpers or basketball players. However this does leave a large group of young adolescent patients; commonly girls who have chondromalacia from no discernable cause. In medical terms these cases are called idiopathic chondromalacia.

It is believed that the pain originating from chondromalacia is due to the inability of the damaged cartilage to cushion and dissipate the load and pressure across the joint. As a consequence the underlying bone is exposed to higher deforming loads and pressures which are interpreted by the body as pain. Unfortunately as yet despite many novel attempts and techniques damaged articular cartilage on the patella cannot be replaced or repaired. The damaged area can however be smoothed over or submitted to a microfracture chondroplasty. These techniques may be helpful. However correction of the underlying cause such as patello-femoral subluxation or dislocation can often be extremely effective. Electrothermal chondroplasty of RF- Radio-frequency ablation is the smoothing of the surface appearance by application of heat. This can cause significant unseen thermal

damage to the articulating surfaces and underlying bone. For more information about articular cartilage repair please see the pages on articular cartilage and chondral injuries.



Soft patellar cartilage



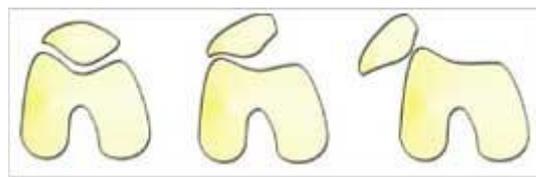
Fibrillated cartilage or classical chondromalacia

Patellar Maltracking

Maltracking is the description of a patella which does not correctly or smoothly move within its groove during knee flexion and extension. The description is subjective, imprecise and refers to several different conditions. The patella may not track because it is subluxed laterally, it may start laterally and then correct itself, alternately it may start in a high position only to move medially sideways into the trochlear groove with flexion. Alternately some habitually dislocating patella's will move laterally into a dislocated position with knee flexion. Other descriptions include lateral hyperpressure, excessive lateral pressure syndrome, lateral patellar compression syndrome, patella tilt, subluxation and dislocation. Other anatomical conditions associated with this include a relatively flat patella, patella alta (high patella), trochlear dysplasia (shallow femoral trochlea groove), femoral torsion (twist), tibial torsion (twist) or a general joint laxity.



Lateral patella subluxation



Stable, subluxed and dislocated patella

Traumatic Patella Dislocation

Patients who have acute patellar dislocation generally present with an acute episode with trauma, pain swelling and difficulty bending the knee. On examination there is often localised tenderness along the medial side of the knee or the edge of the lateral femoral condyle where impaction from the patella occurs as it dislocates. Radiographs should be obtained to demonstrate the position of the patella and anatomy. It is possible that a loose body may be present as a result of damage which occurred to the joint surface during the dislocation. Spontaneous reduction may occur if the patient is able to fully straighten the leg. Alternately this may be undertaken in the accident department. Where a subluxation occurs the patella does not completely dislocate and spontaneously returns to its groove. The patient often reports that the kneecap slipped out, then went back into place

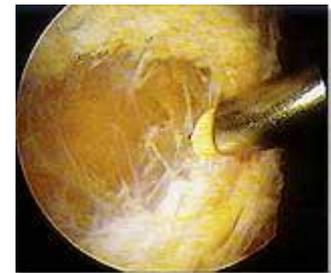
spontaneously. In such patients the chance of further episodes of recurrent dislocation ranges from approximately 15% to 44%. Repetitive episodes or where there has been damage to the articulating surfaces may result in further problems. Surgical stabilisation of the patella is commonly undertaken for such problems, particularly where there is a significant underlying anatomical abnormality causing the recurrent problem to occur.

Patello-femoral Subluxation - Treatment and Rehabilitation

Non-operative management for patello-femoral instability involves maximizing lower-extremity strength and function. Some stability may be provided by a patella cut-out brace or support. This has the effect of stabilizing the patella within the trochlear groove. Patella taping, or McConnell tape technique, is the application of sticking plaster over the skin of the knee in a specific way to control the motion of the patella within the groove. Whilst originally reported to have a high success rate in reducing patello-femoral pain and pain as a result of malalignment and/or instability, this is only achieved whilst the tape is applied and usually only for a short period of time. Subsequent researchers have been unable to reproduce the results of McConnell's original study. More significant patello-femoral stabilising braces are available and are effective at controlling more severe cases of subluxation and dislocation whilst worn.

Patello-femoral Subluxation - Corrective Surgical Procedures

Surgical reconstruction of the patello-femoral joint can only be advised where a specific abnormality which is known to the cause of the patient's symptoms has been identified. All too often a specific diagnosis and the underlying anatomical abnormality is not identified. Alternately an abnormality is treated which is not the cause of the patients symptoms. These failures have resulted in many physiotherapists and surgeons advising against surgical correction for most patients. This appears to be a failure to understand the nature of the individual patient or identification of the abnormality and inappropriate use of the techniques rather than a general failure of the procedure. There are a wide variety of procedures of varying degrees of complexity used in the treatment of anterior knee pain. Each has its place for specific diagnoses.



Arthroscopic lateral release

If by an X-ray or MRI it has been identified that the patella is subluxed or tilted to the lateral aspect of the groove in a patient with pain in the lateral retinaculum or lateral facet chondromalacia, who is helped by a stabilising knee support, then surgical correction of the subluxation is a rational and successful procedure. The easiest and least invasive way to achieve this is by release of the lateral patellar retinaculum by a day case Arthroscopic Lateral Release procedure. This procedure reduces the lateral pull on the patella and allows it to centralise in the groove. This may be more effective in patients with patello-femoral tilt as well as subluxation. In cases where the patella is subluxed medially or where there is medial chondromalacia this procedure may make the patients symptoms worse rather than better.

Other more invasive and aggressive surgical procedures to stabilise the patello-femoral joint may be necessary where a lateral release has proven not to be effective or where a significant underlying abnormality is present causing a more significant degree of subluxation. This was historically done by using the addition of shortening or tightening

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the medial patellar structures with an advancement of the vastus medialis obliquus (VMO) portion of the quadriceps muscle. However this has fallen into disrepute and disuse. The medial patello-femoral ligament (MPFL) is often damaged during a traumatic dislocation. In such a patient repair of the MPFL in the acute setting has produced good results and may also be helpful in the chronic situation as well.

A more reliable procedure for severe and recurrent cases is the more significant correction of the anatomical abnormalities and a formal correction of the position of the patella. This can be undertaken by a proximal realignment of the quadriceps muscles above the patella or more simply by distal realignment. A distal realignment is where the insertion of the patellar tendon to the tibia is moved so that the patella is pulled more medially and tracks centrally in its groove. Recent advances in the technique using a modified Fulkerson's tibial tubercle realignment procedure means that this can be undertaken as a day-case procedure without the need for any immobilisation, brace or plaster cast. Patients can partially weight bear with crutches from the first day and can often discard the crutches after 3-6 weeks. This procedure is also very useful in the treatment of lateral patello-femoral pain due to arthritis and degenerative changes.

Synovial Plicae

Synovial plicae are bands of soft tissue within the knee. They are properly the vestigial remnants of the foetal divisions of the embryological knee. They are commonly present but can sometimes be the cause of anterior knee pain. Specifically this is episodic pain, catching and clicking on descending stairs. David Johnson MD wrote the seminal paper on the treatment of synovial plicae. This was titled "Synovial Plicae Fact or Fiction" and was published in the American edition of the Journal of Bone and Joint Surgery 1996. The folds may become painful when undertaking certain activities. These include jumping, stair climbing or step aerobics. The symptoms may also start after a blow to the front of the knee in a road traffic accident. As the knee bends and straightens a thickened band may be felt to the medial or lateral side of the patella. Surgical removal by a day case arthroscopic procedure has been shown to be successful in 94% of patients.



synovial plica

Patellar Tendonitis

Patellar tendonitis is a common clinical condition seen in sports medicine. The usual complaint is pain well-localised at or near the inferior pole of the patella. The condition is also commonly known as jumper's knee. It frequently affects people who use their knee extensor mechanism in a repetitive manner in "explosive" extension or eccentric flexion such as that in basketball, volleyball, or dancing. It also affects ageing athletes and in particular runners and patients who drive for long periods of time. The condition and a new arthroscopic technique for the treatment was extensively described by Mr. David Johnson. His work on the biomechanics of this condition resulted in an MD Thesis for his fellow Mr. O Basso from Imperial College London. The condition was for the first time identified as resulting from an impingement of the inferior pole of the patella on the posterior aspect of the patellar tendon whilst landing from a jump, running or when the knee was held against resistance as when driving. The arthroscopic procedure designed and described by Mr. David Johnson was shown to result in improvement and a return to sports in 94% of patients.

Pre-patellar Bursae

Prepatellar Bursitis; housemaid's knee is a swelling of the synovial pouch in front of the patellar and under the skin of the front of the knee. The condition is also common in plumbers, carpet layers, roofers, gardeners and other people who spend a lot of time on their knees, often experiencing swelling in the front of the knee. The bursa usually enables the kneecap to move smoothly under the skin. The condition is not usually very painful unless the bursae becomes infected. For a non-infected bursae, anti-inflammatory medication should be initially used. Alternately an injection of methyprednisolone into the bursa sometimes results in it disappearing. Otherwise surgical excision is performed usually under local anaesthetic as a day case procedure. It takes a few days for the knee to regain its flexibility and some weeks before normal kneeling activities can be resumed.

For more information on patellofemoral problems see the following articles:

"Patellofemoral Pain: Let the Physical Exam Define Treatment".

William R. Post, MD.

The Physician and Sportsmedicine, January 1998

<http://www.physsportsmed.com/issues/1998/01jan/post.htm>

"Using Patellofemoral Braces for Anterior Knee Pain."

Scott A. Paluska, MD; Douglas B. McKeag, MD, MS.

The Physician and Sportsmedicine, August 1999

http://www.physsportsmed.com/issues/1999/08_99/paluska.htm

"Patellofemoral Pain Syndrome: A Review and Guidelines for Treatment."

Mark S. Juhn, D.O.

The American Academy of Family Physicians

<http://www.aafp.org/afp/991101ap/2012.html>

"Exercises for Patellofemoral Pain Syndrome"

Mark S. Juhn, D.O.

The American Academy of Family Physicians Information:

<http://www.aafp.org/afp/991101ap/991101b.html>

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