

Anterior Knee Pain in the Military Population

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Abstract

Anterior knee pain in our military population constitutes a diagnostic and therapeutic problem that is not always easily solved. In recent years, a better understanding of the biomechanics of the patello-femoral joint has contributed to the successful classification and treatment of many patients. However, the cause of pain remains elusive in a significant subset of patients who show no clinical or radiographic evidence of patellar malalignment and continue to have persistent pain despite adequate physiotherapy.

In this article, the classification and approach to anterior knee pain are reviewed. Emphasis is placed on dividing patients into four subsets namely; normal tracking, patellar tilt, patellar subluxation and extra-articular causes of anterior knee pain. A more rational approach to the problem can then be employed and successful rehabilitation and/or surgery can be expected.

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Introduction

Anterior knee pain is a common problem seen by family physicians, military doctors and orthopaedic surgeons. In Singapore, our national servicemen move from a relatively sedentary lifestyle in school to rigorous military training within a matter of months. As a result, overuse injuries are common. There has been a slow but definite increase in the incidence of anterior knee pain amongst national servicemen in Singapore (Table I).

To the military doctor, this increasing trend is worrisome especially since each cohort of national servicemen is slowly decreasing. Furthermore, complaints of the patello-femoral joint may range from “nuisance pain” of malingerers to true patellar subluxations.

Anterior knee pain has been compared to low back pain since both these areas in orthopaedics cause very painful conditions with few objective physical findings. This unfortunately leaves the condition open to some degree of subjectivity, which in turn can give rise to discrepancies during medical classification in the Singapore Armed Forces (SAF). As understanding of patello-femoral biomechanics improves, we can no longer group all these patients under the broad and ambiguous category of “chondromalacia patellae”. A

TABLE I: NUMBER OF CASES DOWNGRADED FOR ANTERIOR KNEE PAIN/CHONDROMALACIA PATELLA IN THE SINGAPORE ARMED FORCES

Year	1994	1993	1992	1991	1990	1989	1988
NSF	527	471	300	284	224	239	189
NSM	597	452	347	341	234	202	190

NSF: National Service Full-Time; NSM: National Service Men

careful clinical and radiological evaluation must be performed for each case to differentiate the patients with abnormal patello-femoral mechanics from those with normal patellar tracking.

The Diagnostic Dilemma

Anterior knee pain is classically seen in the adolescent female population. These patients usually have generalised ligamentous laxity and present with hypermobile patellae and genu recurvatum. As such, patellar tracking problems and subtle patellar subluxations are common findings.

In Singapore, we see many young male national servicemen with anterior knee pain. These patients are a different subset and usually do not have ligamentous laxity or patellar tracking problems. Often the anterior

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knee pain is unmasked by overuse during their induction into military service. A proportion of these patients may have tight lateral patellar restraints and present with lateral patellar compression syndrome. Many of them have hamstring tightness causing increased patello-femoral contact stresses and respond to hamstring stretching exercises.

Many patients have been subjected to arthroscopy in the past when presenting with persistent anterior knee pain. However, arthroscopy is invasive and not entirely accurate in determining if pain is spurious. We are able to exclude meniscal and ligamentous pathology in the knee but often see patients with genuine patello-femoral pain but no changes in the patellar articular surface on arthroscopy.¹⁻³ Conversely, autopsy studies have shown that chondromalacia patellae can exist in patients who have no history of anterior knee pain."

The most frequent cause of anterior knee pain is retinacular stress associated with patello-femoral malalignment.⁵ Biopsies of the lateral retinaculum done at the time of lateral release have shown that small nerves in the retinaculum can sustain injury, presumably related to chronic patellar malalignment.

Over a prolonged period however, the chronic patellar tilt causes increased articular loading of the lateral facet of the patella and hence leads to articular breakdown and frank patello-femoral osteoarthritis. This is particularly true when normal cartilage function has already been altered as a result of age or injury.⁵ It is therefore not surprising for a patient to progress from early retinacular pain to eventual articular erosion.

Classification

Patello femoral disorders have been divided into five types, namely traumatic, dysplastic, idiopathic, osteochondritis dissecans and plicae (Table II). This classification system makes a clear distinction between trauma in an otherwise normal knee and conditions that are related to abnormalities listed as patello-femoral dysplasia. Patellar instability rarely exists in a normal knee. Abnormal anatomical variants in the patello-femoral joint are a prerequisite before patellar subluxation occurs. As such, a thorough clinical evaluation and good radiographs are needed to detect evidence of any patello-femoral abnormalities (e.g. patella alta, shallow intercondylar sulcus, deficient lateral femoral condyle or patellar maltracking).

Sometimes, the cause of anterior knee pain cannot be determined despite careful efforts to look for an anatomical reason for the pain. These cases are then classified as idiopathic chondromalacia patellae. This is a misnomer since chondromalacia is a pathologic or arthroscopic diagnosis.

Plicae represent synovial folds that are embryologic remnants of partitions originally separating the com-

TABLE II: CLASSIFICATION OF PATELLO FEMORAL DISORDERS

I. Trauma (conditions caused by trauma in the otherwise normal knee)
A. Acute Trauma
1. Contusion
2. Fracture
a. Patella
b. Femoral trochlea
c. Proximal tibia1 epiphysis (tubercle)
3. Dislocation (rare in the normal knee)
4. Rupture
a. Quadriceps tendon
b. Patellar tendon
B. Repetitive Trauma (Overuse Syndromes)
1. Patellar tendinitis ("jumper's knee")
2. Quadriceps tendinitis
3. Peripatellar tendinitis (e.g. anterior knee pain of the adolescent due to hamstring contracture)
4. Prepatellar bursitis ("housemaid's knee")
5. Apophysitis
a. Osgood-Schlatter disease
b. Sinding-Larsen-Johansson disease
C. Late Effects of Trauma
1. Post-traumatic chondromalacia patellae
2. Post-traumatic patello-femoral arthritis
3. Anterior fat pad syndrome (post-traumatic fibrosis)
4. Reflex sympathetic dystrophy of the patella
5. Patellar osseous dystrophy
6. Acquired patella infera
7. Acquired quadriceps fibrosis
II. Patello-femoral Dysplasia
A. Lateral patellar compression syndrome (LPCS)
1. Secondary chondromalacia patellae
2. Secondary patello-femoral arthritis
B. Chronic subluxation of the patella (CSP)
1. Secondary chondromalacia patellae
2. Secondary patello-femoral arthritis
C. Recurrent dislocation of the patella (RDP)
1. Associated fractures
a. Osteochondral (intra-articular)
b. Avulsion (extra-articular)
2. Secondary chondromalacia patellae
3. Secondary patello-femoral arthritis
D. Chronic dislocation of the patella
1. Congenital
2. Acquired
III. Idiopathic Chondromalacia Patellae
IV. Osteochondritis Dissecans
A. Patella
B. Femoral trochlea
V. Synovial Plicae (anatomic variant made symptomatic by acute or repetitive trauma)
A. Medial patellar ("Shelf")
B. Suprapatellar
C. Lateral patellar

partments of the knee. Four plicae have been described, namely suprapatellar, infrapatellar, medial and lateral. The medial plica is most often of clinical significance. Sometimes, a thick fibrotic band passes medially from

above the patella into the fat pad. This causes pain, tenderness and popping over the medial femoral condyle. Occasionally, a “kissing” lesion may be seen in the form of a crater in the medial femoral condyle. Persistently symptomatic plicae can be resected arthroscopically via a suprapatellar lateral portal.

Osteochondritis dissecans of the patella is rare compared to the medial femoral condyle. Care must be taken to differentiate these from osteochondral fractures and from avulsions of the medial patellar margin associated with patellar dislocations.

Clinical Examination

It is important to differentiate patients with normal patellar tracking, abnormal patellar tilt and patellar subluxation.⁵ Patients with patellar tilt present with pain due to increased contact pressures in the lateral facet, shortening and tightness of the lateral retinaculum and an increased risk of patello-femoral articular breakdown. When conservative measures fail, these patients respond favourably to lateral retinacular release.

On the other hand, patients with patellar subluxation have problems with extensor mechanism instability, increased risk of dislocation, apprehension and patellar hypermobility. They often present with an increased quadriceps angle due to a lateralised extensor mechanism. These patients may require realignment of the proximal and distal extensor mechanism to prevent further symptoms due to subluxations.

Occasionally, patients present with both tilt and subluxation. They are at risk of both instability and accelerated articular damage. Finally, the last group of patients have no evidence of patellar malalignment or subluxation but present with pain. It is difficult to determine which of these patients have genuine pain. Hence, it is necessary to obtain input from the camp medical officers and ground commanders before any decision is made regarding fitness for combat training. It is especially important to avoid any form of surgery in these patients including diagnostic arthroscopy. Surgical treatment should be reserved for patients with clinical and radiological mechanical abnormalities. The abnormal restraint of alignment should be the target of surgical correction.⁵ Extra articular causes of anterior knee pain include patellar tendinitis (Jumpers’ knee), Osgood Schlatter’s and Sinding-Larsen Johansson disease. Diagnosis is usually straightforward. Treatment should include rest, stretching and strengthening. Non-operative management is often effective. Occasionally, operative excision of painful degenerated tendon fibres or removal of loose ossicles from the patellar tendon may be necessary.

Treatment

Excessive lateral pressure syndrome is due to a patel-

lar tilt without associated instability. Treatment should initially be conservative. Jenny McConnell, a physiotherapist in Australia, has formulated a treatment protocol for patello-femoral disorders.⁶ This treatment involves activity modification, patellar taping, training the vastus medialis obliquus and hamstring stretching. She has reported a 96% success rate with her programme. Careful attention to stretching of tight iliotibial bands and hamstrings as well as strengthening of the gluteal, quadriceps and gastrocnemius muscle groups often help to alleviate patello-femoral pain. Cross training with the avoidance of high-impact loading activities is a proven technique in successful rehabilitation.⁷

There are several phases of rehabilitation for the patient with anterior knee pain. The initial phase is designed to reduce pain and swelling, strengthen the vastus medialis obliquus, improve muscle flexibility, educate the patient and correct biomechanical soft tissue imbalances with taping and braces. Phase II incorporates strengthening exercises eccentrically and concentrically with resultant improved endurance of the lower extremity. Phase III involves proprioceptive and functional training and a graduated pain-free return to full activity. Needless to say, these phases frequently overlap and patients vary tremendously in their activity requirements and pain threshold. As such, there is no “cook-book” approach to the rehabilitation of these patients and treatment regimes should be individualised.

Biomechanical changes in the foot and ankle such as pes planus can contribute to anterior knee pain. We have to advise patients on proper shoe wear with adequate shock absorption and a good arch support. Orthotics to compensate for any biomechanical abnormalities in the foot may occasionally be necessary. Another adjunct to rehabilitation is the use of braces in an attempt to normalise patellar tracking. The use of these supports or braces has met with mixed reviews in the literature. When used in combination with a systematic rehabilitation programme, these braces seem appropriate. However, when used alone, they may give little or no relief.

Arthroscopy and lateral release may occasionally be necessary. Surgeons should always be prudent in the diagnosis and surgical treatment of this entity because most patients respond well to physiotherapy and do not require surgery.

The Maquet procedure⁸ was described in 1976 to elevate the tibial tuberosity and decrease the patello-femoral joint force. The original recommendation of at least a 2 cm elevation resulted in many complications. In 1979, Ferguson et al⁹ stated that a 1.25 cm elevation was adequate to reduce the patello-femoral joint force and also to reduce the incidence of complications. The primary indication for anterior realignment is pain due

to arthrosis on the distal articular surface of the patella. Advanced diffuse arthrosis which involve the proximal pole is a contraindication to the procedure. Complications include skin necrosis and anterior compartmental syndrome. However, attention to detail, a long osteotomy of more than 10 cm and an elevation of between 1 and 1.5 cm can reduce the complications and ensure satisfactory results.

Recurrent subluxation or dislocation of the patella is associated with a hypermobile patella, a shallow intercondylar sulcus and lateral patellar translation on radiographs. Femoral anteversion, genu recurvatum and pronated feet may contribute to the patellar instability. Initial treatment should always be non-operative. Realignment procedures can be based proximally, distally or both. Proximal procedures include a lateral release and medial reefing. The Roux-Elmslie-Trillat procedure consists of lateral release, medial reefing and anteromedial transfer of the tibial tuberosity on a periosteal hinge. This procedure is indicated in patients with recurrent subluxation and an increased Q-angle.¹⁰ The contraindications for this procedure are open epiphyseal plates or a normal quadriceps angle.

The tibial tuberosity is moved medially only enough to correct the quadriceps angle to within normal limits. It is important not to move the tuberosity to far medially as this would result in medial subluxation or dislocation. It is also critical that the tuberosity should not be moved posteriorly (as in the Hauser procedure) because this causes increased patello-femoral contact pressures.

Antero-medial transfer of the tibial tuberosity as described by Fulkerson¹¹ takes advantage of the geometry of the proximal tibia and an oblique osteotomy. An antero-medial glide of the patellar tendon insertion can then be achieved. This not only provides a redistribution of forces by realigning the extensor mechanism; it also reduces force concentration by elevating the tibial tuberosity. The procedure is most effective when there is arthrosis of the lateral and/or distal patellar surface associated with malalignment. The procedure is very similar to the Roux-Elmslie-Trillat procedure and involves a retinacular release as well as an antero-medial glide of the tibial tuberosity. Fixation with two or more bicortical screws allows immediate mobilisation of the knee joint. The maximum anterior transfer of the tibial tuberosity that can be achieved with this technique is approximately 17 mm. The amount of anterior shift can be controlled by the angle of the osteotomy. The medial shift should only be enough to correct the patellar tracking to within normal limits.

An alternative in young patients with open epiphyseal plates is the transfer medially of the lateral one-half of the patellar tendon as described by Slocum et al.¹² The logic for medial capsular reefing has recently come into question because it has been shown to increase patello-

femoral contact forces.⁶ Three dimensional shifts are now becoming more popular because of the variety of malalignment problems that accompanying patello-femoral arthrosis or instability. Antero-medialisation of the tibial tuberosity with a distal shift may be indicated in patients with lateral subluxation and patella alta. Conversely, there may be a need for a Fulkerson antero-medial glide with a proximal shift in patients with lateral subluxations and patella infera.

Conclusion

Anterior knee pain will continue to be prevalent in our military population. Hence, military trainers and doctors will need to have a better understanding of the problem and its management. Pre-enlistees should be educated about the demands of military training and the level of fitness required before entering national service.

Military ground commanders must recognise that genuine patello-femoral pain can be severe and disabling. Exercises such as squats and stair-climbing lead to tremendous patello-femoral contact stresses and resultant pain. Cross-training with the avoidance of high-impact loading activities to the knee should be practised in the rehabilitation of these patients. Lastly, military doctors and orthopaedic surgeons should have a sound knowledge of patello-femoral biomechanics and the effect of anatomical variations on the patello-femoral joint and its contact forces. Only then would we be able to correctly diagnose, treat and rehabilitate this difficult group of patients.

REFERENCES

1. McGinty J B, McCarthy J C. Endoscopic lateral release. A preliminary report. *Clin Orthop* 1981; 158:120-5.
2. Metcalf R W. An arthroscopic method for lateral release of the subluxating or dislocating patella. *Clin Orthop* 1982; 167:9-18.
3. Bently G, David G. Current concepts of etiology and treatment of chondromalacia patella. *Clin Orthop* 1984; 189:209-28.
4. Casscells W. Gross pathological changes in the knee of the aged individual. A study of 300 cases. *J Bone Joint Surg Am* 1975; 57A:1033-7.
5. Fulkerson J I, Alexander K, Rosenberg T D, Cox J S. Patellofemoral pain. Illinois, USA: American Academy of Orthopaedic Surgeons, Instrumentation Course Lectures, 1992:57-71.
6. McConnell J. The management of chondromalacia patellae. A long term solution. *Aust J Physiotherapy* 1986; 32:215-23.
7. Miller M, Cooper P, Warner J P. Review of sports medicine and arthroscopy. Illinois, USA: W B Saunders Co, 1994:51-61.
8. Maquet I. Advancement of the tibial tuberosity. *Clin Orthop* 1976; 115:225-30.
9. Ferguson A B Jr, Brown T D, Fu F H. Relief of patello-femoral contact stress by anterior displacement of the tibial tubercle. *J Bone Joint Surg Am* 1979; 61A:159-66.
10. Roux C. Cuxation habituelle de la rotule. Traitement operatoire. *Rev Chir* 1888; 8:682-9.
11. Fulkerson J I. Antero-medialisation of the tibial tuberosity for patello-femoral malalignment. *Clin Orthop* 1983; 177:176-81.
12. Slocum D B, Larson R C, James S L. Late reconstruction of ligamentous injuries of the medial compartment of the knee. *Clin Orthop* 1974; 100:23-55.