PATELLOFEMORAL PAIN SYNDROME:

A Practical Treatment Approach

This article discusses the incidence, presentation, anatomy and biomechanics of patellofemoral pain syndrome (PFPS) before delving deeper into patient examination, the practical application of patellar taping, the use of orthoses and exercise rehabilitation therapy. The article is supported by a series of videos which can also be used as part of a patient education programme, as well as printable patient information leaflets. It is also included within our Patellofemoral Pain Toolkit http://spxj.nl/2so6S0Z. Read this article online http://spxj.nl/2s6sWwA

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MEDIA CONTENTS

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Video: Patellar taping for PFPS – http://spxj.nl/2s6sWwA

Patient Information Leaflet: Proximal Muscle Rehabilitation for Patellofemoral Pain (phases 1–4) – http://spxj.nl/2spGDqV

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BACKGROUND

Patellofemoral pain (PFP) accounts for up to 17% of knee pain seen generally, and up to 40% of knee problems seen in the sporting population (1), with up to 7% of adolescents between the ages of 15 and 19 years suffering with the condition (2). The condition is more common in young adolescents, especially those active in sport, and is also seen in military recruits. In addition to active individuals, inactive adolescents who are subjected to a sudden increase in walking and/or stair climbing may also suffer. In both groups the condition represents an inability of tissue to adapt to increased loading.

PFP is variously described as anterior knee pain, chondromalacia patellae, patella malalignment syndrome and patellofemoral pain syndrome. The condition typically presents as a dull ache over the anterior aspect of the knee, worse following prolonged sitting and when descending stairs. Although more common in youth, the condition can occur at any age and is typically associated with patellofemoral osteoarthritis (OA) in seniors.

STRUCTURE AND FUNCTION OF THE PATELLOFEMORAL JOINT

The patella is the largest sesamoid bone (bone lying within a tendon) in the body, attached above to the quadriceps tendon and below to the patellar tendon. Medially and laterally the patellar retinacula (fibrous tissue to the side of the patella) offer support. The breadth of the pelvis and close proximity of the knee creates an outward (valgus) angle of the tibia compared to the femur. Coupled with this, the direction of pull of the quadriceps is along the shaft of the femur and that of the patellar tendon is almost vertical. The difference between the two lines of pull is known as the Q angle and is often considered an important determinant of knee health. Normal values for the Q angle are in the region of 15–20°.

In full extension, the patella does not contact the femur, but lies in a slightly outward (lateral) position. As knee flexion progresses, the patella should move inwards (medially). If it moves laterally it will butt against the prominent lateral femoral condyle and the lateral edge of the patellar groove of the femur. Throughout flexion, different areas of the patellar under-surface are compressed onto the femur below. At 20° flexion, the inferior pole of the patella is compressed, and by 45° the middle section is affected. At 90° flexion, compression has moved to the superior aspect of the knee. In a full squatting position, with the knee reaching 135° flexion, only the medial and lateral areas of the patella are compressed.

Patellofemoral loads may be as

> “EXERCISE THERAPY THAT COMBINES HIP AND KNEE ACTIONS (RATHER THAN KNEE MOVEMENT IN ISOLATION) IS A MAINSTAY OF TREATMENT FOR THIS CONDITION”

high as three or four times body weight as the knee flexes in walking, and nine times body weight when descending stairs or walking down a slope. Changes in patellar contact area and contact force make knee angle an important consideration in the selection of exercise during rehabilitation, together with applied load (weight or resistance band) and muscle contraction type.

PATIENT EXAMINATION AND DIAGNOSIS

On subjective examination, PFP typically presents as a diffuse dull ache over the anterior aspect of the knee. The pain may be worse with loading in a bent knee position with pain onset on rising from prolonged sitting or with stair climbing. Typically, descending stairs is worse than ascending. There is rarely a history of specific injury, rather a history of symptom exacerbation when loading is increased for example through training increase, competition, or an increase in knee-loading activity during daily living.

PFP must be differentiated from patellar tendinopathy, Osgood–Schlatter syndrome, and Sinding-Larsen and Johansson (SLJ) syndrome. Patellar tendinopathy is more common with jumping actions and commonly presents with pain localised to the inferior pole of the patella (insertion) or patella tendon proper (body). In Osgood–Schlatter syndrome pain is normally restricted to the tibial tubercle. In SLJ syndrome there is normally point tenderness to the inferior pole of the patella, as with insertional tendinopathy, but X-radiography reveals subtle changes with calcification over the longer term. The condition must be distinguished from traumatic avulsion fracture, which shows a definite history of injury.

PFP is reproduced in 80% of patients when performing a squatting action, and tenderness to the patellar edges is seen in 71–75% (3), making these two clinical tests important in objective examination. Traditional grinding tests (patellar compression during quadriceps contraction) have low sensitivity and diagnostic accuracy in PFP (1).

SHORT-TERM PAIN RELIEF

Patellar Taping

Short-term (3 months or less) pain relief may often be provided by temporarily changing the position of the patella through taping. Exercising with the taping in place can modify symptoms, and may re-educate muscle sequencing to change patellar alignment. Initially, open web adhesive taping is applied to protect the skin against excessive tape drag. The pull of the final taping is applied using 5cm zinc oxide tape. Most commonly a medial glide is applied; however, the taping position and applied stress may be varied to provide the best reduction in the patient's symptoms. Taping of this type is likely to facilitate the patient's engagement in rehabilitation (4). Where taping cannot be tolerated because of skin irritation, bracing to limit lateral tracking may be used as an alternative for short-term relief.

Fat pad impingement (Hoffa's syndrome) may coexist with PFP. When in a standing position, the patella rests on the fat pads, and changes to the patella alignment can occur if the pad is enlarged. Relief of fat-pad-related pain may often be given using 'V' taping attached from the tibial tubercle to run either side of the patella. The action is to draw the taping upwards so the patella is cradled in the base of the 'V'. Video 1 demonstrates how to apply patellofemoral taping as well as taping for Hoffa's syndrome.

> "PATELLOFEMORAL PAIN ACCOUNTS FOR UP TO 40% OF KNEE PROBLEMS SEEN IN THE SPORTING POPULATION"

Foot Biomechanics and Orthoses

During normal running gait, the subtalar joint (STJ) is slightly supinated (high arch) at heel strike. As the foot moves into ground contact, the joint pronates (low arch), pulling the lower limb into internal rotation and unlocking the knee. As the gait cycle progresses, the STJ moves into supination again, externally rotating the leg as the knee extends (locks) to push the body forward. This biomechanical action combines mobility and shock absorption (STJ pronation and knee flexion) with rigidity and power transmission (STJ supination and knee extension), and shows the intricate link between foot and knee function.

If STJ pronation is excessive or prolonged, external rotation of the lower limb will be delayed. At the beginning of the stance phase, STJ pronation should have finished but if it continues the tibia will remain externally rotated, stopping the knee from locking. The leg must compensate to prevent excessive strain on its structures, and so the femur rotates instead of the tibia and the knee is able to lock once more. As the femur rotates internally in this manner, the patella is forced to track laterally.

In many circumstances the patella can cope with this extra stress, but if

Video 1: Patellar taping for PFPS (C. Norris, 2017)

Video 2: Strengthening exercises for the knee Part 1 (C. Norris, 2017)

Video 3: Strengthening exercises for the knee Part 2 (C. Norris, 2017)

> REPRODUCTION OF SYMPTOMS DURING A SQUAT AND TENDERNESS TO THE PATELLAR EDGES ARE IMPORTANT CLINICAL TESTS FOR PFP

additional malalignment factors exist, such as anteversion of the femur (internal rotation), vastus medialis oblique (VMO) weakness or tightness of the lateral retinaculum, the lateral patellar tracking may cause symptoms. Biomechanical assessment of the lower limb is useful as part of an objective examination in the management of this condition. If hyperpronation is present, it may be corrected using changes in footwear, patient education and/or orthosis prescription to reduce knee symptoms to give short-term benefits of symptom modification.

Not all patients with PFP benefit from foot orthoses. Benefit can be predicted by greater midfoot mobility, reduced dorsiflexion motion range, and immediate PFP improvement when performing a single-leg squat while wearing an orthosis (5).

REHABILITATION

Exercise therapy that combines hip and knee actions (rather than knee movement in isolation) is a mainstay of treatment for this condition both to reduce pain and increase function in the short, medium and long term (1).

Where individuals get pain on assessment of a single-leg squat, lower limb alignment may be addressed as part of motor control training in the short term to modify symptoms. If patients show a Trendelenburg sign (hip adduction, tibial medial rotation and foot pronation) this movement should be modified using a temporary orthotic and patient re-education to determine if symptoms reduce.

Enhancing hip strength can be achieved by both open and closed chain actions. Closed kinetic chain (CKC) actions are more functional, mimicking the weight-bearing actions that load the leg. However, leg loading in the early stages of the condition may exacerbate symptoms and so open chain actions may be used until pain settles. Additionally, CKC actions will work the hip and knee together, which may not be required in the presence of irritable knee structures. Open chain gluteal actions, such as the traditional clam shell in crook side lying, and the fire hydrant and donkey kick in kneeling, together with hip scissor actions, are useful starting points. Motion range and resistance is progressed with the aim of reducing pain intensity and frequency during daily living actions, and enhancing tissue load tolerance. CKC actions can be begun partial weight-bearing progressing to full weight-bearing. Single-leg squat, step-down (eccentric) and full step (concentric-eccentric) exercises may all be performed initially holding a wall bar in the gym or chair back/pole at home. Focusing on lower limb alignment to avoid excessive hip adduction may reduce symptoms, and the symptom-free movement range and type should initially be chosen. As tissue tolerance is enhanced, both range and alignment should be varied to increase movement variability. Varying training in this way may avoid building fear of certain movement types and encouraging behaviours that avoid actions out of fear of symptom reproduction (hypervigilance).

Resistance should be increased to build lower limb strength, and specific motor control actions may give way to more traditional gym-based lower limb exercises such as leg-press, squat variations, deadlift (bent leg and straight leg), and lunge actions with increasing weight and varying motion ranges and speed. Sport- or task-specific movement should also be incorporated to regain confidence in the limb. Videos 2–6 demonstrate a progression of knee strengthening exercises.

References

1. Crossley KM, Callaghan MJ, Linschoten R. Patellofemoral pain. **British Journal of Sports Medicine 2016;50:247–250**
2. Rathleff MS. Patellofemoral pain during adolescence: much more prevalent than appreciated. **British Journal of Sports Medicine 2016;50(14):831–832**
3. Nunes GS, Stapait EL, Kirsten MH et al. Clinical test for diagnosis of patellofemoral pain syndrome: systematic review with meta-analysis. **Physical Therapy in Sport 2013;14:54–59**

> PATELLOFEMORAL PAIN RARELY HAS A HISTORY OF SPECIFIC INJURY

Video 4: Strengthening exercises for the knee Part 3 (C. Norris, 2017)

Video 5: Strengthening exercises for the knee Part 4 (C. Norris, 2017)

Video 6: Proprioceptive and functional strengthening exercises for the knee (C. Norris, 2017)

4. Barton CJ, Lack S, Hemmings S et al. The 'Best practice guide to conservative management of patellofemoral pain': incorporating level 1 evidence with expert clinical reasoning. **British Journal of Sports Medicine 2015;49:923–934**
5. Crossley, Stefanik KM, Selfe J et al. 2016 Patellofemoral pain consensus statement from the 4th International Patellofemoral Pain Research Retreat, Manchester. Part 1: terminology, definitions, clinical examination, natural history, patellofemoral osteoarthritis and patient-reported outcome measures. **British Journal of Sports Medicine 2016;50:839–843**.

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DISCUSSIONS

- **What is the Q angle and why is it useful?**
- **If a patient presents with knee pain, which tests would you perform to diagnose patellofemoral pain (PFP) and how would you rule out other related syndromes?**
- **What can be done to provide short-term relief from PFP?**
- **Create a progressive series of exercises for rehabilitation from PFP.**

KEY POINTS

- **Patellofemoral pain (PFP) is a common knee problem in sport.**
- **PFP typically presents as a dull ache over the anterior aspect of the knee, which is worse after prolonged sitting or when descending stairs.**
- **The Q angle is a measurement of the angle between the line of the quadriceps muscle and the line of the patellar tendon: a normal Q angle is 15–20°.**
- **Patellofemoral loads can be as high as nine times body weight when descending stairs.**
- **Differential diagnoses include patellar tendinopathy, Osgood–Schlatter syndrome, and Sinding-Larsen and Johansson syndrome.**
- **Two important diagnostic tests are the reproduction of PFP during performance of a squat and tenderness to the patellar edges.**
- **Taping can often provide short-term pain relief and allow rehabilitation.**
- **Patients with greater midfoot mobility and reduced dorsiflexion motion range are more likely to benefit from foot orthotics.**
- **Rehabilitation involves exercise therapy to increase hip strength.**
- **Rehabilitation can begin with open chain exercises with subsequent progression to closed chain and then sport- or task-specific movements.**

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