



## Management of Patello-femoral pain

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*Patello-femoral pain is a multifactorial problem. There are many causes of patello-femoral pain which have been cited in the literature, including an increased Q angle, tight lateral structures, tight hamstrings and gastrocnemius muscles, tight anterior hip structures, pronated feet, patella alta/baja, vastus medialis oblique insufficiency, and poor activation of the gluteus medius posterior fibres. These factors cause a change in pressure distribution of the patella on the femur.*

Most patello-femoral conditions may be successfully managed with physical therapy. The aims of the treatment are twofold: first, to unload abnormally stressed soft tissue around the PF joint by optimising the patellar position and second, to improve the lower limb mechanics, which, if executed well, will significantly decrease the patient's symptoms.

Stretching the tight lateral structures and changing the activation pattern of the VMO may decrease the tendency for the patella to track laterally and should enhance the position of the patella. Stretching the tight lateral structures can be facilitated passively, by the therapist mobilising and massaging the lateral retinaculum and the iliotibial band, as well as the patient, performing a self-stretch on the retinacular tissue. However, the most effective stretch to the adaptively shortened retinacular tissue may be obtained by a sustained low load, using tape, to facilitate a permanent elongation of the tissues. This utilises the creep phenomenon, which occurs in viscoelastic material when a constant low load is applied. It has been widely documented that the length of soft tissues can be increased with sustained stretching. The magnitude of the increase in displacement is dependent on the duration of the applied stretch, that is if the stretch is applied for long periods the increase in displacement is large, hence the term time dependent. If the tape can be maintained for a prolonged period of time, then this, plus training of the VMO to actively change the patellar position, should have a significant effect on patellofemoral mechanics. However, there is some debate as to whether tape actually changes the position of the patella. Some investigators have found that tape changes PF angle and lateral patellar displacement, but congruence angle is not changed (Roberts, 1989). Others have concurred, finding no change in congruence angle when the patella is taped, but congruence angle is measured at 45° knee flexion, so subtle changes in patellar position may have occurred before this (Bockrath, 1992).

A recent study of asymptomatic subjects found that medial glide tape was effective in moving the patella medially ( $p=0.003$ ) but ineffective in maintaining the position after vigorous exercise ( $p<0.001$ ). But, tape seems to prevent the lateral

shift of the patella that occurred with exercise ( $p=0.016$ ) (Larsen et al 1995). The issue for a therapist, however, is not whether the tape changes the patellar position on x-ray, but whether the therapist can decrease the patient's symptoms by at least 50%, so the patient can exercise and train in a pain free manner.

### Patellar taping

Patellar taping is unique to each patient, as the component/s corrected, the order of correction and the tension of the tape is tailored for each individual, based on the assessment of the patellar position. The worst component is always corrected first and the effect of each piece of tape on the patient's symptoms should be evaluated by reassessing the painful activity. It may be necessary to correct more than one component. After each piece of tape is applied, the symptom producing activity should be reassessed. The tape should always improve a patient's symptoms immediately. If it does not, then, the order in which the tape has been applied or the components corrected should be re-examined.

If a posterior tilt problem has been ascertained on assessment, it must be corrected first, as taping over the inferior pole of the patella will aggravate the fat pad and exacerbate the patient's pain. The posterior component is corrected together with a glide or a lateral tilt with the non-stretch tape being placed on the superior aspect of the patella, either on the lateral border to correct lateral glide or in the middle of the patella to correct lateral tilt. This positioning of the tape will lift the inferior pole out of the fat pad and prevent irritation of the fat pad.

If there is no posterior tilt problem, the glide may be corrected by placing tape from the lateral patellar border to the medial femoral condyle. At the same time the soft tissue on the medial aspect of the knee is lifted towards the patella to create a tuck or fold in the skin. The skin lift helps anchor the tape more effectively and minimises the friction rub (friction between the tape and the skin), which can occur when a patient has extremely tight lateral structures. In most cases, hypoallergenic tape is placed underneath the rigid sports tape to provide a protective layer for the skin and if there seems to be additional skin problems a plastic coating, either a spray or a roll-on may be applied to the skin, prior to the tape application.

The mediolateral tilt component is corrected by placing a piece of tape firmly from the middle of the patella to the medial femoral condyle. The object is to shift the lateral border away from the femur so that the patella becomes parallel with the femur in the frontal plane. Again the soft tissue on the medial



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aspect of the knee is lifted towards the patella.

External rotation is the most common rotation problem and to correct this, the tape is positioned at the inferior pole and pulled upwards and medially towards the opposite shoulder while the superior pole is rotated laterally. Care must be taken so that the inferior pole is not displaced into the fat pad. Internal rotation, on the other hand, is corrected by taping from the superior pole downwards and medially.

The patient must be taught how to position the tape on him/herself. The patient should be in long sitting with the leg out straight and the quadriceps relaxed. The clinician is aiming for at least a 50% decrease in symptoms. If this has not been achieved further correction may be necessary with ongoing evaluation of patellar position as correction of one component may change the other components.

If the tape cannot change the patient's symptoms or even worsens the symptoms, then one of the following must be considered:

- i) the patient requires tape to unload the soft tissues.
- ii) the tape was poorly applied.
- iii) the assessment of patellar position was inadequate.
- iv) the patient has an intra-articular primary pathology which is inappropriate for taping.

## Unloading

The principle of unloading is based on the premise that inflamed soft tissue does not respond well to stretch. For example, if a patient presents with a sprained medial collateral ligament, applying a valgus stress to the knee will aggravate the condition, whereas a varus stress will decrease the symptoms. The same principle applies for patients with an inflamed fat pad, an irritated iliotibial band or a pes anserinus bursitis. The inflamed tissue needs to be shortened or unloaded. To unload an inflamed fat pad, for example a 'V' tape is placed below the fat pad, with the point of the 'V' at the tibial tubercle coming wide to the medial and lateral joint lines. As the tape is being pulled towards the joint line, the skin is lifted towards the patella, thus shortening the fat pad. The same type of 'V' tape may be used to unload the distal end of the ITB when treating iliotibial friction syndrome. The point of the V is at the lateral joint line with the tape coming out wide to the anterior aspect of the femur above and the anterior aspect of the tibia below.

It has been fairly well established that taping the patella relieves pain (Gilleard et al 1998, Powers et al 1997, Bockrath et al 1992, Conway et al 1991), the mechanism of the effect is still being debated in the literature. It has been found that taping the patella of symptomatic individuals such that the pain is decreased by 50% results in an earlier activation of the VMO relative to the VL on both step up and step down. Stepping down in particular caused an 8.3° differential between the VMO and VL, as not only was the VMO activating earlier than the pre taped condition, but the VL was significantly delayed in the taped con-

dition (Gilleard et al 1998). However, in a study by Cerny (1995), where all subjects had a medial tilt and internal rotation of the inferior pole taping, there was no change in activation pattern of the VMO and VL when the subjects were taped. But patellar taping has been associated with increases in loading response knee flexion as well as increases in quadriceps muscle torque. When the quadriceps torque of symptomatic army personnel was evaluated in taped, braced and control conditions, it was found that the taping group generated both higher concentric and eccentric torque than both the control and braced groups. The braced group did perform better than the control group in the eccentric situation. This increase in muscle torque did not correlate with pain reduction (Conway et al 1991).

Even in an osteoarthritic group taping the PF joint in a medial direction has a significant effect on pain. Fourteen patients with a mean age 70 years and radiographic evidence of tibiofemoral and patellofemoral osteoarthritis participated in a single blind, blind observer randomised crossover trial of three different forms of taping - neutral, lateral, medial. Patients were not told which tape was thought likely to be effective. The knee pain was recorded with a 10cm VAS before and one hour after tape application. Tape was kept on for four days and overall pain on each of the four days was recorded in a diary. After four days the patients removed the tape and were asked to score the change in symptoms in the treated knee compared with before taping. After a three day interval the procedure was repeated for the second tape position and following a further four days of tape application and three day interval, they entered the final arm of the study. At the end of the study the assessor recorded which week of treatment each patient had preferred. Medial patellar taping was significantly better than lateral or neutral tape for pain scores, symptom change and patient preference. In this elderly osteoarthritic group medial patellar taping resulted in a 25% reduction in knee pain (Cushnagen et al 1994).

## Principles of using tape to correct the patella

The tape is kept on all day everyday until the patient has learnt how to activate his/her VMO at the right time, that is, the tape is like trainer wheels on a bicycle and can be discontinued once the skill is established. The tape is removed with care in the evening, allowing the skin time to recover. The tape can cause a breakdown in the skin either through a friction rub or as a consequence of an allergic reaction. Preparation of the skin and skin care advice is essential.

The patient should never train with or through pain or effusion, as it has been shown quite conclusively in the literature that effusion has an inhibitory effect on muscle activity (Spencer et al 1984, Stokes et al 1984, deAndrade 1964). If the patient experiences a return of the pain, then the patient should readjust the tape.



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If the activity is still painful, the patient must cease the activity immediately. The tape will loosen quickly if the lateral structures are extremely tight or the patient's job or sport requires extreme amounts of knee flexion.

## Muscle Training

The current debate when rehabilitating the PF joint is over the type of strengthening of the quadriceps muscle. Powers concludes that, because there is no difference in the activation pattern of the VMO and VL in symptomatic individuals and the ratio of the two muscles is the same, generalised quadriceps strengthening is all that is required when rehabilitating patients with PF pain. However, this seems at odds with clinical findings and other research, where electrical stimulation of the VMO and EMG biofeedback training have demonstrated similar positional changes on x-ray (Koh et al, Ingersoll et al 1991).

To determine the effect of quadriceps training on the patellar position of asymptomatic college students, Ingersoll & Knight conducted a three week training program. The students were randomly assigned to one of three groups - a control group, a group who trained with an EMG biofeedback on the VMO to improve its activity and a group who performed progressive resisted strengthening to the whole quadriceps (DAPRE). The congruence angle of the patella was measured before and after training for each group. The position of the patella did not change in the control group. The EMG biofeedback group demonstrated a medial glide of the patella and the patella was more centered in the trochlea, whereas the DAPRE group demonstrated a lateral displacement of the patella, even though there was a 170% increase in quadriceps strength in this group. This study indicates that it is possible to selectively train the VMO to have an effect on the patellar position. What types of exercises are most appropriate in training? From the current evidence available, it seems that closed chain exercise, i.e. when the foot is on the ground, is the preferred method of training, not only because closed kinetic training has been shown to improve patellar congruence, but muscle training has been found to be specific to limb position (Douchette et al 1995). In a group of patients with lateral patellar compression syndrome, it was found that open chain exercise with isometric quadriceps sets at 10° intervals with 3kg weight resulted in more lateral patellar tilt and glide from 0-20° on CT scan. Closed chain exercise by pushing a foot-plate with resistance cords attached to provide 18kg resistance demonstrated improved congruence from 0-20°. This study supported the findings of Koh, Grabiner, DeSward who found that stimulation of the VMO at full extension produced medial patellar rotation, tilt and glide, whereas isometric quads contraction produced lateral patellar rotation, tilt and glide.

## Consideration of foot problems

Patients who exhibit prolonged pronation during mid stance in gait, may be shown how to train the supinators of their feet. This should improve the stability of the foot for push off and

decrease the increased valgus vector force created at the knee by the abnormal foot pronation. The position of training is mid-stance, the patient is instructed to lift the arch while keeping the great toe on the ground, and then pushing the first metatarsal and great toe into the ground. The rationale behind this exercise is that if the base of the first metatarsal is lifted, using the tibialis posterior muscle, the line of action of the peroneus longus is improved. The peroneus longus can then efficiently act on the first metatarsal and improve the stability of the first ray in preparation for push off (Root et al 1977). If the patient is unable to keep the first metatarsophalangeal joint on the ground when the arch is lifted, then the foot deformity is too large to correct with training alone and orthotics will be necessary to control the excessive pronation.

## Conclusion

Management of patellofemoral pain is no longer a conundrum if the therapist can determine the underlying causative factors and address those factors in treatment. It is imperative that the patient's symptoms are significantly reduced. This is often achieved by taping the patella, which not only decreases the pain, but also promotes an earlier activation of the VMO and increases quadriceps torque. Management will need to include specific VMO training, gluteal control work, stretching tight lateral structures and appropriate advice regarding the foot, be it suitable footwear, orthotics, muscle training or taping.

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