Cyclists' knee injuries - patellofemoral syndrome

What to do about patellofemoral pain, which accounts for a quarter of all cycling problems

Cycling has grown steadily in popularity over the last 20 years, as sports-active people have gradually come to realise that it represents a fantastic way to improve fitness in a 'joint-friendly' manner (ie, without the repetitive joint-impact forces associated with running). Overall, cycling is considered to be much less injury-producing than running, and indeed many runners substitute cycling for running workouts in order to 'give their legs a break' and recover more completely between running sessions.

None the less, regular cycling training is in fact associated with a significant number of 'overuse' injuries (injuries which result when the chosen volume or intensity of training causes damage to tissues which are not adequately repaired during a training cycle), and research indicates that knee pain, and more specifically what is called the patellofemoral syndrome, is the most common cycling injury, accounting for around 25% of all cycling problems (‘The biomechanics of cycling,’ In: Holloszy JO, ed., Exercise and Sports Science Reviews, Baltimore, Md: Williams & Wilkins; pp. 127-167 1991).

Traditionally, chronic knee pain in athletes involving the patella and surrounding structures has often been referred to as 'chondromalacia patellae'. However, in truth chondro-malacia patella refers to a softening and fissuring that can be observed on the surface of the patella (knee cap) and thus is only one of many sources of knee discomfort.

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Biomechanical abnormalities of the patellofemoral complex (the knee cap, the femur, and their associated muscle and connective tissues), in conjunction with strenuous training, are believed to be responsible for most cases of chronic knee pain in cyclists. These abnormalities are believed to put undue pressure on cartilage within the knee during the constant knee flexion and extension associated with cycling, producing degeneration of the cartilaginous structures. As the cartilage breaks down, extra pressure is then put on the bones which come together at the knee joint, producing bone pain and inflammation, and byproducts of the cartilage destruction may irritate the synovial membrane of the knee, causing synovitis and significant discomfort (‘A Review of the Etiology, Biomechanics, Diagnosis, and Management of Patellofemoral Pain in Cyclists,’ International Sports Medicine Journal (on-line), Vol. 2(1), April 2001).

Different explanations

What causes the poor biomechanics that can lead to patellofemoral pain? Experts have offered a variety of explanations, including poor quadriceps function, vastus-medialis insufficiency, subtalar-joint pronation, poor muscle flexibility, abnormal lower-limb biomechanics, incorrect bicycle and equipment settings (saddle height, cleat position, cleat type and shoe type), abnormal fore-foot and rear-foot alignment, leg-length discrepancies,
and varus or valgus knee malalignments. Training factors linked with patellofemoral pain include hill training, cycling with high gears at a low cadence, and a sudden increase in training volume.

Generally, true patellofemoral pain presents itself as pain in the front of the knee, particularly in the top-front and top-inside-front of the knee area. Initially, the pain is characterised by a rather diffuse ache around the patella, and occasionally it is described as a vague knee pain 'underneath the kneecap'. Climbing stairs or sitting for prolonged periods can make the pain worse. Patellofemoral-pained knees may 'lock up', 'give way', 'catch', make 'cracking' noises, and exhibit swelling ('Differentiating between meniscal and patellar pain,' Physician and Sports Med., vol. 17(8), pp. 95-108, 1989). The duration of pain can vary from a few minutes after cycling training to pain that starts during a workout and lasts for several hours after training ceases. In some cases, the pain is chronic and does not resolve itself between workouts.

'In more than 80% of cyclists with patellofemoral pain, there was excessive side-to-side swinging of the knee during downstroke'

As mentioned, lower-limb bio-mechanics during cycling are believed to be important in determining the risk of patellofemoral pain. Research in this area has a long way to go, but kinematic analysis of the knee has been used to evaluate cyclists for the presence of abnormal knee movement - the idea being that it might be possible to define certain movement patterns associated with a higher risk of patellofemoral pain ('Injury prevention for cyclists: a biomechanical approach,' In Burke, ER, ed. Science of Cycling, Champaign, Ill: Human Kinetics Pubs Inc; pp.145-184, 1986). In a recent study, in more than 80% of cyclists presenting with patellofemoral pain, an abnormal mediolateral deviation of the knee during the downstroke of cycling was demonstrated (ie, there was excessive side-to-side swinging of the knee during downstroke, as the knee underwent extension). In a control group of cyclists with no patellofemoral pain, most had a linear pattern of downstroke, with little mediolateral deviation ('Abnormal patterns of knee medio-lateral deviation (MLD) are associated with patellofemoral pain (PFP) in cyclists,' Med Sci Sport Exerc, vol. 28(5), p. 554, 1996).

The proper steps to take

If you're a cyclist who develops patellofemoral pain, your first task is to decrease the pain and swelling around your affected knee. You'll need the standard curatives - active rest, application of ice, perhaps some local ultrasound, plus the sensible use of non-steroidal anti-inflammatory drugs (no research has looked at which of these commonly recommended courses of action are actually superior). In about 80% of cyclists with patellofemoral pain, use of these simple modalities will alleviate symptoms significantly in a relatively short period of time ('Chondro-malacia patellae in athletes - clinical presentation and conservative management,' Am J Sports Med, vol. 7(1), pp. 5-11, 1979).

However, note that these conservative and traditional treatments only decrease symptoms temporarily. If you have patellofemoral pain and 'cure' yourself with rest and ice - and then return to the kind of training you were carrying out before the pain arose, in most cases the discomfort will come right back again. In one study of conservative
Patellofemoral-pain treatment which included a long follow-up, it was found that only 30% of patients remained symptom free after 12 months ('Management of chondromalacia patellae: a long term solution,' Aust J Physiother, vol. 32(4), pp. 215-222, 1986). The reason for this, of course, is that the rest, ice, drugs, and ultrasound do not correct the biomechanical deficiency or lack of strength which is actually creating the problem.

Thus, once symptoms have subsided, the real goal is to improve joint mobility, muscle strength and power, and ultimately the function of the patellofemoral joint. The quadriceps muscles, and in particular the vastus medialis obliquus muscle, need to be fortified for cycling (using resistance exercises such as leg presses), abnormal movements of the lower limb need to be identified and corrected, and training errors need to be eliminated. Hill training should be approached cautiously and progressively, and all upswings in volume and intensity should be made in a gradual manner. Cycling techniques which decrease patellofemoral joint-reaction forces should be emphasised, at least at first; these include spinning, using low rather than high gears, and (as mentioned) avoiding excessive amounts of hill training.

The drawbacks of surgery

As is almost always the case for athletic injuries, surgical options should be considered only if the above steps have failed (for one thing, the long-term outcomes of surgical interventions to correct patellofemoral pain in cyclists have been very poorly studied in a scientific setting). The surgical procedures for patellofemoral pain include lateral retinacular release, distal realignment, dynamic realignment, patellar shaving, and even patellectomy. A lateral retinacular release involves the cutting of all the lateral structures from the patellar tendon to within the muscle fibres of the vastus lateralis, accomplished during an arthroscopy. Fairly good results have been obtained with this technique, but it’s very important to note that in most cases the post-operative rehabilitation programme was considered an important element in the overall success of this procedure ('Subluxation patella. Conservative versus postsurgical patella rehabilitation,' In: Margine RE, ed. Physical Therapy of the Knee. New York, NY: Churchill-Livingstone; pp. 127-129, 1988).

Dynamic realignment involves the transfer of muscles or tendons to counteract the lateral tracking of the patella, thereby increasing the effect of the medial pull of the vastus medialis obliquus muscle. Outcomes associated with this procedure haven’t exactly been over-whelming; as critics have pointed out, the technique interferes with an already weakened muscle. Indeed, post-operative recovery appears to be quite slow ('Surgical overview of the patello-femoral joint,' In: Mangine RE, ed. Physical Therapy of the Knee. New York, NY: Churchill Livingstone; 1988).

Likewise, reports on patellar shaving and patellectomy don’t exactly give one a warm and cuddly feeling; patellar shaving has been shown to produce variable and often only temporary improvement of pain, and patellectomy has severe negative effects on the biomechanics of the knee, as you might expect (who thought up this one?). In contrast, a very simple procedure - washing out the knee (arthroscopic lavage) - can have a profoundly positive effect on knee pain. Potentially, it can remove small particles of cartilage that produce synovitis.
Conclusions?

Before undertaking serious cycling training, it makes sense to spend time strengthening one’s knees, using exercises like leg presses, squats, bench step-ups, bicycle leg swings, knee extensions, hamstring curls, stair climbing, and very small amounts of cycling against high resistance. Once regular cycling training begins, workouts should advance in duration and intensity only gradually, and symptoms of patellofemoral pain should be treated quickly - with augmented recovery, icing, and perhaps anti-inflammatory medications. Most importantly, you should realise that the appearance of knee pain indicates an inability of the knee to stand up to the training that is being carried out. This situation, in which training outpaces the ability of the knees to adapt, leaves athletes with two choices: they can either back down on their training or bulk up their efforts to fortify their knees in a cycling-specific way.