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# Editorial

The 1970's were a pivotal time for Sports Medicine. For reasons that are still unclear, long distance, especially marathon running suddenly developed as a popular recreational activity for many thirtysomething's who had not previously considered themselves to be particularly athletic. The result was that the numbers of entrants in road races such as the New York and London marathons and our own Comrades Marathon, suddenly jumped from a few hundred to tens of thousands. Whilst this passion for marathon running has dissipated somewhat in the last 5 years, its influence is still felt with the growth in participation in diverse recreational activities including aerobics and other gymnasium activities, cycling, walking and hiking, and water sports.

But perhaps the greater contribution of the 1970's to Sports Medicine was the acceptance of podiatry as a crucial component in injury treatment and prevention especially in mechanically repetitive sports like running. Prior to the 1970's, the management of these injuries followed a traditional approach that focused exclusively on the site of injury. No attention was given to an understanding of why the injury happened in the first place. As a result, the majority of injured runners in those years soon became ex-runners. Fortunately the skills of an evolving profession in North America soon began to seek answers in an unusual direction. These podiatrists spearheaded by Dr Richard Schuster in New York and Drs John Pagliano and Steve Subotnick in California, inspired a revolution in our understanding of how these injuries occurred. Their genius was to suggest that identifiable and correctable abnormalities in the lower limb could explain why these injuries were resistant to our conventional treatments which failed to acknowledge their importance.

In this edition of the Journal, guest editor Dennis Rehbock and his colleagues address these issues in the first edition of our Journal ever to be dedicated exclusively to podiatry. We are also privileged to include a paper from one of these inspirational podiatrists Dr John Pagliano who describes his with management of the iliotibial band friction syndrome, perhaps one of the running injuries that is most resistant to therapy. His ideas will be of value to all who struggle with this injury.

Recently a local Cape newspaper carried the interesting opinion of a leading politician who was dissatisfied with what he saw as the fragmentation of medical services. His specific complaint was that prior to and following major hip surgery, he had not been referred for a programme of exercise rehabilitation. Yet when, on his own initiative, he had availed himself of this treatment, he had experienced substantial benefit. Why, he wanted to know, was such referral not routine?

Sports Medicine is leading the way in showing that sportsmen and women, regardless of their ability, benefit most from a multidisciplinary approach, involving experts from a wide range of fields.

It is a pleasure for this multidisciplinary Journal, to provide our podiatric colleagues with the appropriate forum to display their expertise.

**Professor Tim Noakes**  
**Editor**

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# Guest Editorial

Dennis Rehbock - Guest Editor

This issue of the Journal is devoted to podiatric sports medicine.

It gives me great pleasure to be the guest editor of this issue of the South African Journal of Sports Medicine.

In South Africa we are a very small group of podiatrists with an interest in sports medicine and podiatric sports medicine. Our field of interest has developed over many years, based on American podiatric sports medicine and our own experiences. Through personal contacts, increasing involvement in treating sports injuries, and more recently the presentation of podiatric papers at South African Sports Medicine Association (SASMA) Congresses, we are being recognised for our role in the management of injured sportsmen and women. With the modern multi-disciplinary approach to the management of sportsmen and women, the importance of biomechanical analysis and treatment of the feet and lower limb becomes vital for improved performance and injury prevention and treatment.

Mr Bernhard Zipfel describes how forefoot varus, a common foot type, can influence subtalar joint pronation. This foot type causes compensatory overpronation in the foot and may need biomechanical correction.

Bernhard Zipfel is programme leader of the Podiatry department of the Technikon Witwatersrand and a practising podiatrist in the West Rand.

Mr Mike Els provides us with a review of sesamoiditis of the first metatarsal. An increase in the weight bearing ballistic types of sport has resulted in this injury becoming more common.

Mike Els is a lecturer at the Podiatry department of the Technikon Witwatersrand and a practising podiatrist in Alberton.

Mr Darryl Cohen describes the effect of excessive pronation of the foot on patellofemoral pain syndrome. This highlights the role of the podiatrist in the treatment of patellofemoral pain syndrome by means of biomechanical analysis and the prescription of orthotic therapy.

Darryl Cohen is a practising podiatrist in Johannesburg.

In this Journal I have included some work by Dr John Pagliano. Dr Pagliano is a very old friend and colleague from Long Beach California in the United States of America. He is a practising podiatrist in America with a great interest in podiatric sports medicine. Dr Pagliano presented a paper and a clinical workshop at the 1995 SASMA Congress in Durban.

Mr Philip Carstens looks at a podiatric approach to some cycling injuries. This is a sport that is not often associated with foot and lower limb injuries.

Philip Carstens is a practising podiatrist in Cape Town.

As sports podiatrists we are being called upon to take our place in the field of sports medicine. Our recognition by the sports medicine fraternity and the South African Sports Medicine Association will urge us to new heights of excellence in our field of podiatric sports medicine. □

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# Forefoot varus and its influence on subtalar joint pronation

Bernhard Zipfel NHD Pod(SA), NHD PS Ed(SA)

## INTRODUCTION

Forefoot varus is a well recognised foot type and the measurement of the forefoot angle compared to the rearfoot is commonly referred to in podiatric literature. Different disciplines appear to have differing opinions on the definition of forefoot varus and its role in causing lower limb pathology which may lead to a lack of understanding of the etiology of many lower limb injuries especially in long distance runners. Forefoot varus was first defined by Root et al.<sup>1</sup> as an inverted position of the forefoot in relationship to the rearfoot. This is a frontal plane deformity and can be readily seen from the posterior view of the foot by creating a line perpendicular to the bisection of the calcaneus which represents the transverse plane of the rearfoot. This line is then compared to the plantar surface of the metatarsals and any angulation between the two lines determines the degree of forefoot varus present.<sup>2</sup> This comparison is made with the subtalar joint in neutral and the forefoot (midtarsal joint) fully pronated. The etiology of forefoot varus is thought to be a delayed derotation of the head and neck of the talus and decreases from 5 degrees (below 5 years) to 2 degrees in the adult according to Tax (1965).<sup>3,4</sup> Excessive angulation of the forefoot in relation to the rearfoot commonly results in compensatory subtalar joint overpronation and may result in lower limb injuries especially in long distance runners.<sup>5</sup>

### Neutral position and the recognition of forefoot varus

During the stance phase of the gait cycle, the subtalar joint moves through the motions of pronation and supination in order that the foot may act as a mobile adapter (pronation) during the contact and midstance phase and a rigid lever (supination) during the propulsive phase. The primary reasons for these motions is to make the foot function more efficiently and thereby reduce the incidence of injury.<sup>6,7</sup> The foot strikes the ground in a supinated position, moves into a pronated position in order to absorb shock and resupinates in order to propel the body forward.<sup>8</sup> In order for the subtalar joint to move from a supinated position into a pronated position it must go through a neutral position in which the joint is neither pronated nor supinated. This occurs shortly after heel strike and just before heel lift. At the point before heel lift the foot is still flat on the ground with the body weight perpendicular to the foot. The ground reaction forces load the lateral side of the forefoot, dorsiflexing the fifth metatarsal head and fully pronating the midtarsal joint<sup>1,3,6</sup> into a position perpendicular with the posterior bisection of the calcaneus. This occurs because the natural non-weightbearing position of the forefoot is slightly inverted and the eversion range of motion is usually available

to allow the forefoot to adapt to the weightbearing position. At this critical point during the stance phase the subtalar joint is neutral and the midtarsal joint fully pronated so that the foot is neither pronated nor supinated. Root et al.<sup>1</sup> stated that the foot, at this point in the gait cycle is in its most functional position and that the timing of this neutral position is essential in determining the correct amount of supination for efficient propulsion and toe-off.<sup>1,7</sup> Wernick and Langer<sup>8</sup> defined subtalar joint neutral as the palpation of the head of the talus attaining osseous congruency between the head of the talus and the navicular bone. The lateral side of the foot is loaded to resistance so that the midtarsal joint is fully pronated.<sup>4</sup> By manipulating the foot into this position (Figure 1), the critical point just before heel lift can be simulated and any biomechanical abnormalities seen. Observations are best done with the patient prone (Figure 2).



Figure 1. Neutral position. Note position of hands.



Figure 2. The classic position for observing forefoot varus.

Strictly speaking, forefoot varus is an osseous frontal plane deformity,<sup>9</sup> but an element of soft tissue involvement may be present,<sup>4</sup> especially in children<sup>10</sup> which

is indicated by reduced midtarsal joint range of motion. This is difficult to determine, as midtarsal joint range of motion has no fixed parameters.

The soft tissue component of forefoot invertus is referred to as forefoot supinatus. The use of these terms is purely academic, as the resulting compensation is the same regardless of the etiology causing the forefoot to be inverted.

#### The compensatory mechanisms of forefoot varus

Forefoot varus compensates by subtalar joint pronation.<sup>13,11</sup> Jones and Todd<sup>12</sup> stated that a greater than 4 degree forefoot varus will cause maximum eversion of the calcaneus provided that the eversion range of motion is available at the subtalar joint (Figure 3). The resulting compensatory pronation has been recognised in the beginning walker<sup>4,11</sup> and Subotnick<sup>5</sup> identified that forefoot compensatory pronation results in many problems of the medial aspect of the foot, ankle and leg and may result in lumbar lordoses causing back pain. In short, compensatory overpronation may be responsible for almost any common running injury of the lower extremity.

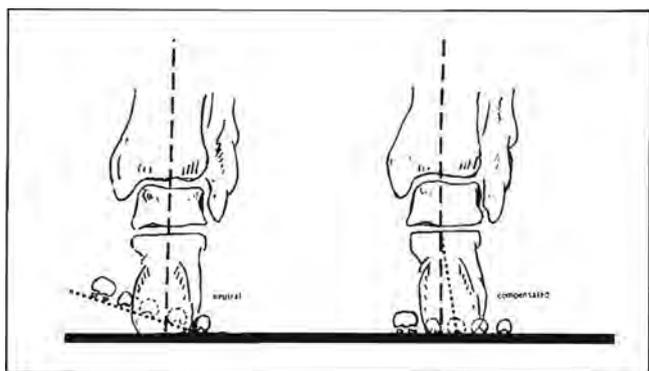


Figure 3. Forefoot varus in neutral non-weightbearing position and compensated weightbearing position.

Should the eversion range of motion not be available in the subtalar joint, the joint will maximally evert and this is known as partial compensation.<sup>8</sup> An example of this could be that there is a forefoot varus of 10 degrees, but the eversion range of motion at the subtalar joint is only 5 degrees and the joint can thus only compensate 5 degrees for the 10 degree forefoot varus. In the rare event of there being no eversion range of motion available in the subtalar joint, then the forefoot varus would remain uncompensated and the foot would function in a supinated position. When full compensation takes place and the foot remains pronated before and after heel lift, the foot does not adequately resupinate for propulsion and toe off. This results in instability of the foot and that is transferred into the leg with the potential for causing a number of foot and lower limb injuries. Should partial or no compensation take place, then the subtalar joint will attempt to evert at the calcaneus, and unable to do so adequately, result in unnatural stresses being applied to the joint and surrounding tissue.

#### The measurement of forefoot varus

Philps<sup>13</sup> put emphasis on the measurement of forefoot varus in orthotic manufacture. Yale<sup>14</sup> referred to the forefoot measuring device. Spencer<sup>15</sup> and Seibel<sup>1</sup> described the use of both the forefoot measuring device and the tractograph in measuring forefoot varus. These measurements are difficult and poor results are obtained.<sup>10</sup> O'Donnell(1995)<sup>10</sup> suggested that there is poor inter-examiner reliability using the forefoot measuring device and it can be presumed that similar devices currently in use do not consistently produce the same results as they work on the same principle. Much has been said about the degree of forefoot varus producing compensatory pronation<sup>4,12,13</sup> and surgical evaluation was described by McGlamry et al<sup>6</sup> but there has been a failure to determine the repeatability and reproducibility of forefoot varus measurements.

The classical instruments used for the measurement of forefoot varus are the forefoot measuring device, which is difficult to use and gives poor measurement<sup>10</sup> and the tractograph or goniometer which is easier to use than the forefoot measuring device.<sup>3</sup> Both methods require the forefoot to be compared to the posterior calcaneal bisection, which is technically to achieve consistently.<sup>17</sup> Literature quantifies forefoot varus in terms of degrees, but fails to explain exactly how these measurements were taken nor does it consider the accuracy of standard methods of measurement.

#### Conclusion

Forefoot varus is an extremely common foot-type and is responsible for compensatory overpronation in a large percentage of distance runners resulting in many of the common running injuries. By understanding the biomechanics of forefoot varus, the etiology of pronation and subsequently the resulting injury can be diagnosed and treated. Although this foot type is difficult, if not impossible to measure, the most common method of 'measurement' is to subjectively estimate the degree of deformity, which appears to be adequate in the author's opinion for clinical purposes. The harmful effects of subtalar compensation can be reduced by modifying the sockliner innersole of the running shoe with a forefoot medial wedge made of EVA or similar material. In some cases it may be necessary to make a neutral orthosis with forefoot medial posting depending on the amount of control required. In both cases the ground is in effect brought up to the forefoot, instead of the forefoot rolling down onto the ground forcing the subtalar joint to compensate by pronating. Many common running injuries can be adequately managed by limiting the compensatory effects of forefoot varus.

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continued on page 11

# A review of Sesamoiditis of the first metatarsal

Michael Els NHD POD(SA)

## INTRODUCTION

Sesamoids can become tender and painful and so too the associated structures and joint complex can be affected, this is loosely termed as sesamoiditis.

Commonly known as the tibial and fibial sesamoids they lie in the tendon slips of the flexor hallucis brevis tendon and underlie the first metatarsal head. These two bones have the function of elevating the first metatarsal head, to disperse impact forces, protect the flexor hallucis longus tendon, reducing friction and allowing the first metatarsal to glide posteriorly during the propulsive phase of gait.<sup>7</sup>

Sesamoiditis is a pain syndrome becoming more common due to the increase in popularity of sports.<sup>2</sup> Though the condition can be found in patients of any age or activity level and may present with symptoms of sudden onset, acute or chronic duration and with or without a history of associated trauma or systemic disease. The condition can be classified as either congenital, anatomical, arthritic, infectious, systemic or ischaemic.

## Etiology

The most common cause of sesamoiditis is repetitive microtrauma from jumping sports,<sup>2,4</sup> such as basketball, netball and in cricket bowlers, where as much as fifty percent of the individuals weight is transmitted through the first metatarsalphalangeal apparatus.

Sesamoiditis is also seen in women due to wearing of high heeled shoes which force the first metatarsal to be vertical, placing the hallux in extension which in turn fixes the medial and lateral sesamoid bases under the metatarsal.<sup>7</sup>

Biomechanical derangement of the lower limb, such as rigid planterflexed first ray, a forefoot valgus or a foot with a marked talar declination angle seem to be predisposed to sesamoiditis.

Typically a sesamoidal fracture is transverse or communicated and one or both sesamoids are involved.<sup>5</sup> It is more common for the tibial sesamoids to be fractured because of the increased load in closed kinetic chain of gait. These injuries should be differentiated from congenital bipartite, tripartite sesamoids which result from the incomplete coalition of the primary ossification centres.<sup>4,5</sup>

## Clinical features

A localized pain on the affected sesamoid is usually described, aggravated by weightbearing and isolated on deep and firm palpation.<sup>3</sup> Pain could be either post traumatic or of insidious onset. Active or passive dorsiflexion and plantarflexion elicit pain. Localized signs of inflammation may or may not occur in the surrounding first metatarsalphalangeal joint. In insidious

sesamoiditis the appearance of adventitious bursitis and or hyperkeratosis underneath the first metatarsalphalangeal joint.<sup>6</sup>

There are many conditions which cause a similar metatarsalgia and may be local or systemic in nature. Osteochondritis or Treve's disease is avascular necrosis of sesamoids showing both lytic and scleritic changes with fragmentation occurring.<sup>1,4</sup>

Radiographic changes are not always seen with sesamoiditis and requires observation for differential diagnosis. Occasionally sesamoiditis can produce a positive bone scan. Differential diagnosis from osteochondritis, fracture, infection, neuritis of the medial plantar nerve, or bursitis.

## Management

Initial treatment involves the need to relieve the pressure off the sesamoid bone. A cushion pad with an aperture over the sesamoids and strapping of the hallux in a planter flexed position in order to relax the tendons containing the sesamoids.<sup>3</sup> Icing, prescription of analgesics and advice on rest and appropriate footwear. The injection of local anaesthetic and anti-inflammatory cortisone derivatives are of help.<sup>4</sup> The prescription of a custom made innersole with a single wing plantar metatarsal pad or where required for more biomechanical correction a "u" out Sheaffer plate orthotic to compensate for a first metatarsal equinus.<sup>4,7</sup> A plaster cast may be used to immobilize and decrease weightbearing of the first metatarsalphalangeal joint if initial padding fails to reduce the symptoms.

If conscientious conservative treatment does not help, surgical removal may be required. This is accomplished by an incision at the medial planter aspect of the metatarsal head with care taken to avoid the planter medial nerve, a dorsal intermetatarsal approach to reach the lateral sesamoid may also be taken.<sup>5</sup> Removal however results in a change of biomechanics to a certain degree and the risks invalidating the function of the short flexors which may lead to subsequent deformities.

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# Excessive pronation as an etiology in patellofemoral pain syndrome

Darryl Cohen NHDPod(SA)

Patellofemoral pain is a common condition facing practitioners. Whilst the condition is common, it is a difficult condition to treat, and there is no clearly defined management protocol. There are many beliefs about the cause of patellofemoral pain, and generally it is accepted to be a condition occurring due to maltracking of the patella.

## Anatomy of the patellofemoral joint

In order to have a good understanding of patellofemoral syndrome, it is vital that the anatomy of the joint is well understood. The patellofemoral joint comprises the articulation between the femur and the patella.

The patella surface of the femur (Fig 1) is situated at the anterior aspect of the condyles of the femur. It extends proximally more on the lateral side, the proximal border being oblique, runs distally and medially, and is separated by the tibial surfaces by two faint grooves crossing the condyles obliquely. Where the medial groove ceases, the patella surface continues to the lateral part of the medial condyle as a semilunar area adjoining the anterior region of the intercondylar fossa, this area articulates with the medial vertical facet of the patella in full flexion.<sup>4</sup>

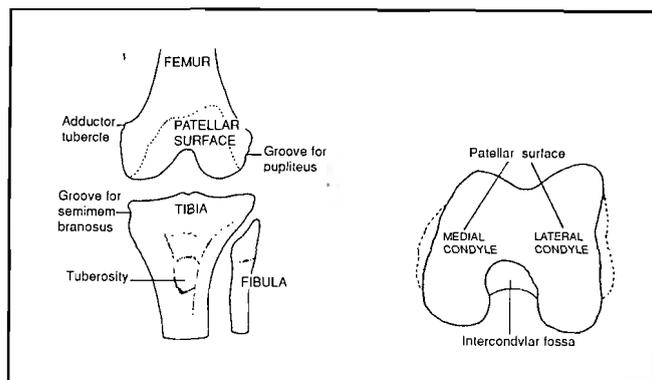


Figure 1. The Knee joint showing the patella surface<sup>2</sup> (Coetzee 1987)

The patella is the largest sesamoid bone in the body, and its main biomechanical function is to increase the effective lever arm of the quadriceps. This bone also centralizes the divergent forces of the quadriceps into one tendon, namely the patella tendon, thus helping to provide stability to the knee joint.<sup>5</sup>

The patella is shaped like an inverted triangle (Fig 2), with rounded sides. The base (proximal end) gives attachment to the quadriceps femoris muscles, and its apex (distal end) gives attachment to the patella ligament and in turn to the tibial tuberosity.<sup>2</sup> The anterior

surface sub-cutaneously is separated from the skin by a prepatella bursa, and is covered by an expansion from the tendon of quadriceps femoris, which blends superficially with fibres of the patella ligament.<sup>4</sup>

The posterior surface of the patella has a proximal smooth, oval, articular area, crossed by a smooth vertical ridge which fits the groove on the femoral patella surface and divides the patella into a medial and larger lateral facet. Both the ridge and flanking are naturally protected by articular cartilage. A narrow strip, proximally broader, is marked off medially from the medial facet, which makes contact with the femoral condyle in extreme flexion. Distal to the apex is a roughened area at the attachment of the infrapatella tendon and proximal to this the area between the roughened apex and the articular surface is covered by an infrapatella fat pad. The thick superior border as an attachment for the rectus femoris and vastus intermedius slopes down and forward, except near the posterior margin. The medial and lateral borders are thinner and converge distally forming the attachments for the expansions of the tendons of vastus medialis and lateralis. Near the superolateral angle is a shallow, circular depression for a distinct attachment of the tendon of vastus lateralis.<sup>3</sup>

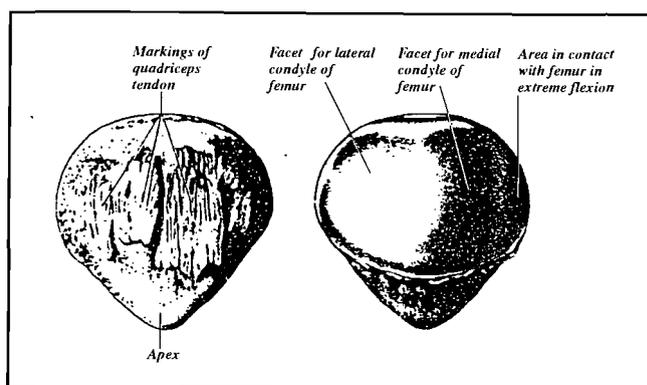


Figure 2. Anterior and Posterior views of the Patella (Gray 1989)

## Gait as an etiology in patellofemoral pain

A long distance runner's feet make contact with the ground approximately five thousand times in an hour's run, and thus it is vital that both their feet and lower extremities are functioning at their best.<sup>1</sup>

Gait can be divided into two phases; the stance phase and the swing phase. The stance phase is further divided into heel strike, and mid-stance and toe-off.

As the foot strikes the ground on its lateral aspect, the knee is in full extension (Fig 3), the femur and tibia

are externally rotated but in the process of internally rotating through to a quarter of the midstance phase, and the knee joint begins to move into flexion. Thereafter the femur and tibia begin to externally rotate for the rest of the stance phase.<sup>6</sup> As the knee joint flexes the compressive force of the patellofemoral joint increases; this may help to understand why the pain is often present when a patient rises from sitting, climbs stairs or is sitting with the knee flexed ('cinema sign').<sup>7</sup>

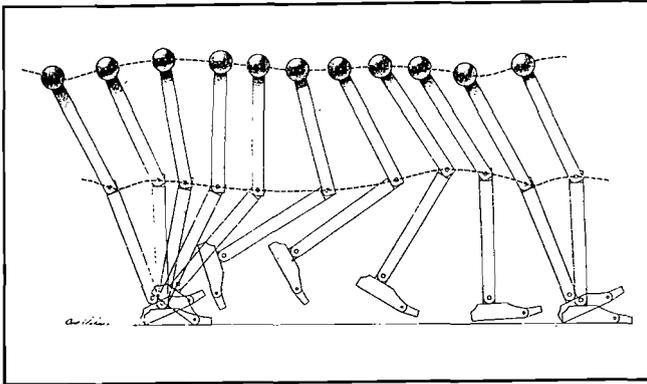


Figure 3. Position of the knee throughout the gait cycle (Whittle 1991)

With the above in mind, it becomes easy to understand that if the foot pronates excessively beyond 25% of stance phase, the tibia and femur are still internally rotated when they should be externally rotating. Thus with the excessive pronation comes excessive internal rotation of the tibia and femur, an increase in the Q-angle and therefore maltracking of the patella<sup>1</sup> (Fig 4). This excessive internal rotation also causes an abnormal pull of the quadriceps on the patella. This usually occurs as the knee flexes and the patellofemoral joint is experiencing increasing compression forces. Since with excessive pronation, the origin and insertion of the quadriceps are situated lateral to the patella, the quadriceps tend to pull the patella in a lateral direction.<sup>1</sup>

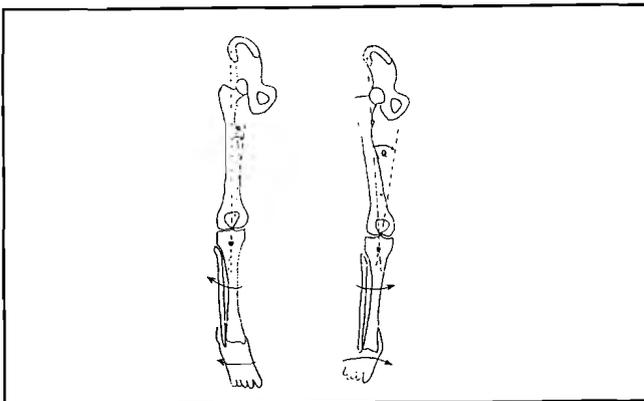


Figure 4. The change in the Q-angle in relation to the position of the foot.

Illustrative Case study to indicate the typical patient with this condition and the response to therapy.

**Subject:** 23 year old female presented with bilateral patellofemoral pain, brought on by aerobics. The Clarke's test was positive and crepitus was evident and the patient was experiencing the 'cinema sign'. There was a quadriceps imbalance between Vastus lateralis and Vastus medialis. She was not responding to the McConnell taping and exercise programme, a usually successful therapy. Foot biomechanics showed a forefoot invertus and hypermobility in both feet. Gait examination revealed excessive sub-talar joint pronation, beyond 25% of the stance phase. The weightbearing foot as viewed on a podiascope was very planoid.

**Treatment:** Semi-flexible moulded sports orthotics were manufactured. These comprised 2mm polypropylene vacume moulded to a plaster cast for specificity, with forefoot and rearfoot medial posting of a firm EVA, and an arch filler of low density EVA for cushioning. The patient was advised on easing into the orthotics.

**Result:** Within three weeks the patient was completely asymptomatic. When trying without the orthotics, the symptoms immediately returned.

#### Conclusion

The exact cause of patellofemoral pain may not have been accurately identified, perhaps because there is no single cause. It is therefore vital that all possible etiologies are considered, including quadriceps imbalance which has proven to be quite successful when treated, using taping and exercise therapy by a qualified physiotherapist. From the above it is also clear that in the complete treatment of patellofemoral pain it is important to ensure that patients have had a full biomechanical gait assessment, and any gait abnormalities corrected.

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# Iliotibial band syndrome (ITBS) in long distance runners

John W Pagliano DPM, MS

## ABSTRACT

This painful condition on the lateral side of the knee was diagnosed in 4.9% of 4,198 long distance runners treated for lower extremity musculoskeletal complaints. Many of these runners related a significant change in their running habits, i.e., changes in distance, speed, terrain, surface and/or training shoes prior to the onset of their symptoms. The mean age for athletes examined was 34.5 years for males and 32.6 years for females. Females were found to be disproportionately high in ITBS when compared to other running injuries. Surprisingly, ITBS cases are reliably lighter than other categories treated for lower extremity injuries. Despite the lateral knee pain most runners were able to continue running but had their workouts and distance compromised.

There did not appear to be any relation between ITBS and valgus or varus foot types. Our original study showed a correlation between varus knee alignment and ITBS. It was rarely seen in a valgus position.

Once present, the symptoms often persisted from two to six months. All of the runners in our series were treated by non-surgical measures including rest, reduction in running, anti-inflammatory medication, local steroid injections, new shoe gear and/or orthoses.

Shoes did not seem to be a contributing factor but we feel the use of a well-cushioned training flat with a good heel counter is essential for controlling this problem.

Iliotibial band syndrome (ITBS) is one of the more common injuries among long distance runners. With the advent of jogging and competitive running over the past several years this syndrome has become more widely recognized.<sup>1,3,4,6,7,8,9</sup> Iliotibial band syndrome has been classified as an overuse injury developed by repetitive movement of the iliotibial band as it slides over the prominent margin of the lateral femoral condyle as the knee flexes and extends.<sup>2,7</sup> It occurs in approximately 5% of all runners treated for musculoskeletal complaints.

The iliotibial band itself is a thickened strip of fascia lata that extends from the iliac crest to the lateral tibial tubercle (Gerdy's tubercle) and receives part of the insertion of the tensor fascia lata and gluteus maximus. With flexion the tensor fascia lata pulls the band anteriorly and with extension the gluteus maximus shifts the band posteriorly.<sup>2</sup>

At the knee joint the band acts as a stabilizing ligament between the femoral condyle and the tibia. Evans believes that because it crosses two joints its effect on the knee varies according to the position of the hip. To achieve maximum stability in standing the ITB locks the knee into extension and contributes to pelvic slouch by its action on the hip. Evans also believes the ITB enables us to rest while

standing and that it appeared phylogenetically with the development of upright posture.

As the knee flexes and extends during athletic activity, the iliotibial band rubs over the lateral femoral condyle and an inflammatory condition is produced. The pain is usually localized above the knee joint but can extend up the lateral side of the leg.

Orava,<sup>4</sup> in cadaver dissection, has found a reddish brown bursal thickening under the ITB in the vicinity of the femoral condyle. He states that this condition is the result of the iliotibial band rubbing over the femoral condyle. If one were to walk stiff legged, the condition would not be as pronounced as the band no longer rubs over the epicondyle. Running, climbing stairs and deep squats aggravates the condition.

Our original study of 84 patients with iliotibial band syndrome showed that the age ranges from 15 to 63 years of age with a median age of 33.9. Of those, 56% were men and 44% were women. This contrasts with our original prediction of 70% male and 30% female. We feel that there is a greater than expected number of women with ITBS and is therefore a gender-related running injury.

Of those 83 patients seen with ITBS, 32 (33%) had right knee involvement, 38 (46%) had left knee involvement, 13 (16%) had bilateral involvement and one case was not recorded.

This shows a higher than predicted value for the left knee. We had expected only 32% to have left knee involvement and 31% to have bilateral involvement. It is difficult to draw a conclusion on this evidence.

All of the runners examined wore shoes that were designed for running. Ten different brands were worn and 90% wore one pair of socks.

Clinical histories revealed that the majority of the patients with ITBS ran less than 62 km per week (Table 1) and had running between one and five years with an equal number over five years. (Table 2) More injured runners with ITBS than control runners with other injuries ran between 32-62km.

| km per week | % with ITBS | Control group with (%) other running injuries |
|-------------|-------------|---|
| 1-32        | 38          | 45  |
| 32-62       | 48          | 34  |
| 63-94       | 14          | 14  |
| 95-126      | 4           | 5   |
| 127+        | 1           | 2   |

| Experience level   | Proportion of runners (%) |
|--------------------|---------------------------|
| Less than 3 months | 4                         |
| 3-6 months         | 2                         |
| 6 months to 1 year | 16                        |
| 1-5 years          | 38                        |
| 5 years+           | 40                        |

Most runners failed to seek medical care until the severity of the pain had reached levels where their workouts would be compromised or terminated due to increased pain levels. (Table 3)

| Severity of pain                      | Proportion of runners (%) |
|---------------------------------------|---------------------------|
| Pain only after running               | 8                         |
| Pain before, during and after running | 23                        |
| Workout compromised by pain           | 52                        |
| Unable to work out                    | 17                        |

Symptoms often persisted two to six months but some runners ran with the condition for more than two years. Usually, once the condition was corrected, it very rarely returned under careful athletic guidelines.

Examination of training records indicated that the pain was aggravated by repetitive movements such as running, climbing stairs and squatting. The patients could generally walk for long distances but were limited in their running activities.

Diagnosis was somewhat complicated but usually confirmed by tenderness elicited by palpation of the area of the lateral femoral epicondyle. Usually the popliteal tendon, lateral collateral ligament, anterior lateral fat pad, lateral joint line and patellar tendon were not tender to palpation. Joint masses and cystic masses were ruled out.

Clinical examination revealed that the patient could jog in place and hop without significant discomfort. There was no ligamentous laxity and anterior drawer, pivot shift or jerk tests, and McMurray's test were also negative. Renee's "creak" sign was also absent while palpating the lateral aspect of the knee. In most cases there was a neutral knee alignment or varus knee alignment. Very few had a genu valgum deformity.

In our initial study<sup>9</sup> we found that the longitudinal arch structure was normal in the majority of runners while nine had pes planus deformities and 11 had high arches. Seven of the 48 original study patients were wearing orthoses, four rigid and three flexible, before the onset of symptoms. X-rays usually showed no degenerative changes or prominent ridges.

In examining training programs<sup>9</sup> we found that most

patients had made a significant change in their running schedule, either in time or distance. The addition of interval work was also reported. The addition of hilly terrain was also implicated and a few patients stated that they had changed from a soft running surface to a hard running surface when the symptoms appeared.

Treatment included reduction of distance and speed. We wished to treat most of our athletes by non-surgical methods and rest was our treatment of choice. We advocated the application of moist heat on a daily basis. The use of a Pro Knee Sleeve appeared to stabilize the outer knee area and to provide heat to the knee area. This also limited the athlete in squatting and stair climbing activity. A local steroid injection was of help in some cases. The patients were allowed to return to running on an asymptomatic basis with the addition of proper training shoes and a softer running surface such as packed grass or dirt.

No single treatment seemed better than others. We used a "mixed bag" of treatments to meet the patients' desires and patience. Orava recommends the use of topical vasodilatory agents but these were not used in our population.

Noble, described a surgical technique used in nine of his 220 patients who did not respond to conservative treatment.<sup>6</sup> He transversely split the posterior 2.0 cm of the iliotibial band at the area of the lateral femoral epicondyle so that a portion of the band was not taut at 30 degrees of flexion. He did not believe in excision of the prominent ridge. Only two runners in our series did not respond to conservative treatment but surgery was not elected in these patients.

The higher degree of left knee injury may indicate that running on a sloped terrain or on the crown of the road may cause some friction on the knee rather than on a flat surface. The syndrome was usually seen in ectomorphs and mesomorphs and was generally absent in endomorphic populations. This may be due to the higher percentage of fat deposited around the knee area.

It was more common in those running between 20 and 40 miles per week and in those who had increased their mileage and speed prior to onset of symptoms. Increasing the mileage was the most often noted change. Obviously, one has to run a certain distance in order to incite and sustain an inflammation reaction of the lateral femoral epicondyle. Most could run with pain, but they usually ran fewer hills and reduced both mileage and speed. As in most studies, there are probably a great number of subclinical cases in which the patients adjust their own schedule without seeking medical advice and the condition may spontaneously improve.

A specific brand of shoes could not be implicated in causing symptoms. But three patients did note a recent change in shoes and an additional three described running on worn-out shoes. One patient did not experience symptoms until he began adding glue to the bottom of his shoes. (The role of footwear may be a contributing factor in certain cases but in our sampling this was not apparent.)

It does not appear that foot structure is a significant contributing factor. A cavus foot may result in a more varus stress on the knee but this is speculative. Some patients could participate asymptotically in other

sports, i.e., racquetball, softball and basketball without pain. They experienced pain only with sustained running and constant repetitive knee movement.

The differential diagnoses should include torn lateral meniscus, capsular and ligamentous tears and avulsions, discoid meniscus, pseudogout and chondromalacia patella or popliteal tendinitis. Synovial plications in our experience have not been symptomatic on the lateral side of the knee with running. The long-term prognosis for iliotibial band syndrome appears to be good, although some patients had recurrent symptoms if they did not follow proper guidelines.

Although there are many types of treatment for ITBS, we have broken our treatment regime into the following:

- 1) Rest
- 2) Physical therapy modalities
- 3) Anti-inflammatory medications
- 4) Local steroid injections
- 5) Foot orthoses
- 6) Knee stabilizer
- 7) Topical vasodilatory agents (ORVA)
- 8) Training flats
- 9) Asymptomatic exercise
- 10) Surgical

Physical therapy modalities were prescribed on an every-other-day basis or three times weekly. Moist heat was applied on a daily basis either at the physical therapy facility or at home. This was applied with a moist pack or whirlpool, 110 degrees for 20 minutes. The purpose of the moist heat is to reduce pain, reduce spasm, increase blood flow, reduce joint stiffness and to increase collagen extensibility.

Electrical stimulation or H-wave is used to reduce muscle atrophy, reduce spasm, reduce edema and reduce pain.

Therapeutic measures also include soft tissue mobilization to include massage or musculofascial release.

Stretching may include proprioceptive neurofacilitation and passive massage.

Perhaps the most effective is ultrasound, applied directly at 7.5 watts/cm<sup>2</sup> for seven minutes.

The use of a good, stable training shoe on a level surface is recommended. Shoe selection will be discussed in the oral presentation.

I recommend the use of a good warmup prior to the running workout. This may include a one-half mile walk. Ice may be applied briefly after the workout.

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# A Podiatric approach to common lower extremity injuries in cycling

Philip A Carstens (ND. POD S.A.)

The modern day Podiatrists importance and input to cycling is not a superficial interest, but it becomes a science to improve performance, prevention and treat injuries, correct techniques and to give a vital service to research and data on this neglected but growing field of sports medicine, especially in this current competitive and professional sports era. The most important feature of a bicycle is how it fits the rider.<sup>9</sup> Performance, comfort and the risk of injury can be affected by variations, sometimes as little as 5mm in the riding position. The general belief is that cycling is a harmless, innocuous and low impact activity. Bicycling is actually a very popular aerobic exercise that can be harmful if not done properly with the correct equipment, settings and under supervision. Cycling is a favourite prescription for the rehabilitation of certain post-surgical conditions when the patient is not able to do other exercises. It can however lead to overuse injuries of the lower extremities (including the lower back) due to improper settings, biomechanical malalignments and wrong riding techniques.

When treating a patient with an injury caused by cycling, it is important to determine whether it is the patient's primary sport and what type of cycling is exercised, e.g. mountain biking, racing, track, touring, trainer(rehab.) or triathlete biking.

## Some key questions are:

1. What type of cycling is exercised? (to determine equipment and terrain)
2. At what rate do you pedal? (ideally between 70-110 r.p.m.)
3. What type of shoe is used? (cycling shoes are currently categorised into cleated, clip's, mountain bike and touring, although several of the categories may overlap.)
4. Do you use cleats, toe clips or clipless pedals and what type? (this determines what position the foot is kept in)
5. Do you know your knee position on your bicycle at 3/6'0 clock respectively? (it shows quickly if the seat height or position must be adjusted)

Before you can proceed to making any diagnosis and prescribe treatment you must have knowledge of the following:-

1. **The anatomy of cycling** - A general description of the anatomy involved is a basis for understanding the general injuries and the prevention of these injuries. The anatomy mainly involved is the muscles and joints of the neck, back, arms, pelvis, legs and feet. This varies in degree from regions during specific movements. The quadricep and gastroc-soleus muscles are of the main power suppliers and the knee and subtalar joints are of the most importance, their strength and flexibility can prevent knee and lower leg injuries.<sup>5</sup> (Fig 1)

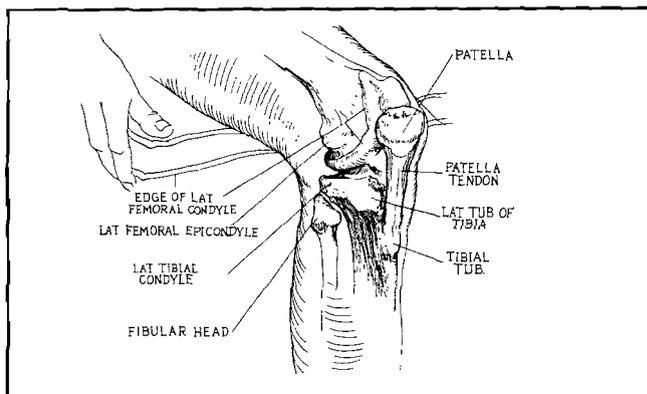


Figure 1. Anatomy of the knee joint, anterolateral aspect.

2. **Cycling biomechanics** - During a pedal cycle, the foot moves from top dead centre (TDC=0) to bottom dead centre (BDC=180) and proximally back to TDC. As with the closed kinetic chain gait cycle, a change in a joint angle generally affects the joints distal and proximal to it because of the ground-foot-leg-thigh linkage. Cycling has the same chain, except the foot is fixed on the pedal, and there is no heel contact. Minimal metatarsophalangeal joint motion is allowed because the rigid cycling shoe is fixed to the pedal. A remarkable difference between gait and cycling occurs in the phase where maximum pronation corresponds respectively to a dorsiflexed and plantarflexed ankle. As the foot enters the power phase of the pedalling stroke, the ankle plantarflexes, the knee extends and the tibia medially rotates. This everts the calcaneus, pronates the subtalar joint and unlocks the mid-tarsal joint.
3. **Proper settings of a bicycle** - Machines such as the elite (Fig 2), the fit kit, and Serotta size cycle, and specialised computer programmes such as probike fit can be used. In practise it is mainly done manually. The vital factors in sizing are saddle height (Fig 3), the length of the top tube, amount of seat post exposed when saddle height is correct, the clearance between your crotch and the top tube. Relative to height, women generally have shorter torsos than do men. Sizing a woman's bike by inseam length and seat tube size can often result in too long a top tube. The best is to have a longer seat post and smaller bike frame. Childrens fitting is done by wheel sizing. These factors will vary slightly depending on the cycling activity and the patient's physique.

## PHYSICAL EXAMINATION

1. Standard biomechanical assessment, checking head, shoulders, torso, pelvis, hips, knees and feet positions,

motions, lengths and alignments.<sup>4,5</sup> Doing measurements to determine any degree of abnormality, in particular Genu Varum or Valgum, external or internal tibial torsion. (Fig 4a & 4b)

2. On bike, riding assessment. It is advisable to use a video camera for playback if you are not familiar with cycling biomechanics and also to compare after settings and adjustments have been made. Place the patient on a trainer using his own bicycle and marking the tibial tubercle clearly with a bright coloured koki pen. Video shooting must be done from the front, sides and rear. The patient should cycle  $\pm 2$ min. at between 70-110 rpm pedal cadence on a high gear.

From the front the knees should move straight up and down.<sup>11</sup> As the foot pronates, the knee often moves medially towards the top tube during the power phase, and laterally during pull up. From the rear the legs should move straight up and down with both feet fixed on the pedals with minimal in-out toe movement and the buttocks must stay in the same seat position with no rocking of the hips.<sup>7</sup> From the side with the foot in the top dead centre position, the knee ideally is flexed approximately 100 to 110 degrees and the ankle is slightly dorsiflexed or 0 degrees. The ball of the foot should be on the axis of the pedal when the foot is in the 3 o'clock position with the knee in a plum line position to it (Fig 5). Once the foot reaches bottom dead centre the knee ideally is extended to about 160-165 degrees, the ankle is maximally plantarflexed and the foot in supination. Determine if any abnormality can be detected and if; adjust the settings accordingly.

### COMMON INJURIES

Many biomechanical problems can lead to injuries, even with the bicycle properly positioned. Most lower extremity injuries occur during the power phase when the foot moves from top dead centre to 120 degrees, with the peaking of force at 90 degrees.

Simple strains of the thoracic paravertebral muscles or lumbosacral paravertebral muscles can often be alleviated by shifting position, moving the seat forward (or backward) on its mount or varying the length of the handlebar stem. The lower back is also at risk of pain due to the bent over position.

Knee pain is the most common injury in cyclists.<sup>6</sup> It is usually caused by chondromalacia patellae, but can include patellar tendinitis, bursitis, and myotendinitis quadriceps (where it inserts into the superior aspect of the patella).<sup>8</sup> (Fig 6) The quadriceps provides the power in cycling and also the area most often injured in a bicycle crash usually with contusions. These injuries should be treated with ice, massage and immobilisation of muscle action to prevent myositis ossificans. Often the rider is to blame for the knee pain in that the seat is too high or low. If too low, the knee flexed too much at the area of most force in the down stroke, generating excessive pressure across the patellofemoral joint.<sup>2</sup> From full extension to full flexion of the knee the patella glides caudally  $\pm 7$ cm on the femoral condyles. Both the medial and lateral fascets of the femur articulate with the patella from full extension to 90 degrees of flexion. Beyond 90 degrees of flexion the patella rotates externally, and only medial femoral facet articulates with the patella. At full flexion of the patella sinks into the intercondylar groove. (Fig 7a & 7b)

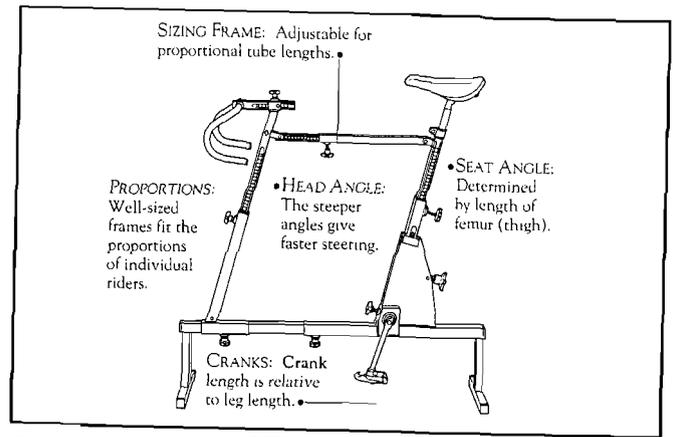


Figure 2. Example of the Elite size cycle.

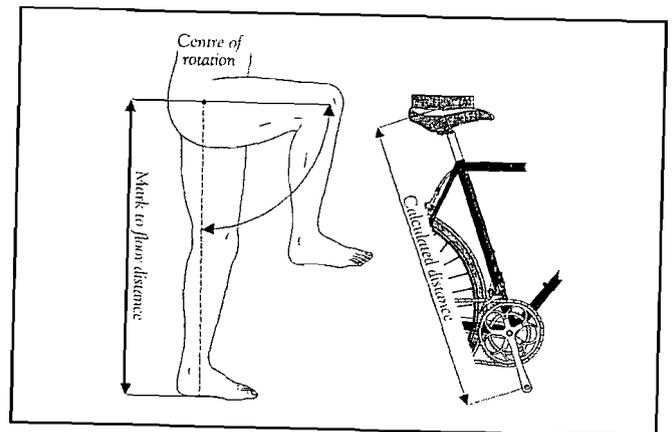


Figure 3. Saddle height.

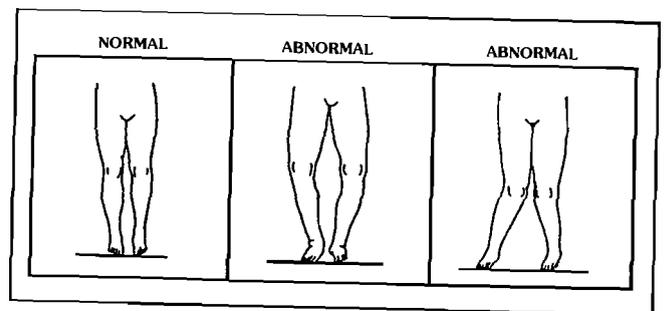


Figure 4a. Normalcy of leg position.

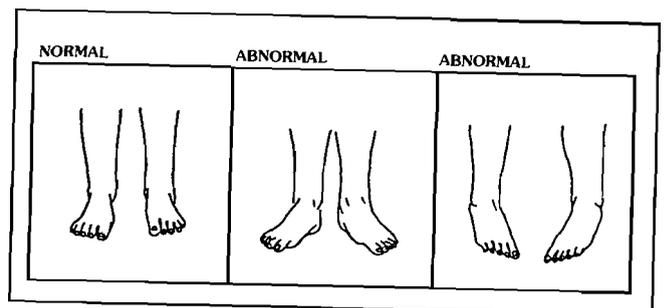


Figure 4b. Normalcy of foot position.

Cleat placement can also put excess strain on the knee. Cleats that are adjusted too far outwards cause pressure placement on the outside of the knee and too much inwards on the inside of the knee. Shoes should be adjusted such that the metatarsal heads (wider part of the foot) are placed directly over the pedal spindle. (women need a little more inward tilt to account for wider hips.) Knee pain can also be caused by pushing gears that are high. When cranking along slowly in a high gear, at low cadence the rider is getting more force across the patellar femoral joint. Pronation can lead to pain, mostly in elite riders or riders cycling in sneakers or running type shoes, allowing more subtalar joint motion because of the lack of rigidity. This can lead to knee and other pronatory type injuries like posterior tibial tendinitis, plantar fasciitis, bursitis neuroma type and soft tissue pressure injuries, including toenail problems.

Orthotics can be used to correct these problems,<sup>6</sup> but are different to running type orthotics because they do not fit well in the shoes and there is no heelstrike or stance phase in cycling. Running type orthotics are designed to work during heel strike and toe-off. Good results can be achieved with a variation of forefoot wedging or cleat adjustment in cyclists. Some canting can be done underneath the cleat, although with some newer pedal systems it becomes impossible. Orthotic control must be applied to the forefoot, even in the absence of a measurable forefoot deformity. Orthotics must be very specific for sports that require no or little metatarsophalangeal motion such as cycling, skiing or skating.<sup>7</sup> Preferably the forefoot posting must be placed extrinsically and is extended beyond the metatarsal heads to the sulcus of the toes. This will give good forefoot control. A dense rubber material can be used for the posting and the orthotic must fit properly in the shoe. If the shoe becomes too narrow the patient might have to change to a different shoe. It is important that the amount of forefoot posting equals the amount of posting that would normally have been used in the rearfoot, plus the amount that is required in the forefoot. A biopedal can also be used to correct various discrepancies.<sup>7</sup>

The gastrocnemius soleus muscle is another power source. Tears will result in pain upon plantar flexion of the foot. (Fig 8) Cyclists with achilles tendonitis must avoid pulling up during the passive phase. If severe, apply R.I.C.E. and physical therapy. To prevent one can wedge the heel; stretching exercises; strapping and the use of anti inflammatories.<sup>6</sup> Complete rupture rarely occurs during cycling. Traumatic injuries - knowledge of first aid is required and proper wound cleaning techniques must be applied.

Numbness is a common complaint affecting the hands, feet, genitals and buttocks area. Numbness to the genitals and hands is very common and is referred to as cyclist's palsy. The cause for affecting the genitals is compression of the pudendal nerve. The saddle type; height; position and tilt must be checked and corrected. Padded cycling pants must be worn. Numbness in hands and feet can be due to cold and exposure or too narrow and tightly fitting shoes; toe clips; gloves or too tight a grip. Treatment involves changing to the right shoe size, gloves, and keeping the hands and feet warm. Regular movement of the fingers and toes will allow for increased circulation.

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Figure 5. Knee position over pedal spindle, with crank at 3 o'clock.

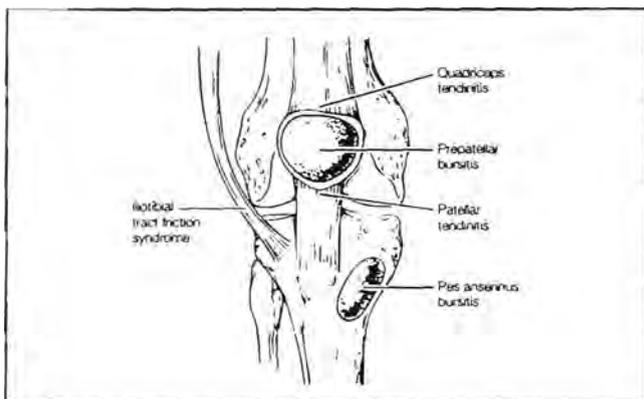


Figure 6. Types of extra-articular inflammation sites of the knee.

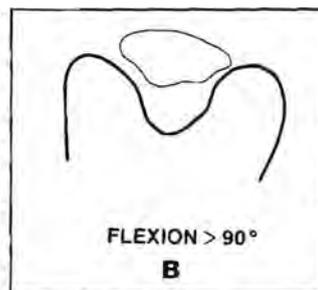
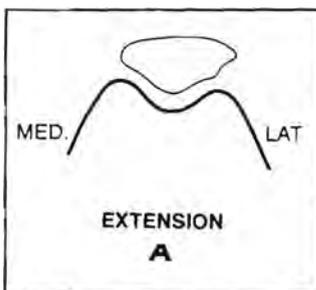


Figure 7a. Knee extension. Figure 7b. Knee flexion.

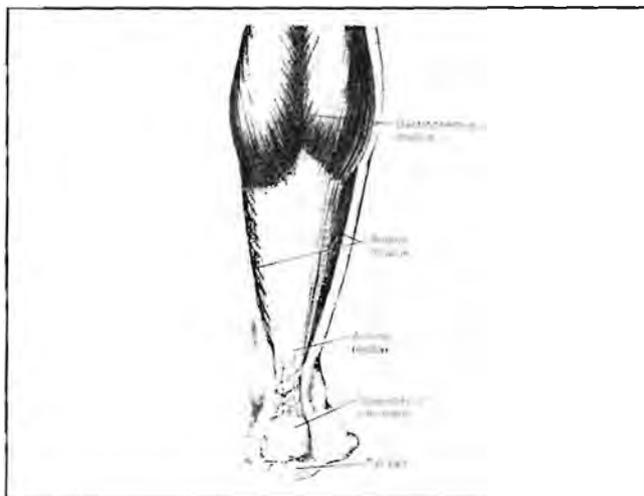


Figure 8. Inflamed Achilles tendon.

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