

Early management of the iliotibial band friction syndrome (ITBFS) in distance runners

**A dissertation prepared by Petrus Gunter (GNTPET002)
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List of abbreviations

ITBFS (Iliotibial band Friction Syndrome)

ITB (Iliotibial band)

LLD (leg length discrepancy)

NSAID (Non steroidal anti-inflammatory drugs)

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Abstract

Background: The Iliotibial Band Friction Syndrome (ITBFS) is a chronic injury on the lateral aspect of the knee, commonly seen in distance runners. The pathology of the condition is that of repetitive mechanical friction of the iliotibial band over the lateral femoral condyle, resulting in acute inflammation that can progress to chronic scarring. A number of potential risk factors and treatment modalities for ITBFS have been suggested. However, the scientific basis for risk factors and treatment modalities for this condition has not been documented well.

Objective: The primary objectives of this thesis were firstly, to critically review the scientific evidence for the risk factors and treatment modalities for ITBFS, and secondly to document whether local corticosteroid infiltration, which is one of the most common modalities in the early treatment of ITBFS, is effective in reducing pain during running.

Methods: In the first component of this thesis, the current published literature on the risk factors and treatment for ITBFS was critically reviewed using Evidence Based Medicine criteria. All the published studies documenting risk factors or treatment modalities for ITBFS were analyzed and then classified according the type of study. The results from each study were then rated as Grade A, B or C evidence according to established criteria. In the second component of this thesis, 18 runners presenting with at least Grade II ITBFS, who met the inclusion criteria, underwent baseline investigation including a treadmill running test during which pain was recorded on a visual analog scale (VAS) every minute. The subjects were then randomly assigned to either a corticosteroid infiltration group

(EXP=9) or a placebo control (CON=9) group. The EXP group was then infiltrated locally with hydrocortisone and the CON group with local anesthetic. The same laboratory based running test, during which pain was recorded on a VAS, was performed prior to infiltration (Day 0), and after 7 days and 14 days. The main measure of outcome was total pain during running, which was calculated as the area under the curve of a pain vs. time graph for each running test.

Results: In the first component of this thesis, the review of the literature clearly identified that there is very little scientific evidence to support a causal relationship between the majority of the postulated risk factors for ITBFS. Furthermore, treatment modalities for ITBFS have not been investigated through randomized controlled clinical trials with one exception. In particular, the practice of local corticosteroid infiltration in the early phase of treatment has not been investigated. In the second component of this thesis was a tendency for a greater decrease in total pain experienced by subjects in the EXP compared to the CON group during the treadmill running tests from Day 0 (EXP=222 \pm 71, CON=197 \pm 31), to Day 7 (EXP=140 \pm 87, CON=178 \pm 76) ($p=0.07$). There was however a significant decrease in total pain from Day 7 (EXP=140 \pm 87, CON=178 \pm 76) to Day 14 (EXP=103 \pm 89, CON=157 \pm 109) in the EXP compared with the CON group ($p=0.01$).

Conclusion: There is little scientific evidence to support the hypothesis that postulated extrinsic and intrinsic risk factors cause ITBFS. At best there are associations between certain risk factors and ITBFS, and future research should

be directed to clearly establish cause-effect relationships. Although there is also very limited scientific evidence to support the hypothesis that treatment modalities are effective. The results from the second component of the thesis did show, in a randomized controlled clinical trial, that corticosteroid infiltration reduces pain during running after 14 days. Although this study is limited by the relatively short duration of follow-up, it does add to the evidence supporting the use of this treatment in the early phase of ITBFS.

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Chapter 1

Introduction and scope of the thesis

The iliotibial band friction syndrome (ITBFS) is a common injury presenting as 1.6 to 12% of all running related injuries at Sports Medicine Clinics. Runners presenting with this injury experience pain on the lateral aspect of the knee, usually at a predictable distance and this may force the athlete to stop or slow down. It is often only possible to continue running if the knee is held in extension. This injury eventually forces the athlete to run shorter and shorter distances until virtually no training is possible.

The aetiological factors contributing to the development of ITBFS are complex and not well understood. It appears that there are very few data from well-conducted scientific studies to identify specific causes for ITBFS in runners. In Chapter 2 of this thesis, an Evidence Based Medicine approach is followed whereby scientific studies that have examined the causes for ITBFS are identified. Factors for which there is no evidence, limited evidence or those for which a clear cause-effect relationship exists are then discussed.

There are many postulated treatment modalities for ITBFS. It does appear that very few have been well studied, and the efficacy of most of these modalities has not been evaluated in randomized controlled clinical trials. Also in Chapter 2,

Evidence Based Medicine criteria are used to assess the scientific support for the use of treatment modalities for ITBFS.

As a result of the review on treatment modalities, it was clear that treatment modalities have to be tested using randomized controlled clinical trials. Therefore a randomized controlled clinical trial was designed to test the hypothesis that local corticosteroid infiltration is effective treatment in the early phase of ITBFS. The methods, results and discussion of the findings of this study are reported in Chapter 3 of this thesis.

Finally, in Chapter 4, a summary, conclusion and proposals for future studies is reported.

Chapter 2

Iliotibial band friction syndrome in runners: a critical review of risk factors and treatment modalities

Introduction

The iliotibial band friction syndrome (ITBFS) can be defined as a chronic inflammatory condition on the lateral aspect of the knee resulting from repetitive friction between the iliotibial band and the lateral femoral condyle. This clinical syndrome of pain on the lateral femoral condyle associated with long distance running was first described in 1973 ¹. These authors described the condition as tendoperiostitis in the lateral femoral condyle. Although Colsen and Armour mentioned the condition in 1975 ², the name "iliotibial band friction syndrome" (ITBFS) was given to the condition by Lieutenant Commander James W. Renne of the United States Naval Reserve in 1975 ³, who described the clinical features, radiographic findings and management of sixteen cases of the ITBFS in naval officers undergoing 6 months of military training ³.

The ITBFS is now a well described overuse injury of the knee in distance runners ⁴⁻¹², military recruits ^{3,13}, weight lifters ⁷, downhill skiers ^{1,7}, soccer players ^{7,14}, cyclists ¹⁴ and athletes engaged in circuit training ⁷.

Clinical anatomy of the iliotibial band

The iliotibial band, also known as the iliotibial tract or the band of Maissiat, is a fibrous structure connecting the ilium to the tibia. Vesalius, who first described its anatomy in 1552, considered it as a muscle and therefore grouped it with the other five muscles of the tibia. However, the most comprehensive monograph of an early anatomist on the anatomy and functions of the iliotibial band was written by Jaques Maissiat in 1843 - hence it is also known as "the band of Maissiat". The most comprehensive recent review on the anatomy and functions of the iliotibial band was published more than four decades ago ¹⁵.

The iliotibial band is unique because it is a structure peculiar to man ¹⁵. It is only in the human lower extremity that there is an open space between the tendon of the biceps femoris and the vastus lateralis muscles at the knee joint. This space allows the passage of the iliotibial tract for insertion into the lateral tubercle of the tibia ¹⁵. The erect posture of man, when compared to quadrupeds, is characterized by a change in the position of the pelvis from a horizontal to almost a vertical plane. This change was associated with the development of a large gluteus maximus muscle mass and a strong anterolateral ligament of support - the iliotibial band ¹⁵.

The iliotibial band originates proximally from the iliac crest, predominantly from the iliac tubercle ¹⁶. It also attaches along most of the length of the iliac crest on

its most lateral lip. The iliotibial band has also been defined as the vertical component of the fascia lata of the thigh ¹⁶. The iliotibial band (vertical fibres of the fascia lata) is intimately associated with the tensor fascia lata muscle anteriorly. The gluteus maximus muscle attaches to the upper part of the horizontal fibres of the fascia lata. Despite the close association of the iliotibial band to these two muscles, it is regarded as an independent structure and not a tendon of either one of these two muscles, as was commonly believed ¹⁵. The deep fibres of the tensor fascia lata and the gluteus maximus muscles do however blend with the deep surface of the iliotibial band in the region of the greater trochanter of the femur.

The iliotibial band runs distally along the lateral aspect of the thigh. It is connected to the intermuscular septum, and therefore the linea aspera on the femur, from the greater trochanter proximally to the supracondylar tubercle of the lateral condyle of the femur distally ¹⁵. The distal end of the iliotibial tract is thicker and attaches to i) the lateral border of the patella anteriorly (iliopatellar band), ii) the lateral tibial tubercle (Gerdy's tubercle) and, ii) the anterior fibres of the biceps tendon posteriorly ^{15;16}. The functional anatomy of its distal attachment is complex and has recently been reviewed ¹⁷.

The iliotibial band is thus a fibrous band extending from the iliac crest proximally to the lateral tibial tubercle (Gerdy's tubercle) and adjacent structures distally.

Along its course it is attached to the femur except in the area between the upper part of the lateral femoral condyle and the lateral tubercle of the tibia.

Biomechanics of the iliotibial band

The Iliotibial band spans across the hip and the knee joints. These two joints are important during stance and motion of the upright man. The biomechanics and function of the iliotibial band can therefore be considered separately during standing (static) and walking or running (dynamic) functions of the lower limb.

Static functions of the iliotibial band

The importance of the iliotibial band in maintaining normal balance of the body in stance has been described in one of the earliest monographs detailing its anatomy and function¹⁸. However, it was only a century later that this observation was substantiated by some scientific evidence¹⁹. Inman calculated theoretical torque values about the hip joint during one-legged stance in 35 individuals. Using electromyography, he then proceeded to measure the actual torque values in three positions of the pelvis; level pelvis, pelvis tilted up 20°, and with the pelvis sagged. In all these positions the theoretical torque value was greater than the actual torque value, indicating that the fascia lata, and therefore the iliotibial band, contributed significantly to pelvic stability during one-legged stance¹⁹. Furthermore, he noted that the contribution of the fascia lata to the

torque was greatest in the sagged pelvis position and least with the pelvis in the tilted position. This study showed firstly, that the iliotibial band is an important structure that provides abductor torque during one-legged stance, and secondly that tension in the band increases with progressive hip adduction.

It is now well established that the combined pull of the gluteus maximus muscle, the tensor fascia lata muscle, and the tension in the iliotibial band is posterior to the axis of rotation of the hip joint during standing²⁰. Minimal hip muscle action, as demonstrated by electromyographic studies, is therefore required during symmetrical standing¹⁶. These findings are further substantiated by the clinical observation that a Trendelenburg gait develops after surgical release of the iliotibial tract¹⁶.

At the knee joint it has been observed that the iliotibial band contributes to the lateral stability of that joint¹⁵. In full knee extension, the iliotibial band lies anterior to the axis of rotation of the knee. In this position it helps to maintain the knee in full extension, again with minimal muscle action²⁰. The function of the iliotibial band during standing is therefore to maintain the hip and knee in full extension. This is associated with minimal muscle action and therefore, the iliotibial band has therefore also been named the "Ligament of Idleness" or the "Ligament of Boredom"¹⁶.

Dynamic functions of the iliotibial band

The dynamic functions (during walking and running) of the iliotibial band are not as well described as its static functions. The iliotibial band has important dynamic functions at both the hip and the knee joint.

In hip flexion, such as during the swing phase of running, the ITB is anterior to the axis of rotation of the hip joint²⁰. In this position it helps to maintain hip flexion. With progressive hip extension the band moves posteriorly and crosses the greater trochanter of the femur.

At the knee joint the dynamics of the ITB are similar to that described in the hip joint. In full knee extension the band is anterior to the axis of rotation of the knee joint. With progressive flexion, the band moves posterior to cross the lateral femoral condyle at approximately 30° of knee flexion²⁰. During walking and running hip flexion and knee flexion occur simultaneously during the swing phase, whereas extension occur simultaneously during the stance phase.

Repetitive knee and hip flexion and extension movements therefore characterize walking and running. This causes repetitive antero-posterior movement of the iliotibial band over the greater trochanter proximally and the lateral femoral condyle distally.

Aetiology of the iliotibial band friction syndrome

The mechanism of injury in the iliotibial band friction syndrome is thought to be due to the repetitive antero-posterior movement of the iliotibial band over the lateral femoral condyle³. Movement of the ITB across the lateral femoral condyle occurs with the knee at about 30° knee flexion. A similar but less common condition has been described for the antero-posterior movement occurring at the hip joint. In this condition, the movement causes mechanical irritation of the trochanteric bursa resulting in a trochanteric bursitis.

The frictional force of the ITB over the lateral femoral condyle could be exacerbated if i) the movement is very frequent or ii) if there is increased passive tension (inflexibility of the iliotibial band, forced hip adduction, or tibial rotation) or active tension (contraction of the tensor fascia lata) in the ITB during the movement. Factors that are responsible for the development of ITBFS can therefore be classified into either one of these two groups.

It is however conventional to classify aetiological factors associated with overuse injuries as either intrinsic or extrinsic. Although there are a number of postulated intrinsic and extrinsic aetiological factors for ITBFS, none of these have been well studied until recently. The majority of published reports have been in the form of case series^{8;21;22}. There is only one case control study in runners that has examined the risk factors associated with ITBFS²³. The postulated intrinsic and

extrinsic aetiological factors for ITBFS as well as their postulated mechanism/s of injury will now be discussed.

Intrinsic risk factors

A number of intrinsic risk factors have been postulated as causes of the ITBFS.

These include:

- Leg length discrepancy
- Cavus feet
- Forefoot varus
- Rearfoot valgus
- Rearfoot varus
- Tibial varus
- Genu varum
- Somatotype
- Age
- Gender
- Adductor contracture
- Weakness of the hip abductor muscle groups
- Poor pelvic stabilization (lateral pelvic tilt)

The majority of these intrinsic risk factors have all been identified from case series. In only one, case-control study has specific risk factors been associated

with ITBFS²³. There are no prospective studies that have identified specific intrinsic risk factors for ITBFS.

A leg length discrepancy has been postulated^{21;22;24}, and identified²³ as a factor associated with ITBFS (Average LLD: ITBFS=5mm, Control=1mm). This mechanism of how a LLD can cause ITBFS is not known, but may be related to increased tension in the ITB of the affected limb when there is increased adduction in the stance phase of ambulation. However, there has been no association between the side of injury and the side of the longer or shorter leg^{22;23}.

Lower limb malalignment has also been postulated as a cause for ITBFS. The following specific abnormalities have been mentioned as possible abnormalities in runners with ITBFS: cavus foot⁸, rearfoot varus^{21;22;25}, rearfoot valgus⁵, forefoot varus^{21;22}, and genu varus^{8,22}. Functional genu varus secondary to ligamentous laxity has also been mentioned as a possible intrinsic risk factor⁵. In a case-control study, the following biomechanical abnormalities have been associated with ITBFS²³.

- Tibial varus (ITBFS=46%, Control=9%)
- Increased Q angle (ITBFS=15°, Control=11°)
- Forefoot varus (ITBFS=7°, Control=2°) in female runners only

The mechanisms by which these abnormalities may cause ITBFS have not been well documented but it has been postulated that they increase the passive tension in the ITB. As mentioned previously, increased tension in the ITB will increase the frictional force between it and the lateral femoral condyle. Genu varus, tibial varus, rearfoot varus and a cavus foot may all potentially increase the passive tension in the ITB by nature of their anatomical abnormality⁵.

A second group of lower limb biomechanical abnormalities have all been postulated to increase and/or prolonged subtalar joint pronation during the stance phase of running. Subtalar joint pronation is thought to be associated with internal tibial rotation, which in turn will alter the orientation of the lateral tibial tubercle - the distal insertion of the ITB^{5;26;27}. Internal rotation of this insertion point may increase the tension in the ITB during the rapid extension of the knee at the end of the stance phase, again increasing the frictional force between the ITB and the lateral femoral condyle.

Other intrinsic factors that have been mentioned as possible risk factors for ITBFS are excessive prominence of the lateral femoral condyle⁵, age, male sex^{7;9} and ecto- and mesomorphic somatotypes⁹. However, there is no scientific evidence to verify these as risk factors.

It again needs to be emphasized that none of these postulated aetiological factors have been well studied, and that the mechanisms of injury that are described are purely speculative.

Extrinsic risk factors

There are few well-conducted studies that identify specific extrinsic risk factors for the development of the ITBFS. In a number of case series extrinsic aetiological factors such as training errors, and incorrect footwear have been postulated.

The most common training error that has always been postulated to cause the ITBFS relates to training volume. Errors in training volume include excessive running distance per week^{5,6,9,28,29}, years of training⁹, and/or a sudden increase in training^{5,6,29}.

The type of training and the training surface may also be associated with the development of ITBFS. In particular hill training^{1,5,9,28}, speed training^{5,7,9}, training on cambered roads^{6,9,22} and, training on hard surfaces^{1,9} have been associated with ITBFS. The mechanisms by which training errors cause this syndrome has not been well studied.

However, because none of these studies included suitable non-injured control groups, no conclusions can be made regarding specific extrinsic risk factors. In one case control study, the following extrinsic risk factors for ITBFS were identified ²³:

- Training less on a gravel road (ITBFS=8%, Control=23%)
- Not training on both sides of the road (ITBFS=92%, Control=63%)

In this study there were no significant differences between the ITBFS and control group with respect to years of running, or increased training volume.

In one study, a reduced knee flexion angle, such as during downhill running has been postulated to increase the biomechanical risk of ITBFS ³⁰. In this study, cadaveric knees showed a large variation in the width of the ITB, and may reflect individual predisposition to ITBFS.

However, it is probable that training errors cause the ITBFS through repetitive movement of the ITB across the lateral femoral condyle (increased weekly distance, sudden increase in training), or that the tension in the ITB is increased (training on a cambered road, hill training, speed training, hard surfaces).

However, none of these mechanisms have been well documented.

Finally, footwear, in particular hard running shoes²², anti-pronation shoes⁹ or army boots¹ have been postulated as aetiological factors in the development of the ITBFS. It has been postulated that the mechanisms by which footwear may cause ITBFS is increased tension in the ITB. Again, this has not been investigated scientifically.

Pathology of the iliotibial band friction syndrome

The gross pathology and histopathology of ITBFS has been described^{3,5;7;14;31}. It must be pointed out that these studies only described the pathological findings in patients that were treated for the condition by surgery. These cases are not representative of most patients that present with the ITBFS because only chronic cases or cases refractory to conservative treatment are referred for surgery.

The macroscopic appearance of the tissue between the distal ITB and the lateral femoral condyle, observed at the time of surgery, resembles chronic inflammation^{5;14;31}. The appearance of the tissue has been described as a reddish brown thickening resembling a bursa⁷. No true bursae have been observed by most^{5;14;31}, but in one case, yellow viscous fluid could be aspirated from a "bursa" that developed at the site³. It is likely that the repetitive mechanical irritation is responsible for the chronic inflammatory response. This process may, in some cases, then cause the formation of a false bursa in the area⁷.

Histological examination of tissue removed from the site at surgery revealed fibrous tissue with a synovial-like structure showing many areas of mucoid degeneration or fibrinoid necrosis ¹⁴. Chronic inflammatory cells have also been noted in specimens ⁵.

In summary, the pathological findings at surgery of ITBFS are consistent with the proposed mechanism of injury, which is repetitive mechanical irritation of the band over the lateral femoral condyle. In long standing cases, such as those that require surgery, the chronic inflammatory response may be associated with the formation of false bursal tissue. Early treatment of the inflammation is thought to be important to decrease the possibility of scarring ³¹.

Epidemiology of the iliotibial band friction syndrome

The incidence of ITBFS (expressed as annual incidence or occurrence per participation hours) has not been documented well for any of the activities in which the condition has been described. In general, ITBFS has been documented in case series where its occurrence is reported as a percentage of the total number of injuries.

In only one prospective study the annual incidence of ITBFS in a group of runners could be calculated. In this study 60 runners (sprinters, middle- and long-

distance runners) were followed up for one year and all the injuries were documented. The annual incidence of ITBFS in this group of runners was 1.7%.

In one of the largest published case series on running injuries, ITBFS accounted for 11.8% of all injuries in male marathon runners and 21.2% of all female marathon runners³². In this study, ITBFS was the second most common injury in male and female marathon runners. In the same series ITBFS was also the second most common injury in recreational runners (males, 6.7%; females, 7.2%), but it was less common in middle distance runners (males, 3.6%; females, 2.7%). In a similar survey of running injuries conducted by the same authors in the same population 10 years ago, ITBFS was responsible for 4.6% and 3.8% of all injuries in male and female runners respectively²⁴. The authors concluded that the frequency of ITBFS, as a percentage of all running injuries, appears to have increased in the last two decades³².

In most other series the frequency of ITBFS is expressed as a percentage of all lower extremity injuries in runners. This percentage has been documented as 4.7%⁹, 5%³³, and 6.4%⁷. It has also been reported that between 14% and 17% of all knee injuries in runners are due to ITBFS^{28,33}.

The incidence of ITBFS in military recruits undergoing basic training has not been well documented. In only one study, an incidence of approximately 1.6% over a six-month training period can be calculated³. In a more recent study, the

incidence over a 12-week training period has been reported as 5.8% for female, and 4.0% for male recruits³⁴. The epidemiology of ITBFS in other sports has not been studied.

In summary, the precise incidence of ITBFS has not been documented. However, it appears to be a common overuse injury in distance runners and military recruits. In a recent review, the frequency of ITBFS has been estimated as varying between 1.6-52%¹⁰. Finally, it appears that in the last decade, there is an increase in the frequency of the occurrence of ITBFS in runners³².

Clinical diagnosis of the iliotibial band friction syndrome

The clinical features of ITBFS have been well described. The diagnosis of the condition is easy to make provided a comprehensive history is taken and a thorough clinical examination is performed. The assessment of the patient should also include a clinical biomechanical assessment of the lower limb to identify possible intrinsic risk factors that may be associated with ITBFS.

Clinical history

The hallmark of this condition is pain experienced on the lateral aspect of the knee during repetitive flexion and extension movements of the knee. The features of the pain are that it:

- is usually well localized to the lateral femoral condyle
- is sharp in nature
- occasionally radiates inferiorly to Gerdy's tubercle
- is characterized by a sudden onset, usually after a specific time (or distance) of running
- is often more intense at the point when the leg comes into contact with the ground during deceleration (when contraction of tensor fascia lata occurs at 30° knee flexion)
- is often worse during downhill running (contraction of tensor fascia lata)
- can be relieved by walking with a fully extended knee - "stiff leg"

It is also important to obtain an accurate history of the training habits (recent increases, downhill running), running shoes (recent changes, worn shoes) and running surface (changes, hard road, excessive road camber) from the runner. These factors have all been postulated as training errors associated with ITBFS.

The history should also include questions to exclude symptoms associated with other knee and hip pathology as well as systemic disease.

Clinical examination

The clinical examination should include a general, local and regional examination. The outstanding feature of the local examination is tenderness over the lateral femoral condyle, which is located 2cm above the lateral joint line of the knee. Rarely, a cystic swelling over the lateral femoral condyle can be the main finding³⁵. The following provocative tests can often reproduce the symptoms:

- Asking the patient to go for a run and repeating the local clinical examination
- Rubbing across the lateral femoral condyle with an examining finger
- Holding a finger on the lateral condyle while flexing and extending the knee.

Tenderness is classically elicited at 30-40° of knee flexion³¹

- Weight bearing on the affected limb at knee flexion of 30-40° will also reproduce the pain

Special clinical tests

The following special clinical tests are important to perform in order to plan optimal management strategies.

Clinical test for iliotibial band tightness (Obers test)

A specific clinical test to document the tightness of the iliotibial band was first described by Frank Ober in 1936³⁶. In this test the patient lies with the

unaffected limb on the couch. The hip and knee of the unaffected limb are both flexed to 90° . The examiner then stabilizes the pelvis with one hand so that the anterior superior iliac spines are aligned vertically and are perpendicular to the couch surface. With the other hand the examiner then flexes the affected (upper) knee and brings the hip to full extension. The hip is then passively adducted (toward the couch) until resistance is felt. Iliotibial band tightness can then be classified according to the degree of adduction as follows²⁰:

- No tightness: Affected knee touches the couch
- Moderate tightness: Affected knee can be adducted but not touch the couch
- Severe tightness: Affected knee cannot be adducted.

The value of performing this test is to determine the degree of tightness of the ITB so that advice can be given to the patient regarding ITB stretching.

Clinical biomechanical evaluation

This evaluation should be performed to identify possible lower limb biomechanical abnormalities that have been associated with ITBFS. This information is important for the correct management of the condition.

Isokinetic muscle strength testing

Isokinetic muscle function testing may be performed if there is clinical evidence of weakness of the abductors. The abductor/adductor strength ratio, and the hip abductor eccentric muscle strength have been shown to be less than non-injured control runners vs. runner with ITBFS³⁷. This indicates that a resistance-training program to improve abductor muscle strength, in particular eccentric muscle strength, is important in the management of this condition.

Special diagnostic imaging tests for iliotibial band friction syndrome

In general, no special diagnostic tests are required to make the diagnosis of ITBFS. In some cases special investigations may be required to exclude other possible diagnoses^{38,39}.

Magnetic resonance imaging (MRI) and soft tissue diagnostic ultrasound

In general, MRI or another form of imaging such as soft-tissue diagnostic ultrasound is not required to make the diagnosis of ITBFS. However, in some instances, particularly where there is a noticeable swelling, MRI or ultrasound may be necessary to rule out other causes of lateral knee swelling (cyst)^{40,41}.

The specific MRI findings in ITBFS have recently been described⁴². These findings support the fact the signal alteration suggests soft tissue inflammation, particularly beneath the posterior fibers of the ITB.

Differential diagnosis of the iliotibial band friction syndrome

The differential diagnosis of ITBFS is that of gradual onset of lateral knee pain. In general, the conditions that may simulate the clinical picture of ITBFS can be classified according to injuries or disease in the anatomical adjacent to the ITB. These are listed in Table 2.1.

Table 2.1: Differential diagnosis of chronic lateral knee pain in athletes

Anatomical area	Clinical condition
Iliotibial band	Iliotibial band friction syndrome
Patella	Patellar subluxation/dislocation Lateral retinaculitis Patellofemoral pain
Lateral meniscus	Meniscal tears Meniscal degeneration Meniscal cysts
Lateral femoral condyle	Osteonecrosis Bone stress injuries

Tendons	Popliteus tendinopathy Biceps femoris tendinopathy
Ligaments	Lateral collateral ligament Proximal tibio-fibular ligament
Muscles	Lateral head of gastrocnemius strain
Joints	Proximal tibio-fibular joint

Management of the iliotibial band friction syndrome

In all the reported case series on ITBFS an approach to management is described. However, the management options are not well studied and their efficacy is not confirmed based on evidence from controlled clinical trials, but rather on anecdotal observations. In most cases treatment has been aimed at correcting the postulated aetiological factors. There are few well-conducted clinical trials that have studied specific treatment modalities for ITBFS.

The approach to management of ITBFS is generally non-operative. Surgery is only rarely required. The current approach to management of the ITBFS will therefore be discussed by analyzing the evidence for the efficacy of non-operative and operative treatment of ITBFS. The approach used will be that of assigning evidence based medicine grades to each study that has published a treatment modality for ITBFS. The following grading system will be used in the

critical review of each treatment modality (Table 2.2.) to grade evidence for use of treatment modalities in the management of ITBFS.

Table 2.2.: Evidence based grading system for assessing treatment modalities for ITBFS

Grade	Sub-grade	Criteria
A	A+	<ul style="list-style-type: none"> • Meta analysis
	A	<ul style="list-style-type: none"> • Randomized double blind placebo controlled clinical trial
B	B+	<ul style="list-style-type: none"> • Randomized, but not blinded, placebo controlled clinical trial • Non placebo controlled clinical trial
	B	<ul style="list-style-type: none"> • Non-randomized controlled clinical trial
C		<ul style="list-style-type: none"> • Case series

Non-operative management of ITBFS

The non-operative management of ITBFS can be divided into two phases based on two important principles of treatment; i) a primary phase aimed at treatment of the inflammatory response to provide pain relief and ii) a secondary phase aimed at correction of the underlying aetiological factors and return to sports activity.

The duration of the primary phase is usually one to two weeks whereas that of the secondary phase is variable.

Primary phase treatment (0-14 days)

Primary phase treatment is aimed at reduction of the acute inflammatory response. The rationale for treating the inflammatory response is to alleviate the symptoms and to limit fibrosis and permanent scarring³¹. It is well documented that an inflammatory response can be treated by a number of modalities. These include rest, ice, anti-inflammatory medication and physiotherapeutic modalities⁴³.

Rest

It has been suggested that complete rest is important in the primary phase management of ITBFS^{3;7;28;29}. There are no well-conducted studies to support rest as a treatment modality for ITBFS and the evidence is only from published case series (Grade C evidence). The rationale for rest is to remove the mechanical irritation, which was the stimulus responsible for initiating the inflammatory response. However, most runners will not comply with the instruction of complete rest. It is for this reason that others recommend a period of "active rest" as part of the primary phase treatment of ITBFS. "Active rest" may consist of either a reduction of activity^{5;9;22;25} or an alternative activity⁵.

Non-steroidal anti-inflammatory medication

The use of non-steroidal anti-inflammatory medication is a treatment modality that is used in the primary phase treatment of ITBFS. This medication is usually administered as oral non-steroidal anti-inflammatory drugs (NSAIDs) ^{3,5;7;9;14;25}.

Despite the widespread use of anti-inflammatory medication in the primary phase treatment of this condition, the efficacy of these drugs in the treatment of ITBFS has only been studied in a single well-controlled clinical trial ⁴³ (Grade A evidence).

In this study, the efficacy of anti-inflammatory medication was compared to other treatment modalities such as physiotherapy. It was shown that a combination of an analgesic –anti-inflammatory agent was superior to physiotherapy or a simple non-steroidal anti-inflammatory drug in the first 14 days of treatment ⁴³. However, different groups or dosages of anti-inflammatory medication have never been compared. This information is essential for the prescription of safe and effective treatment in patients with ITBFS.

Local infiltration of corticosteroids

Local infiltration of the affected area with corticosteroids has also been widely advocated and is commonly used in the primary phase treatment of ITBFS^{1;5;9;14;28;29;31}. The evidence for the efficacy of corticosteroids in the treatment of ITBFS comes only from published case series (Grade C evidence).

Physiotherapeutic modalities

The use of physiotherapy has also been advocated in the primary phase treatment of ITBFS by a number of authors^{1;7;14}. In particular modalities such as local ice application^{5;9;21;28}, heat^{3;8}, ultrasound¹, and short wave diathermy⁷ have been used.

Recently, it has also been advocated that vigorous rubbing should be applied over the iliotibial band at its most tender site²⁸. This form of massage is similar to deep transverse friction (DTF) massage, which is a common form of therapeutic massage used by physiotherapists. There is also anecdotal evidence that DTF is beneficial in the treatment of more chronic forms of ITBFS where fibrous adhesions may have formed between the ITB and the lateral femoral condyle.

It should be noted that despite the apparent popularity and possible success of physiotherapy modalities, no clinical trials have been conducted to support its

use in the primary phase treatment of ITBFS. Data for the use of these modalities only comes from published case series.

In most of these reported case series a combination of the above treatment modalities have been employed. However, a major limitation in all these case series was the lack of control groups. It is therefore impossible to determine the success rate of any of these modalities of treatment, either alone or in combination. The success rate of the treatment (number of patients responding well to treatment), where a number of different treatment modalities have been employed, has been reported as 83%⁹ to 100%²². In other series conservative treatment was reported as "successful in most cases". However, at present the evidence for the true success of these modalities in the primary phase treatment of ITBFS is at best anecdotal (Grade C evidence).

Secondary phase treatment (> 14 days)

The aims of treatment in this phase are to correct the underlying aetiological factors responsible for the condition and to assist the sports person to return to the full level of competition as rapidly as possible.

The underlying aetiological factors responsible for ITBFS have not been well documented, and this has already been discussed. The effectiveness of treatment modalities in the secondary phase of treatment has also not been well

studied. However, from the reported case series it has been postulated that the problem is usually related to i) extrinsic factors such as training errors or footwear, ii) intrinsic biomechanical abnormalities of the lower limb that may exacerbate the rubbing of the ITB over the lateral femoral condyle or iii) both extrinsic and intrinsic factors.

Correction of extrinsic risk factors

It is clear that, in the secondary phase treatment of ITBFS, most authors recommend that attention be given to the correction of possible training errors. These corrections include i) a reduction of weekly running distance ^{5,9,22,25}, ii) avoiding hill training ^{1;5;22;28}, iii) training on soft surfaces ²², iv) decreasing running speed ^{5,22}, v) changing the side of the road that the runner normally runs on ^{5,22}, and vi) temporary participation in other sports ^{5,7}. However, none of the advice regarding the correction of training errors has been studied, other than reported in case series (Grade C evidence).

Correction of intrinsic risk factors

A number of postulated intrinsic aetiological factors for ITBFS such as age, sex and somatotype are clearly not correctable. However, if there is a lower limb biomechanical abnormality, documented tightness of the ITB or an identifiable muscle weakness, these may be correctable.

The problem in ITBFS is that the correctable lower limb biomechanical abnormalities have not been well identified in controlled studies. It is therefore not surprising that, in general, advice regarding the correction of specific intrinsic factors is often vague^{8,25,28,29} and that there is a wide variation in the advice given by authors.

It has been suggested that lower limb biomechanical abnormalities can be corrected by i) wearing of appropriate running shoes^{9,22}, ii) alteration of existing footwear^{21,22}, or iii) the prescription of an appropriate orthoses^{8,21,22,28,29}. The method of correction depends on the type and severity of the biomechanical abnormality. Furthermore, data suggesting that shoes or orthoses can be used in the treatment of ITBFS are only obtainable from case series (Grade C evidence). A detailed discussion on the different methods that are used to correct these abnormalities is however beyond the scope of this review.

Only a few authors have provided more specific advice regarding the correction of intrinsic biomechanical abnormalities. A documented leg length discrepancy appears to be only abnormality where specific advice regarding correction is given²¹⁻²³. However, there are no controlled intervention studies to support the correction of LLD in the treatment of ITBFS (Grade C evidence).

ITB inflexibility or tightness, as detected by Obers test, is a specific postulated intrinsic aetiological factor that may be correctable by stretching. A number of

authors have therefore advocated regular stretching of the ITB in the management of ITBFS^{6,8,22,27,29}. Details regarding specific techniques of stretching have been described⁶, but there are no data from controlled studies to support the use of stretching the ITB as part of the treatment of ITBFS (Grade C evidence).

Muscle weakness, in particular weakness of the abductor muscles of the hip may be an important correctable intrinsic cause for ITBFS. It has therefore been suggested that strengthening of this muscle group be included in the treatment of ITBFS⁴⁴. In one case series, it has been shown that a 6-week rehabilitation program aimed at the correction of hip abductor weakness resulted in improvement of pain in 22/24 runners with ITBFS³⁷. These data, although suggestive of the benefits of correcting hip abductor muscle strength in the treatment of ITBFS, are from case series only (Grade C evidence).

In summary, a number of treatment modalities to correct postulated risk factors for ITBFS have been identified, and reported as successful. However, because none of these have been well studied, it is not possible to give clear guidelines on the most effective management of ITBFS in the secondary phase of treatment. The only exception is the use of anti-inflammatory medication in the first phase of treatment of ITBFS, where there is evidence from a well-controlled clinical trial.

Surgical management

It is generally accepted that surgical intervention in the treatment of ITBFS should only be considered after an adequate course of non-operative treatment^{5;7;8;14;22;29;44}. This form of treatment is generally required in less than 5% of cases. The first procedure that was performed was described in 1980⁵. It was based on the fact that at 30° knee flexion the posterior fibers of the ITB abut on the lateral epicondyle. In this position these posterior fibers lie across the lateral femoral condyle and a 2cm incision is therefore made to split these posterior fibers. The V shaped defect that results decreases the tension and therefore the friction of the ITB over the lateral condyle. In published case series, the results of surgery are very good with 80-100% of the athletes returning to running within 2-7 weeks after surgery^{5;14;29}. In a recently published case series of 22 runners who underwent surgery following failed non-operative treatment, 49% had excellent, 36% good and 2% fair results¹¹. However, these data are only from case series and therefore the evidence for the use of surgical treatment in ITBFS is graded as C.

Summary and conclusion

In this review the history, anatomy, biomechanics, epidemiology, pathology, aetiology, clinical diagnosis and management of the iliotibial band friction syndrome (ITBFS) is discussed. The ITBFS can be defined as an inflammatory condition on the lateral aspect of the knee resulting from repetitive friction between the iliotibial band and the lateral femoral condyle. The ITB is a fibrous structure extending from the iliac crest to the lateral tibial tubercle which has important static and dynamic functions at the hip and knee joint. The mechanism of injury in ITBFS is thought to be the repetitive antero-posterior movement of the ITB over the lateral femoral condyle. The precise aetiological factors for ITBFS have not been well documented but intrinsic and extrinsic factors have been postulated to cause ITBFS. The pathology of ITBFS is repetitive acute inflammation, leading to chronic inflammation and false bursa formation between the ITB and the lateral femoral condyle. The precise incidence of ITBFS in different sports is not known but it accounts for 10-20% of injuries in distance runners. The management of ITBFS can be divided into primary phase (decreasing the pain and inflammation) and secondary phase (correcting underlying aetiological factors) treatment. The modalities used in the treatment of ITBFS have not been well studied, and more well-conducted randomized clinical trials are required to assess the efficacy of different treatment modalities for this condition.

Chapter 3

Local corticosteroid injection in the management of Iliotibial Band Friction Syndrome (ITBFS) in runners: A randomised placebo controlled trial

Sections of this Chapter have been accepted for publication in the British Journal of Sports Medicine

Abstract

Objective: The primary objective of the study was to establish whether a local injection of methylprednisolone acetate (40 mg) is effective in decreasing pain during running in runners with recent onset (< 2 weeks) iliotibial band friction syndrome (ITBFS).

Methods: Eighteen runners with at least Grade II ITBFS underwent baseline investigations including a treadmill running test during which pain was recorded on a visual analogue scale every minute. The runners were then randomly assigned to either the experimental (EXP=9) or a placebo control (CON=9) group. The EXP group was infiltrated in the area where the ITB crosses the lateral femoral condyle with 40mg methylprednisolone acetate mixed with a short-acting local anaesthetic and the CON group with short-acting local anaesthetic only. The same laboratory based running test, was repeated after 7 and 14 days. The main measure of outcome was total pain during running (calculated as the area under the pain vs. time graph for each running test).

Results: There was a tendency ($p=0.07$) for a greater decrease in total pain (mean \pm SD) during the treadmill running in the EXP group compared to the CON group tests from Day 0 (EXP=222 \pm 71, CON= 19 \pm 731) to Day 7 (EXP=140 \pm 87, CON=178 \pm 76), but there was a significant decrease in total pain during running ($p=0.01$) from Day 7 (EXP=140 \pm 87, CON=178 \pm 76) to Day 14 (EXP=103 \pm 89, CON=157 \pm 109) in the EXP group compared with the CON group.

Conclusion: Local corticosteroid infiltration effectively decreases pain during running in the first two weeks of treatment in patients with recent onset ITBFS.

Keywords: iliotibial band friction syndrome, running, knee, corticosteroid infiltration

Introduction

The iliotibial band friction syndrome (ITBFS) can be defined as an inflammatory condition of the lateral aspect of the knee resulting from repetitive friction between the iliotibial band and the lateral femoral condyle. It is a fairly common running injury and accounts for between 1.6 and 12% of all running related injuries^{21,45}. In a recently reported survey of athletes seen at a Sports Injury Clinic, it was the second most common running injury¹². It has also been described in military recruits undergoing training^{10,34;46-48}, cyclists^{10,14;35;49;50}, football players^{7,14}, downhill skiers^{1,7}, and weight lifters⁷.

The classic clinical presentation of the injury in runners is that of gradual onset, progressive lateral knee pain. The pain often starts at a predictable distance and is often relieved when the knee is kept in full extension, and is aggravated by repetitive knee flexion, particularly at a 30-degree knee flexion angle. This injury eventually forces the athlete to run shorter and shorter distances until virtually no training is possible.

Numerous etiological factors possibly contributing to the development of ITBFS have been described. These include 1) factors that cause repetitive movement of the iliotibial band over the lateral femoral condyle such as a sudden increase in the volume of training and hill training^{5,6;9;51}, 2) factors that may increase the tension and thus a frictional force over the lateral femoral condyle such as genu

varus⁸, rearfoot varus²¹, a cavus foot^{5;52}, iliotibial band inflexibility, weakness of the hip abductor muscle group³⁷, abnormal lower limb alignment⁵³, knee flexion angle at footstrike³⁰ and 3) other intrinsic factors such as an excessive prominence of the lateral femoral condyle⁶, younger age¹², male sex^{7;9} and ecto- and mesomorphic somatotypes⁹. There are however few data from well-conducted scientific studies to link these factors in a causal relationship to the development of ITBFS in runners.

The gross pathology and histopathology of ITBFS has been described in tissue obtained at the time of surgery. Features of chronic inflammation^{5;14} characterize the macroscopic appearance of tissue between the distal ITB and the lateral femoral condyle. A reddish brown bursal thickening under the iliotibial tract, possibly due to chronic inflammation has been observed⁵, but a true bursa does not appear to be characteristic of the pathology^{5;54}. These findings have been supported by more recent reports using Magnetic Resonance Imaging (MRI) to define the pathology in ITBFS^{42;55;56}. Histological examination of tissue obtained at the time of surgery showed areas of mucoid degeneration of fibroid necrosis¹⁴. It therefore appears that the pathology of ITBFS is that of an acute inflammatory process resulting from repetitive trauma to the tissues between the ITB and the lateral femoral condyle⁴⁵. If left untreated, the acute inflammatory process continues and can result in the chronic inflammatory response that has been observed at the time of surgery. Surgery is usually performed only in refractory cases¹¹.

The treatment for ITBFS in the early phase (first 2 weeks) therefore involves management of the local inflammation and pain. It is this time period in the course of the injury that is the focus of this research study. After the inflammatory process has been treated, correction of the underlying causes of the injury becomes a priority.

A number of treatment modalities have been suggested for the early phase of treatment of ITBFS. These include rest^{3;10;14;28;45;54;57}, alternative activity such as pool running⁴⁴, reducing the amount and intensity of running^{5;9}, ice^{5;9;21;28;43;45}, stretching^{6;8;45}, massage^{28;43;58}, and oral non-steroidal anti-inflammatory drugs^{3;5;7;9;10;14;43-45;57;57}. However, there are very few published randomized controlled trials to support the use of these treatment modalities in the early phase treatment of ITBFS. In only one randomized placebo controlled clinical trial a combination of an anti-inflammatory/analgesics treatment together with physiotherapy have been shown to increase total running time and decrease pain in the first 2 weeks of treatment⁴³.

In addition to the treatment modalities already mentioned, it is also popular clinical practice to inject the area between the lateral femoral condyle and the iliotibial band with corticosteroids in order to reduce the local inflammation^{8;14;28;44;45;57;57}. However, despite this popular practice, the effect of local corticosteroid injection at the site of tenderness has never been evaluated in a randomized placebo controlled clinical trial.

The aim of this study was to determine whether a single local infiltration of corticosteroids into the area between the ITB and the lateral femoral condyle decreases pain during running in the first two weeks of treatment.

Methods

Study setting

The study was conducted at the Sports Medicine Clinic of a Staff Model Health Maintenance Organization (Vaalmed) in South Africa. At this facility all the general medical services (dentistry, pathology, laboratory, physiotherapy, pharmacy, hospital, specialist, general practitioner services) as well as the sports medicine services are rendered.

Subjects

All male and female runners between 20 and 50 years of age attending the Sports Medicine Clinic, who were diagnosed clinically as suffering from ITBFS, were potential subjects for the study. They were all athletes from local running clubs, and were either self referred or referred to the Sports Medicine Clinic by their general practitioners.

Approval from the Ethics and Research committee of the Faculty of Health Sciences of the University of Cape Town for the study was obtained prior to the onset of the study.

The diagnostic criteria for ITBFS were based on history, clinical examination, and special clinical tests for ITBFS. Patients were considered if they presented with pain of recent onset (in the last 14 days) on the lateral aspect of the knee during repetitive flexion and extension movements of the knee.

Subjects underwent a full clinical assessment. The following information was obtained from each subject: age, weekly running distance, best 10 km running time, pain localization, degree of pain, past medical and surgical history, history of allergies (lignocaine or corticosteroids), and family history.

Specific features of the pain were, that it had to be 1) well localized to the lateral femoral condyle, 2) sharp in nature, 3) characterized by a sudden onset, usually after a specific time (or distance of running), 4) more intense at the stage when the foot comes into contact with the ground during deceleration (when contraction of tensor fascia occurs at 30 degrees knee flexion), 5) worse during downhill running because there is a reduced angle of knee flexion at foot strike when running downhill; therefore the posterior border of the ITB is in the "impingement zone" over the lateral femoral condyle for a longer period of time³⁰ and 6) relieved by walking with the knee in full extension.

The history was followed by a full clinical examination to confirm the diagnosis of ITBFS and to exclude any contraindications to methylprednisolone administration. The principle author performed all the medical assessments. Specific features in the clinical examination of the knee that were considered to be diagnostic of the condition were, 1) tenderness of the lateral femoral condyle located 2cm above the lateral joint line of the tibiofemoral joint, 2) holding a finger on the lateral condyle while flexing and extending the knee and eliciting pain at 30-40 degrees of knee flexion⁵, and 3) pain on weight bearing on the affected limb at knee flexion of 30-40 degrees. The diagnosis was made on the basis of a classic history and the presence of criteria 1 and at least one of the other two criteria on clinical examination.

Subjects with a confirmed clinical diagnosis of ITBFS were excluded from the study if there 1) was an insignificant degree of pain (less than a Grade II-injury) - a grade II injury was defined as pain severe enough to impair the runner's running performance but not severe enough to stop the runner from continuing to run, 2) was an unwillingness to adhere to the period of rest, icing and abstaining from running during the first 14 days of treatment, or 3) if the subject had a history of allergy to methylprednisolone acetate or lignocaine.

A total of 45 runners were screened and 18 male runners fulfilled the inclusion criteria for the study, and were therefore included in the study.

Day 0: Screening, familiarization, and randomization

All the subjects reported to the testing laboratory and underwent a familiarization process. Subjects dressed in appropriate running gear including their normal running shoes (that were used for each subsequent test), and were then familiarized with the treadmill running test.

A previously validated {130} treadmill running test was used to measure the amount of pain that subjects experienced during normal running. At first the subjects commenced with a warm up period of 5 minutes. During this phase, all the subjects ran on the motorized treadmill at a slow speed equivalent to 7 minutes per kilometer. A 10-point visual analogue scale (VAS) was used during the test to measure the pain experienced by subjects during running (Figure 3.1.). Each subject was instructed to report the severity of the typical pain on the lateral side of the knee at the site of ITBFS pain at the end of every minute of the test. A chart with the VAS was displayed on the wall in front of the treadmill so that the subject could easily see it while running.

Figure 3.1.: Pain perception scale an the VAS

0	NO PAIN
1	
2	MILD PAIN
3	
4	
5	MODERATE PAIN

6	
7	
8	SEVERE PAIN
9	
10	UNBEARABLE PAIN

After the warm-up period (first 5 minutes of running), the speed of the treadmill was increased to the subjects' best recent 10 km running speed pace. This speed was then maintained for 30 minutes or until the pain reached 8 (severe pain) on the VAS. The test was terminated if the pain reached a score of 8 or after 30 minutes.

After the treadmill-running test had been completed, the subjects were randomly assigned to either the experimental (EXP) or the control group (CON) in a single blind (subject blinded but not investigator) fashion. The experimental group (EXP, n=9) then received an injection of 40mg (1 ml) methylprednisolone acetate (Depot-Medrol, Pharmacia and Upjohn, Craighall, Johannesburg, South Africa) mixed with 10mg (1 ml) Lignocaine hydrochloride (1 %) (Fresenius Kabi, Halfway House, South Africa) while the control group (CON, n=9) received an injection of 20mg (2 ml) Lignocaine hydrochloride (1 %) into the space between the lateral femoral condyle and the ITB.

The principal author used the following technique while injecting the subjects:

- After explaining the injection technique the subject was positioned lying on his side with the affected leg on top.

- The knee was flexed to 30° and the point of maximal tenderness, which is the area to be injected on the lateral femoral condyle, was identified and sterilized using a 90% ethyl alcohol solution
- 2ml of either 1% Lignocaine solution (CON group) or 1ml of methylprednisolone acetate together with 1 ml 1% Lignocaine hydrochloride (EXP group) was drawn up into a 2.5ml disposable syringe
- While identifying the iliotibial band with the left hand's thumb and sliding it over the posterior border of the iliotibial band, the left hand's index finger was kept on the area to be injected
- Approaching from the posterior aspect the needle was directed at 90° degrees to the long axis of the body and medial to the posterior border of the iliotibial band
- The needle was advanced until it was under the index finger of the left hand deep to the iliotibial band at the point of maximal tenderness just lateral to the lateral femoral condyle tubercle and the solution was injected slowly over 15 seconds.
- The subject was then observed for 20 minutes in case of any allergic or other adverse reaction occurring

Each subject was then told not to run for a period of 14 days. The subjects were allowed to continue with work-related activities but were not allowed to engage in any exercise training. In addition, each subject was asked to keep a daily pain record in a diary. Subjects were requested to record any side effects or adverse

reactions they experienced. Each subject was also instructed to report for a follow-up treadmill running test after 7 and 14 days. The only other treatment that each subject was given was an instruction to ice the area twice daily at 12-hour intervals for 30 minutes. The patient was told to wrap the ice in a towel while applying it to the area.

Days 7 and 14

The subjects were followed up after 7 and 14 days. During these visits it was established whether the subject adhered to the initial period of relative rest and if there were any side effects or adverse reactions experienced. The treadmill running test as described in the previous section was repeated. After the test on day 7, the subject was instructed to once again abstain from any running or other athletic activities for the following 7 days and asked to report again for the Day 14 post-infiltration visit. During the final visit (Day 14) the same measurements as those during the visit on Day 7 were completed.

Statistical analysis of data and measures of outcome

The results of the study were analyzed by the Department of Statistics at the University of Potchefstroom (Vaal Triangle Faculty). The Stat Advisor package on the mainframe computer was used. The two groups were compared with respect to the following general characteristics: age, weight, height, running history, and training history (best 10 km running time, weekly running distance). The main measure of outcome of the study was the total pain experienced during running). A graph depicting the pain (VAS units) on the Y-axis (1-10), and time run (minutes) on the X-axis was drawn for each of the three treadmill tests for each subject. The area under the pain vs. time curve was calculated as a measurement of the total pain experienced during running in each subject. If the pain became severe (score of 8) and the test had to be terminated, the area of the pain vs. time for that subject was calculated using the maximum pain score of 8 for the remainder of the test (until 30 min). The total pain experienced during running was compared between the EXP and CON groups on Days 0,7 and 14 and for each group over the 14-day time period.

Standard skewness and standard kurtosis were used to establish whether there were any differences in physical characteristics between the two groups.

Different tests were then used to establish whether there were any differences in the outcome of the injections in the EXP and CON groups. A t-test was used to compare the means of the two samples. It also constructs confidence intervals

for each mean and for the difference between the means. An f-test was also run to compare the standard deviations of the two samples. The level of significance was established as $p < 0,05$.

Results

Physical characteristics, running and training history

The physical characteristics of the subjects in the CON and EXP groups are depicted in Table 3.1.

Table 3.1.: Physical characteristics and training history of the EXP and CON groups. Values are mean (SD)

	CON group (n=9)	EXP group (n=9)	P Value
Total weekly Distance (km)	82,5 (9.3)	83.3 (9.7)	0,87
Best 10km time (min)	46.6 (6.7)	46.8 (6.9)	0,96
Age (years)	28.9 (5.0)	29.0 (6.5)	0.87
Height (cm)	177.9(11.1)	176.4(8.3)	0.86
Weight (kg)	70.5 (8.0)	73.3 (7.3)	0.72

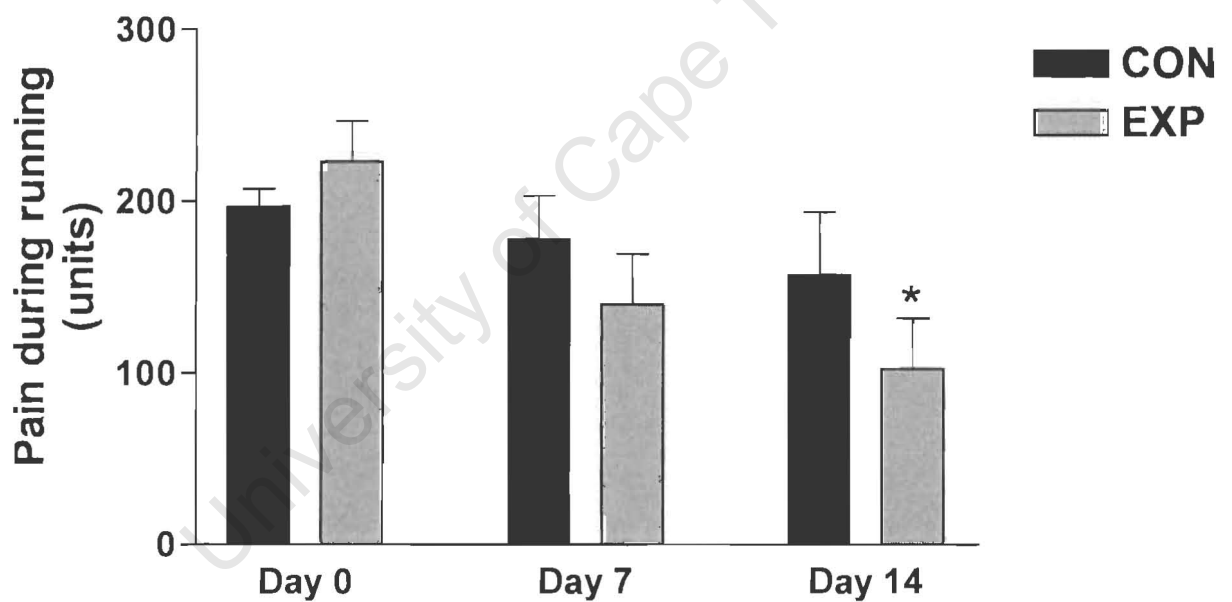
There were no significant differences between groups

There were no significant differences in any of the physical characteristics, running history or training history between the two groups.

Total pain during running

The results of the total pain (pain X time) experienced by the patients during the 30 minute treadmill running test for the CON and EXP groups is depicted in Figure 3.2.

Figure 3.2.: The total pain experienced during running in the two groups at Day 0, 7 and 14 (Values are mean and SE)



*: Indicates a significant difference from the value at Day 0 ($p=0.01$)

There was a significantly greater decrease in total pain experienced by subjects during running in the EXP compared to the CON group in the period from Day 7 to Day 14 ($p=0.01$). In the period from Day 0 to Day 7, the subjects in EXP group

had a tendency to decrease their total pain during running ($p=0.07$). There was also a significant improvement (% improvement) in pain during running in the EXP group compared with the CON group in the period Day 7 to 14 ($p=0.01$) (Figure 3.2.).

Side effects/adverse reactions

None of the subjects reported any side effects or adverse reactions as a result of either the placebo or the active injection.

Discussion

In this study the efficacy and safety of injection of methylprednisolone into the area between the lateral femoral condyle and the iliotibial band was evaluated. The only other form of treatment during the study period was ice on the area for 20 minutes twice daily. The results of this study show that local infiltration with corticosteroid decreases pain during running more so than placebo after 14 days in patients with ITBFS of recent onset. In this study, both groups showed improvement in pain during running, which may be attributed to a period of rest, and the application of ice. However, the group receiving a local corticosteroid injection had a significantly greater decrease in pain during running compared with the control group.

The pathology of ITBFS is an inflammation resulting from repetitive mechanical trauma. The inflammation results in pain, mainly during running. Pain during running can be graded on a VAS scale from 1-10 and therefore effectiveness of different treatment modalities can be evaluated. In a previous study we have shown that a functional treadmill running test during which pain was recorded every minute is a valid, effective and sensitive method to evaluate the effects of different treatment modalities for running related pain {130}. Importantly, this method eliminates recall bias, as pain is recorded while performing the activity.

This study has some limitations. Firstly, the sample size is relatively small. This was due to the fact that despite recruiting 45 runners the majority of runners who were eligible did not want to refrain from running for the 14-day study period. Recruitment of subjects for this study took in excess of 24 months, highlighting the difficulty in performing these types of controlled trials in the running population.

A second limitation is the short duration of the study. A period of 14 days was selected for the follow-up period because the medication is likely to have shown an effect if the pain was due to an acute inflammatory process. Furthermore, as mentioned runners were only willing to comply with the request to refrain from running for that period but not any longer. Although an attempt was made to follow up the runners in each group for much longer, there was such a large variability in their return to running, their volume of running, the type of

rehabilitation program, alterations in footwear and the use of orthoses, all of which form part of the second phase treatment of this condition. Therefore, no conclusions on the longer-term benefits of the corticosteroid treatment compared to placebo could be made in this group.

In conclusion, the results of this study show that the infiltration of the lateral femoral condyle area deep to the iliotibial tract with corticosteroid decreased pain during running after 14 days. Therefore the practical recommendation to a sports physician treating runners is that local corticosteroid infiltration is effective and safe in the early (first 14 days) treatment of recent onset ITBFS. However, it must be emphasized that identification and correction of underlying causes for ITBFS must form part of the management.

Chapter 4

Summary and conclusion

This thesis focused firstly on a review of the possible causes and treatment of the ITBFS in runners. A review, using Evidence Based Medicine criteria identified that the causes of iliotibial band that have been postulated have not been tested in well conducted prospective studies. Therefore, at best risk factors that are associated with ITBFS have been identified, but the cause effect relationship has not been established.

In future studies, these risk factors have to be studied to establish a cause-effect relationship using a prospective asymptomatic cohort of runners, and follow them up over a time period until a proportion of them develop ITBFS. Alternatively, controlled clinical trials can be used to intervene with specific risk factors and measure outcome. These studies are difficult to perform as they will require large sample sizes, are costly and many confounding variables will have to be controlled.

There are also very few clinical trials to support the use of suggested treatment modalities. Most studies examining treatment modalities for ITBFS to date have been case series, where no control groups are included. In this thesis, the results of a study are reported where one treatment modality was tested in a randomized controlled clinical trial. Local corticosteroid infiltration was shown to effectively

relieve pain during running 14 days after treatment. Although limited by small sample size, and relatively short follow-up time, this finding enables clinicians to administer this treatment with more confidence, and it therefore contributes to a better understanding of the treatment of ITBFS. However, it is clear that many more randomized clinical trials are required to examine the efficacy of other early and late phase treatment modalities for ITBFS.

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Appendices

Appendix 1

QUESTIONNAIRE 1

1. Age
2. Height.....
3. Weight.....
4. Years running.....
5. Other injuries.....
6. ITB before or not.....
7. Injury:
 - How did it happen?.....
 - Any previous injuries?.....
8. Training:
 - Km per week?.....
 - How long have you been running?.....
 - Training terrain?.....
 - Shoes: Make?.....
 - Previous make?.....
9. Competition:
 - Best 10 km time?.....

Appendix 2

QUESTIONNAIRE 2

ITB

1. Presentation:
2. Findings:
3. Treatment modalities
 - Rest:
 - Ice:
 - Medication:
 - Injection – Hydro Cortisone:
 - Surgery:
 - Physiotherapy:
 - Podiatric treatment:
 - Insoles:
4. Outcome to treatment: