

**THE EFFICACY OF  
THE GRASTON TECHNIQUE INSTRUMENT-ASSISTED  
SOFT TISSUE MOBILISATION (GISTM)  
IN THE TREATMENT OF PLANTAR FASCIITIS IN  
RUNNERS**

**By**

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*Dissertation submitted in partial compliance with  
the requirements for the  
Masters Degree in Technology: Chiropractic  
at the Durban Institute of Technology*

I, Kirsten Maartens, do declare that this dissertation represents  
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## **Dedication**

To Mom, Dad and Nicola

Your Faith, support and unconditional love are my fuel.

Thank you for the sacrifices, the encouragement and the inspiration to follow  
my dreams.

I love you always.

## **Acknowledgements**

Sincere thank you to Dr Charmaine Korporaal, an extraordinary supervisor, for her limitless advice, guidance, support, motivation and patience throughout my period of study, and particularly with research.

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A huge thank you to all the patients who participated in this study, for their dedication and perseverance while seeing this dissertation through

Jesus Christ- my Rock, my Life, my All.

## **Abstract**

Plantar Fasciitis (PF) or “painful heel syndrome” is an inflammation of the plantar fascia at its insertion on the medial calcaneal tubercle. Accounting for 7-9% of total sports injuries, this condition is predominantly due to overuse and is notoriously difficult to treat.

Traditionally treatment focused on the resolution of the inflammation with the application of such modalities cross frictions / transverse frictions being the modality of choice. With such modalities there are however limitations which include the detection of the appropriate areas in which treatment should be given as well as the treatment depth achieved.

The GISTM, however is an advanced form of soft tissue mobilisation that employs the use of specifically designed stainless steel instruments that, when manually brushed over the skin of the affected area, are thought to detect and release scar tissue, adhesions and fascial restrictions. This complementary technique is hypothesized to work in the same manner as cross friction massage, and is thought to achieve quicker and improved outcomes by its detection of the treatment area(s) as well as improving the depth of treatment application. This assertion was however untested.

Therefore the purpose of this study was to determine the efficacy of the Graston Technique Instrument-assisted Soft Tissue Mobilisation (GISTM) in the treatment of Plantar Fasciitis in runners.

Thirty-six subjects were chosen, as per inclusion criteria, for this single-blinded placebo controlled study. The subjects were subsequently divided into two equal groups, Group A and Group B. Group A was the experimental group and received treatment using the Graston Technique instruments and Group B, the control group, received a placebo treatment of detuned ultrasound.

The treatment regime consisted of an initial consultation (in week one) followed by three treatment sessions per week, over a two-week period (weeks two and three) and a single treatment in week four. A follow-up non-treatment session was scheduled in week five.

Data was captured at the initial, the fourth and the seventh visits. This was analyzed in terms of subjective and objective clinical findings as per the respective recording measures of the algometer readings and weight bearing ankle dorsiflexion measure, and, Foot Function Index (FFI) and Numerical Rating Scale (NRS) Pain Rating Questionnaire, respectively.

The SPSS version 11.5 was used to analyze the data. Repeated measures ANOVA was used to examine changes in quantitative outcomes over the time points, and for a treatment effect (time\*group interaction). To control for the partial pairing (i.e. the six participants with bilateral PF) in the inter-group analysis, a variable that classified each subject as paired (both left and right feet used in study) or non-paired (only used once in study) was used as a factor in the model. Correlations between the intra-group changes in the various outcome variables were assessed using Pearson's correlation coefficients.

The two sub-groups of subjective and objective findings were compared to each other, and as an adjunct, descriptive statistics encompassing the variables of gender, race, age, weight and height were analyzed.

The descriptive statistics revealed that the male gender (72.2%) and the white race (63.9%) group were dominant. The average age of all the participants was 36.6 years.

Statistical analysis of the objective and subjective data suggested trends that showed a possibly beneficial effect of the GISTM for the subjective outcomes. Although the NRS readings of both the GISTM and placebo groups improved over time, the GISTM group did not show any significant improvement over that of the placebo group. The FFI results of walking barefoot, walking with

shoes, standing with shoes, descending stairs, and standing on tip toe, however, produced outcomes in favour of the GISTM. Of the objective measures, the algometer readings exhibited favourable outcomes in both Group A and B, while the ankle dorsiflexion measures were relatively insignificant in both Group A and Group B.

These findings imply that the Graston Technique Instrument-assisted Soft Tissue Mobilisation (GISTM) provides an effective treatment for patients suffering from PF especially related to the outcome of pliability and mobility within the plantar fascia as opposed to affecting the clinical outcome of pain.

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## **Glossary of terms**

For the purposes of this research the following definitions will apply:

### **Acute Plantar Fasciitis (PF):**

Acute PF is where the inflammatory process may last up to five days and is characterized by the cardinal signs of swelling, redness, warmth, pain and loss of function (Vizniak and Carnes, 2004:221). This type of inflammatory process may persist for a short period (up to one week) dependant on patient activity and resolves within one week to conservative care comprising rest, cryotherapy and strapping (Vizniak and Carnes, 2004:221). This process is analogous to an inflammatory acute tendonitis (see below)<sup>1</sup>.

### **Subacute PF:**

By default lies between five to seven days and four weeks, which corresponds with the repair phase of collagenous tissue as indicated by Vizniak and Carnes (2004:306)

### **Chronic PF:**

This is found in phase three in the soft tissue healing process where collagen is remodeled to increase functional capabilities of the tendon or ligament to withstand stresses imposed upon it, lasting on average from four weeks to 12 months (Vizniak and Carnes, 2004:306). This process is analogous to a chronic tendonitis (tendonosis), which is referred to as a tendinosis or tendinopathy (see below)<sup>1</sup>. May, *et al.* (2002) indicate that chronic plantar fasciitis is more common than acute or subacute. In support of this, a definition of plantar fasciitis, as stated by Silverman, *et al.* (2003), is, "A chronic recalcitrant Plantar Fasciitis is the failure of symptomatic relief after a minimum of six months of non-operative treatment".

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<sup>1</sup> Tendinopathy (Panni, Tartarone, Maffulli, 2000:392-397) by definition encompasses both tendonitis (acute stage) and tendonosis (chronic stage) (Khan, 2002:626-627), where the term tendinosis refers to tendon degeneration without clinical or histological signs of intratendinous inflammation (Mobic, 2003: online).

## **Chapter 1**

### **INTRODUCTION**

This chapter presents an introduction to the study of the efficacy of the Graston Technique Instrument-assisted Soft Tissue Mobilisation (GISTM) in the treatment of Plantar Fasciitis in runners and is discussed under the following headings:

- The problem and its setting
- Aims and objectives
- Benefits of the study

#### **1.1) THE PROBLEM AND ITS SETTING**

Plantar Fasciitis (PF), or “the painful heel syndrome” (Barrett and O’Malley, 1999:2200), is an inflammation of the fascia on the plantar surface of the foot (Lillegard and Rucker, 1993:168). Chronic stress, and resultant spur formation, coupled with tension-causing biomechanical imbalances seem to be the most common precipitating factors (Lillegard and Rucker, 1993:168; Barrett and O’Malley, 1999:2200). Primarily an overuse injury, PF is commonly found in those people involved in running sports (Krivickas, 1997:141) and makes up 7-9% of total sports injuries (Batt and Tanji, 1995:77). Other etiologies contributing to the condition are abnormal biomechanics, pes cavus and pes planus foot types (Young, *et al.* 2001:467).

Even though many etiologies exist which results in PF being one of the most common disorders of the foot and ankle, it is generally known to be a self-limiting condition (Young, *et al.* 2001:467), and is notoriously difficult to treat (Stephens, 2003). In congruence Brown (1996) states that this condition is difficult to treat, taking between eight and 12 months to recover, and that surgical intervention should not be sought much before this time frame has

elapsed. Of the numerous conservative treatments that have been reported as effective in the treatment of PF, transverse friction massage (Lillegard and Rucker, 1993:169; Hyde and Gengenbach, 1997:478,481) is commonly the treatment of choice.

Cyriax (1984) conceptualised that frictions promoted a traumatic hyperemia, resulting in reduction of edema in the chronically irritated tissues associated with the freeing of adhesions (scar tissue) and eventual induction of controlled inflammation. The Graston Technique Instrument-assisted Soft Tissue Mobilisation (GISTM) employs the use of stainless steel instruments, with the rationale that this technique increases blood flow and tissue healing to the area as well as breaking up soft tissue restrictions (Carey-Loghmani, 2003:12)

As these two forms of treatment are similar in method and effect and cross friction results in improved clinical outcomes, it was hypothesized that GISTM would also hold clinical benefits for the patient. Thus the aim of this study was to determine the efficacy of the GISTM in the treatment of PF, as GISTM could be another modality in the successful treatment of PF.

## **1.2) AIMS AND OBJECTIVES**

The aim of this prospective, single blinded (researcher), randomized, placebo controlled pilot study, was to test the efficacy of the GISTM in the treatment of Plantar Fasciitis in runners.

### **1.2.1) The first objective**

The first objective was to determine the relative efficacy of the GISTM versus placebo in the treatment of Plantar Fasciitis in terms of subjective clinical findings.

#### **The first hypothesis**

It was hypothesized that the GISTM would be effective in the treatment of PF in terms of subjective clinical findings



### **1.2.2) The second objective**

The second objective was to determine the relative efficacy of the GISTM versus placebo in the treatment of Plantar Fasciitis in terms of objective clinical findings.

#### **The second hypothesis**

It was hypothesized that the GISTM would be effective in the treatment of PF in terms of objective clinical findings.

### **1.2.3) The third objective**

The third objective was to determine the relative efficacy of the GISTM versus placebo in the treatment of Plantar Fasciitis in terms of correlations between subjective and objective clinical findings.

#### **The third hypothesis**

It was hypothesized that the GISTM would be effective in the treatment of PF in terms of subjective and objective clinical findings.

## **1.3) BENEFITS OF THE STUDY**

As this treatment tool is only ten years old (Carey-Loghmani, 2003:7), little research determining the GISTM's effectiveness had been done. This fact, along with the many anecdotal case studies that suggest its clinical benefit (Hyde, 2003) provided us with the opportunity to research the tool's efficacy, with the potential of it becoming familiar alongside known modalities, and thus broaden the scope of treatment forms for a variety of conditions, should it be found effective relative to placebo intervention.

In addition to this it would be beneficial to the profession to introduce a new treatment modality to be used as an adjunct to, and be integrated with known treatment forms. In addition to Carey-Loghmani's (2003) reporting that in comparison with other manual forms of treatment (of soft tissue dysfunction) the GISTM instruments provide improved clinical outcomes. Numerous other benefits to the patient and practitioner include:

- a) To the patient: quicker, improved outcomes focus on patient education and participation in managing their condition.
- b) To the practitioner: decreased fatigue, energy conservation, decreased treatment time, increased mechanical advantage, joint conservation and the ability to locate soft tissue lesions more precisely (Carey-Loghmani, 2003:9).

To more fully investigate these assertions, chapter two presents a review of current literature with regard to PF while chapter three addresses the methodological aspects of this study. Chapter 4 presents the results, which are discussed in the context of the literature in order to determine the outcome of the hypotheses stated in the chapter.

Lastly, chapter five provides a synoptic conclusion to the study as well as giving recommendations for future studies in respect of GISTM.

## **Chapter 2**

### **LITERATURE REVIEW**

This chapter presents a review of the available literature with respect to Plantar Fasciitis and is discussed under the respective headings of:

- Definition
- Incidence, prevalence and epidemiology
- Anatomy
- Clinical presentation
- Signs and symptoms
- Differential diagnosis
- Treatment

#### **2.1) DEFINITION**

Plantar Fasciitis (PF), or “the painful heel syndrome” (Barrett and O’Malley, 1999:2200), is an inflammation of the fascia on the plantar surface of the foot (Lillegard and Rucker, 1993:168). Brantingham, *et al.* (1992), state that PF presents as an acute, localised plantar heel pain, resulting from excessive pull on the plantar aponeurosis, which is believed to cause microtrauma with resultant inflammation. This is supported by Watt (2003), who describes PF as a degenerative condition originating from chronic overuse.

In contrast May, *et al.* (2002) state that although PF may be acute, it is more often a chronic condition that is directly related to physical activity. This is supported by Pollard and So (1999), Ryan (1995), and Young, *et al.* (2001), who state that PF is the most common cause of heel pain in adults and those involved in running sports (Krivickas, 1997:141). In addition, Gill and Kiebzak (1996:528) state that PF is viewed as an overuse injury.

## 2.2) INCIDENCE, PREVALENCE AND EPIDEMIOLOGY

Ambrosius and Kondracki (1992) report that PF accounts for 8.5-10% of all sports injuries. This is further supported by Evans and Fairclough (1990:101), Calliet, (1988:344) and Norkin and Levangie (1992:492), who state that PF is common in the athletic population, tallying 7-9% of total sports injuries (Batt and Tanji, 1995:77). Although PF is common in athletes, many patients are not athletic, as noted by Gill and Kiebzak (1996:527). In congruence with this, Davis, et al. (1994) reported that 30 of their 105 patients participated in athletic activity at least three times per week.

Nevertheless, and despite activity level, PF tends to occur mainly in an older age group (over 40) (Ambrosius and Kondracki 1992:29, Davis, et al. 1994:532, Gill and Kiebzack 1996:527, Young, et al. 2001:467).

Discrepancies exist between findings of studies as to gender predominance as some authors report that PF affects both males and females equally (Reid 1992:196), while Ambrosius and Kondracki (1992:29) report a male predominance. In contrast to this, Gill and Kiebzak (1996:528) and the South African studies by Blake (2003), Du Plessis (2002), Hammond (2000) and Morris (2000) report a slight female predominance. Thus the literature seems inconclusive in this respect.

This lack of congruence with regard to some aspects of PF may stem from the assertion by Ryan (1995:891), who notes that the pathophysiology of this condition is often misunderstood and predisposing conditions are frequently not recognized making it an enigmatic clinical syndrome. Furthermore he feels that a lack of understanding, of especially the biomechanics of PF, may have resulted in an inadequate treatment plan and failure to relieve the patients' pain in clinical terms, making research in this field both problematic in terms of clinical definition as well as measurement outcomes (Ryan, 1995:891).

### 2.3) ANATOMY

In order to understand the clinical picture more accurately, it is important to describe the anatomical structures involved before addressing the pathophysiology.

The plantar fascia consists of longitudinally arranged bands of dense fibrous connective tissue extending from the medial calcaneal tubercle on the anterior portion of the calcaneus and fans forwards, forming the longitudinal arch of the foot (Moore, 1992: 463; Young, *et al.* 2001:467).

As this multi-layered fascia radiates distally it becomes wider and thicker (Watt, 2003) and consists of three distinct components: the medial, central and lateral portions (Ambrosius and Kondracki, 1992:30).

The plantar aponeurosis, comprised of a strong, thick, central portion flanked with weaker, thinner medial and lateral portions, divides into five bands, which enclose the digital tendons (Moore, 1992: 463), and inserts distally into the base of each proximal phalanx via the plantar pad (Reid, 1992:131).

This intricate arrangement helps to maintain the longitudinal arch of the foot (May, *et al.* 2002:278), while giving firm attachment to the overlying skin and protecting the underlying vessels, nerves and tendons and their synovial sheaths (Ambrosius and Kondracki, 1992:30). It is also fundamental in the unique function of protection, shock absorption, static support and ability to contract and relax allowing forward propulsion of the lower limb during the gait cycle (Reid, 1992:196, May, *et al.* 2002:278).

When the toes are in the neutral position, the plantar fascia relaxes and there is a simultaneous relaxation of the arch of the foot (Reid, 1992:196). Any dorsiflexion of the toes slides the plantar pads distally, which places tension on the plantar aponeurosis: the architecture of the joints allows the arch to form and this “windlass” mechanism (see Diagram 1) creates a dynamic stable arch and hence a more rigid level for push-off (Reid, 1992:131). The

plantar fascia therefore assists in the development of push-off power during running and jumping (Reid, 1992:196).

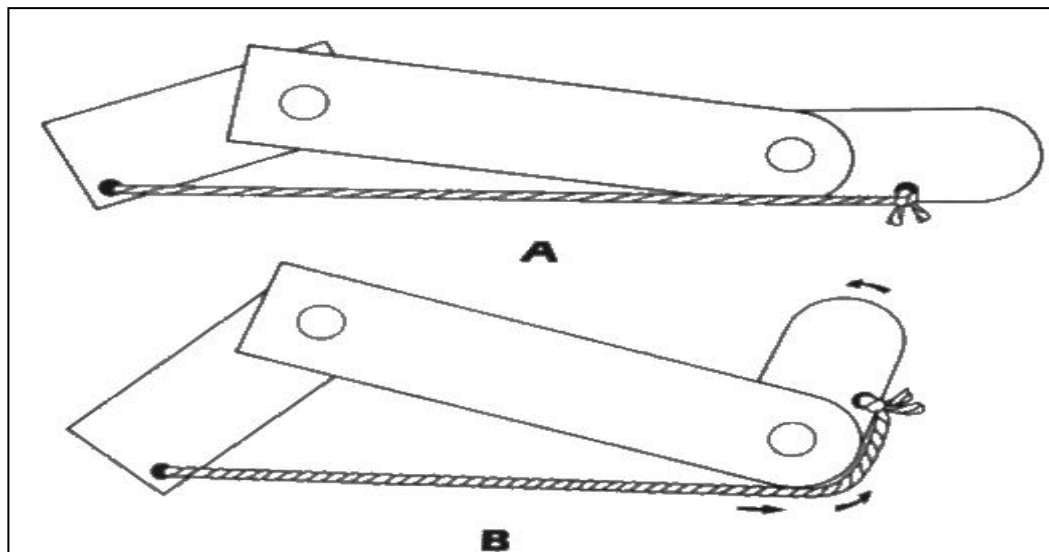


Diagram 1: (A) The resting position of the plantar fascia. (B) Dorsiflexion of the first toe leads to tightening of the fascia and lifting of the arch. ([www.orthoteers.co.uk/Nrujp~ij33lm/Orthfootmech.htm](http://www.orthoteers.co.uk/Nrujp~ij33lm/Orthfootmech.htm)).

There are therefore various etiological factors resulting in PF and these are classified as being biomechanical (most common) (Barrett and O'Malley, 1999), environmental and anatomical (Chandler and Kibler, 1993:344), which could affect this “windlass” mechanism and induce the clinical presentation of PF.

#### **2.4) CLINICAL PRESENTATION**

The pain and discomfort experienced by PF sufferers, is due to collagen degeneration from repetitive microtrauma in the fascia from continuous or excessive pull on the plantar aponeurosis (Brantingham, *et al.* 1992:75).

As a biomechanical cause, Chandler and Kibler (1993), state that maladaptations of runners (i.e. ankle range of motion and strength of posterior calf muscles) can cause functional pronation of the hindfoot such that the forces generated during normal running put more tensile strength on the plantar fascia. Cumulative repetitive force, greater than the fascia is able to

withstand, leads to continual injury on a microscopic level, and the tissue cannot repair itself as rapidly as the damage is being done (Krivickas, 1997:133). The resultant micro-tears lead to an eventual inflammatory response (Ambrosius and Kondracki, 1992:30; Lillegard and Rucker, 1993:168), adhesion formation (Wilk, *et al.* 2000:27), and tearing of the fibres at the fascial attachment (Brantingham, *et al.* 1992:75) resulting in periostitis of the medial calcaneal tubercle (Polkinghorn, 1995:45), which often leads to spur formation.

Thus chronic stress (and resultant spur formation) coupled with tension-causing biomechanical imbalances seem to be the most common precipitating factors (Lillegard and Rucker, 1993:168; Barrett and O'Malley, 1999:2200). This is thought to be further aggravated by abnormal biomechanics, pes cavus and pes planus, cause poor intrinsic muscle strength, exacerbating the problems and resulting in PF (Watt, 1995:53; May, *et al.* 2002:279), which presents as a fairly distinctive clinical entity.

## **2.5) SIGNS AND SYMPTOMS**

In general the pain is insidious in onset, with no associated or reported history of acute trauma (Batt and Tanji, 1995:78). It is localized to an area around the medial calcaneal tubercle, with tenderness extending along the entire medial portion of the plantar fascia, and along the fascial plane towards the metatarsals (Ambrosius and Kondracki, 1992:31; Krivickas, 1997: 141; Barrett and O'Malley, 1999:2200).

Patients often complain of sharp, lancinating pain that is typically well localised (Watt, 2003:53), and is often severe enough to affect performance and alter gait and stride patterns (Ambrosius and Kondracki, 1992:31). This is substantiated by Reid (1992), who states that severe cases of PF may result in athletes bearing weight mainly on the lateral border of the foot and heel, experiencing pain at rest, and limping.

PF of biomechanical origin usually occurs unilaterally, and is worst upon arising in the morning (Reid, 1992:196) or from getting up after prolonged sitting (Krivickas, 1997: 141), and eases with activity (Watt, 2003:53). As a result of this PF has also been shown to limit range of motion of big toe dorsiflexion and ankle dorsiflexion to ninety degrees (Lillegard and Rucker, 1993:169). Watt (1995) and Reid (1992), state that this is due to tightness of the calf muscles, which restricts dorsiflexion of the ankle, and tightens the plantar fascia.

In terms of the clinical presentation of PF, there are several other conditions from which it must be differentiated in terms of the presenting signs and symptoms. These will be discussed in the next section.

## **2.6) DIFFERENTIAL DIAGNOSIS**

PF should be differentiated from other causes of heel pain.

### **2.6.1) Neurological causes**

#### **2.6.1.1) Entrapment of L5/S1 nerve root**

The L5/S1 nerve root provides segmental innervation to the posterior thigh, and the gluteal, anterior, posterior and lateral leg muscles, as well as sensation to the heel, thus being responsible for the plantar response (ankle reflex). Entrapment of, or pressure on this nerve root may produce focal low back pain and sharp pain radiating down the buttocks and posterior aspect of the thigh and leg distally to the heel (Barrett and O'Malley, 1999:2203). The physical examination should include a leg-raising test, which, if painful, may indicate a disorder of the lower back. The pathology can be confirmed or refuted by findings on lumbar x-rays, MRI or CT scans (Reid, 1992:815; Barrett and O'Malley, 1999:2203; May, *et al.* 2002:280)

#### **2.6.1.2) Tarsal Tunnel Syndrome**

This is a compression neuropathy of the posterior tibial nerve or one of its three branches as it courses through the fibro-osseous tarsal canal, from the posterior aspect of the medial malleolus towards the anteromedial aspect of



the calcaneus (Batt and Tanji, 1995:80). Soft tissue masses, callus formation as a result of previous malleolar fracture, inflammation of one of the tendons coursing through the tunnel and increased tension on the posterior tibial tendon and nerve, caused by excessive pronation are all conditions that cause compression of the nerve (Barrett and O'Malley, 1999:2203).

In distinction from PF, the pain is characterised as a numbness / tingling that progresses to burning dyesthesia in the plantar aspect of the foot that is exacerbated by exercise and may persist at rest (Batt and Tanji, 1995:80; Barrett and O'Malley, 1999:2203; May et al. 2002:280). Ryan (1995) states that the pain is worse at bedtime and less on rising.

### **2.6.1.3) Lateral plantar nerve entrapment**

Compression of this nerve between the abductor hallicus and quadratus plantae muscles is commonly seen in runners, dancers, soccer players and tennis players who pronate (May, *et al.* 2002:280). The burning sensation reported by patients is aggravated by daily activities and may even persist at rest (Barrett and O'Malley, 1999:2203).

Brantingham, *et al.* (1992), state that nerve entrapment syndromes can be differentiated from PF by their lack of localised tenderness over the plantar fascia and the presence of a positive Tinel's sign (sharp, shocking pain after tapping over the affected nerve).

## **2.6.2) Skeletal causes**

### **2.6.2.1) Calcaneal stress fractures**

Calcaneal stress fractures are often evident when patients increase their activity (Batt and Tanji, 1995:80; Barrett and O'Malley, 1999:2203). Pain and tenderness are reported over the medial and lateral aspects of the calcaneus (Pollard and So, 1999:95) on weight bearing, and are worsened with prolonged weight bearing (Young, *et al.* 2001:467).

### **2.6.2.2) Calcaneal apophysitis (Sever's disease)**

Calcaneal apophysitis is an overuse injury to the open epiphysis of the posterior calcaneus and usually affects adolescent boys who are obese or those who are extremely active (Ryan, 1995:893; Barrett and O'Malley, 1999:2205). Palpation to the posterior aspect of the calcaneus around the insertion of the Achilles tendon usually reveals local tenderness (Barrett and O'Malley, 1999:2205).

### **2.6.3) Soft tissue causes**

#### **2.6.3.1) Rupture of the plantar fascia**

This uncommon cause of acute heel pain is usually associated with severe, knife-like pain, swelling and subsequent bruising in the medial arch of the foot, which is as a result of physical trauma (Batt and Tanji, 1995:82; Barrett and O'Malley, 1999:2205; Young, *et al.* 2001:467). Physical examination may reveal a palpable deficit in the plantar fascia and severe pain on palpation of the plantar fascia with maximal tenderness distal to the medial process of the calcaneal tuberosity (Barrett and O'Malley, 1999:2205).

#### **2.6.3.2) Fat pad syndrome**

The fat pad is situated in the subcutaneous tissue of the heel and is comprised of globules of fat encapsulated in multiple u-shaped septa (Moore, 1992:463; Brown, 1996:875; Young, *et al.* 2001:467). The functions of this highly specialized structure are to protect the underlying nerves and vessels (Moore, 1992:463) and shock absorption (Moore, 1992:463; Brown, 1999:875). Reid (1992) states that the fat pad degenerates and becomes thinned due to excessive weight bearing on hard uneven surfaces during training; the patients experience pain first thing in the morning and unlike PF, it worsens with activity. Pain experienced by the patient is often localised to the central weight bearing aspect of the heel and pressure applied can give rise to the symptoms (Brown, 1996:875)

#### **2.6.4) Systemic disorders**

Most patients suffering from systemic disorders present with joint pain and inflammation in other areas of the body, but symptoms may begin in the heel. Such conditions include: rheumatoid arthritis, gout, Reiter's syndrome, ankylosing spondylitis, psoriatic arthritis, Behcet's syndrome, systemic lupus erythematosus, gonorrhea, tuberculosis (Barrett and O'Malley, 1999:2206; Batt and Tanji, 1995:82, Brown, 1996:881 Ryan, 1995:893). Barrett and O'Malley (1999) state the importance of a detailed history and physical examination of a patient presenting with heel pain and that systemic conditions should be ruled out through appropriate radiographic and laboratory tests.

However once PF has been identified as the principle cause of the patient's complaint, then it is important to ensure that the correct treatment protocols are applied within the constraints of the presenting PF.

### **2.7) TREATMENT**

#### **2.7.1) Conservative**

PF is notoriously difficult to treat (Stephens 2003), with patients taking anything from between three (Ambrosius and Kondracki, 1992:39) and 18 months (Young, *et al.* 2001:467) to recover. However, conservative treatment is nonetheless uniformly recommended as the initial treatment of choice for PF (Ambrosius and Kondracki, 1992:30, Batt and Tanji, 1995:83, May, *et al.* 2002:278; Watt, 2003:53).

Barrett and O'Malley (1999) and May, *et al.* (2002) suggest that conservative treatment starts primarily by educating the patients as to the etiology of their pain i.e. dynamic stresses or biomechanical factors, and how these factors can be rectified. Furthermore Ambrosius and Kondracki (1992), Batt and Tanji (1995), May, *et al.* (2002) and Watt (2003), state that the inflammatory component causing the discomfort should be addressed. Vizniak and Carnes

(2004) state that inflammation control has limited use, and that this should be addressed in conjunction with a more holistic treatment protocol.

This conservative treatment protocol should include a variety of the following; advice on weight loss, relative rest from activities, physical therapy modalities, orthotics, low-dye taping and correction of footwear and strength training, according to Brown (1996:881-882) and Ryan (1995:893-896).

In this respect Davis, *et al.* (1994:531), completed a study where patients were subjected to a treatment protocol, averaging 10.9 months, of anti-inflammatory medication, rest, heel cushions and Achilles tendon heel stretches, which proved to be successful for 89.5% of the patients. This time frame is similar to the natural history of PF which is between 8 and 12 months (Brown, 1996:881).

For the sake of brevity and ease of presentation, each factor that should be considered in the treatment of PF will be discussed here in isolation.

### **2.7.2) Rest**

According to Reid (1992), the key to effective treatment is rest, to decrease stresses and impact on the fascia. For runners this could mean between 25 and 75 percent decrease in training time. In congruence with this, Barrett and O'Malley (1999) and May, *et al.* (2002) state that this modified, rather than actual, rest is a more realistic approach to take with patients who stand for lengthy periods, or who will not comply with total rest. Chandler and Kibler (1993:349) also suggest that a form of 'active' rest is required to assist with the resolution of PF.

In a study conducted by Wolgin, *et al.* (1994) and in congruence with Stephens (2003), it was found that 25 percent of patients reported rest as being the best form of treatment.

### **2.7.3) Ultrasound and Cryotherapy (Ice)**

The local application of cold for therapeutic reasons, or cryotherapy, is believed to diminish inflammatory reaction to trauma, reduce edema, minimise hemorrhage and produce some analgesia (Reid, 1992: 16; Barrett and O'Malley, 1999:2201). Thus this form of therapy would best be applied in the acute stage of the condition (within the first week) (Vizniak and Carnes 2004:221) in order to achieve optimum effects from this intervention.

Ultrasound assists not only in reducing the inflammatory response of the tissues involved, but also enhances tissue healing (Reid 1992:198; Batt and Tanji, 1995:83; Pollard and So, 1999:96; Du Plessis, 2002:67), by virtue of its micro-massage properties.

In addition, Reid (1992:16) states that specific treatment for PF secondary to a stretching regime includes the use of modalities such as ultrasound, and cryotherapy before stretching and after activity to minimise discomfort or aggravation of the PF already present.

In addition to the local inflammatory component, which can be defined as a result of the plantar fascia injury resulting in PF, there are several predisposing factors that also need to be addressed. Thus with Barrett and O'Malley (1999) stating that most cases of PF are as a result of biomechanical faults that cause abnormal pronation, it has been suggested that the use of several mechanical therapies, as described in the following **three sub headings** can be employed to rectify this problem:

### **2.7.4) Splinting**

Night splints are designed to keep a person's ankle in a neutral position (dorsiflexion) overnight, thus allowing passive stretching of the calf and plantar fascia during sleep (Young, *et al.* 2001:472). As most people tend to sleep with their feet in a plantar flexed position, splinting maintains the length of the plantar fascia as they sleep, which prevents stiffening and contraction

of the fascia that normally occurs during sleep (Ryan, 1995:897, Young, *et al.* 2001:472).

May, *et al.* (2002) recommend five degrees of dorsiflexion to deter contraction of the plantar fascia during hours of sleep, which assists in eliminating the often ensuing micro-tears associated with the painful morning first step.

### **2.7.5) Orthotics and taping/strapping**

Orthotics and taping/strapping are common treatments of choice for PF sufferers (Carey-Loghmani, 2005). Reid (1992) states that low-dye strapping is the taping technique of choice on patients with PF. In addition to this, Ambrosius and Kondracki (1992) state that over the counter arch supports may be useful in patients with acute PF and mild pes planus.

The use of heel cups decreases the impact on the calcaneus and thus the plantar fascia, by elevating the heel on a soft cushion (Young, *et al.* 2001:472) reduces the pull on the Achilles tendon by placing it in a shortened position (Ryan, 1995:893). This also provides for relief of pain and inflammation.

### **2.7.6) Manipulation**

Polkinghorn (1995) conducted a study in which he treated three patients over a one-two month period, with adjustments based on presenting fixations. Treatment resulted in complete resolution of all symptoms and it was concluded that conservative management of PF might be effectively implemented through the use of specific adjusting procedures.

Further to the above study, Du Plessis (2002) conducted a study on the relative effectiveness of pulsed ultrasound as an adjunct to foot manipulation in the treatment of PF. The forty subjects involved in the study were randomised into two groups of twenty. Group A, the experimental group, received foot manipulation and ultrasound as treatment, while Group B, the control group, received manipulation alone. Each group received six treatments over three weeks. From the subjective and objective data

collected, it was concluded that both foot manipulation and pulsed ultrasound, and foot manipulation alone were equally effective in the treatment of PF.

From the forty subjects involved in her study, Blake (2003) concluded that subtalar manipulation alone was effective in reducing pressure pain threshold and improving dorsiflexion range of motion, in comparison with a combination of manipulation and stretching of the triceps surae muscle complex, which did not appear to be more effective.

### **2.7.7) Transverse Friction Massage**

Transverse friction massage is also beneficial in the treatment of PF (Lillegard and Rucker, 1993:169; Hyde and Gengenbach, 1997:478,481). Cyriax (1984) and Prentice (1994) state the effects of frictions include:

- the breakdown of adhesions (scar tissue),
- induction of controlled inflammation,
- increased blood flow (traumatic hyperemia) to the area thereby allowing healing to advance, breaking up existing adhesions in the fascia, increase in fibroblasts and that the new fibroblasts are laid down in parallel (pers. comm. Hyde, 2005).

Cyriax (1984) conceptualised that frictions promoted a traumatic hyperemia, resulting in reduction of edema in the chronically irritated tissues, the freeing of adhesions (scar tissue) as a result of the previously uncontrolled inflammation and eventually inducing controlled inflammation and more structured recovery of the previously inflamed tissues.

It can therefore be stated that transverse friction massage is used in the treatment of chronic inflammation to increase the inflammation to a point where the inflammatory process is complete and the injury can progress to the later stages of healing (Cyriax, 1984). This technique is often used in chronic overuse problems and therefore can also be included in the treatment plan for PF.

## **2.7.8) Graston Technique Instrument-assisted Soft Tissue Mobilisation (GISTM)**

The GISTM uses stainless steel instruments, which are thought to be able to detect and treat soft tissue lesions, by using a variety of multidirectional stroke techniques over the involved soft tissue structure (in this case the plantar fascia). The rationale behind this technique as a treatment modality is (Carey-Loghmani 2002:13):

- to increase blood flow,
- to break up soft tissue restrictions / adhesions and fibroblasts,
- tissue heating to the area,
- increased fibroblasts, mast cell production and phagocytes ( pers. comm. Hyde, 2005)

which is much like the effect hypothesized in cross frictions by Cyriax (1984). Thus GISTM is thought to be an advanced form of soft tissue mobilisation that is used to detect and release scar tissue, adhesions and fascial restrictions (Carey-Loghmani, 2003:7).

Carey-Loghmani (2003) likens the stainless steel GISTM instruments to a tuning fork; when contacting fibrotic tissue, the GISTM instruments reverberate, sending more precise information to the clinician. Much as a stethoscope amplifies what the human ear can hear, the GISTM instruments enhance what the clinician's hands feel thus substantially improving the ability to detect and treat soft tissue dysfunctions, as the GISTM instruments are able to hone into the area that requires the most therapeutic attention.

In this respect the GISTM instruments are contoured to facilitate treatment around different body parts and have been designed as such to conform to different soft tissues contours and joint shapes. This is achieved by the angled or beveled edge of each of the GISTM instruments, which are all designed with unique features to serve specific purposes (Carey-Loghmani, 2003:14). These GISTM instrument designs are, in theory, able to penetrate the soft tissues to a greater degree than the clinician's digital pressure as



would be applied with the standard transverse / cross friction massage, proposed by Cyriax (1984).

Based on anecdotal data, the GISTM is thought to achieve quicker and improved outcomes, and is a complementary technique, not a substitute (Carey-Loghmani, 2003:11).

As the GISTM is hypothesized to work in the same manner as transverse friction massage it could therefore be beneficial in the treatment of PF. Thus, there is a requirement to test the relative efficacy of the GISTM versus Placebo in the treatment of Plantar Fasciitis.

### **2.7.9) Placebo**

Placebo, (“I will please” – Latin) is a dummy treatment administered to the control group in a controlled clinical trial in order that the specific and non-specific effects of the experimental treatment can be distinguished (Dorland, 1994:1298).

This form of treatment is required in this study as the experimental form of treatment (GISTM) has yet to be shown to be better than the application of essentially no treatment at all, other than the attention given to the patient. Once this has been established, it would be feasible to compare this form of treatment to other like modalities such as the transverse / cross frictions in the same or another condition.

## **Chapter 3**

### **MATERIALS AND METHODS**

This chapter presents the materials and methods used, which are discussed under the respective headings:

- Research design and protocol
- Sampling
- Inclusion and exclusion criteria
- Randomisation
- Interventions
- Measurements
- Statistical analysis

#### **3.1) RESEARCH DESIGN AND PROTOCOL**

A prospective, single blinded (researcher), randomized, placebo controlled pilot study, in determining the efficacy of the GISTM in the treatment of Plantar Fasciitis.

#### **3.2) SAMPLING PROCEDURE**

Advertisements (Appendix G) informing the public of the study being conducted, were placed in newspapers, on notice boards around the Durban Institute of Technology campus, at sports and running clubs and at weekly marathons in and around the greater Durban area.

Telephonic interviews, and interviews conducted in person at sports clubs and marathons were conducted to screen patients and exclude any subjects who do not fit the criteria. Questions included asking:

- the patient's age,
- the number of kilometres run per week,

- duration of symptoms,
- the exact location of the pain,
- whether the symptoms were as a result of / or concomitant with trauma (fractures, dislocations),
- whether the prospective patient was aware of having any sero-negative arthritis (as per references in the exclusion criteria)

Subjects suitable for the study were then evaluated at an initial consultation. A diagnosis of PF was made based on case history, relevant physical examination and foot and ankle regional examination, which was conducted by a peer researcher. Subjects were concomitantly screened for compliance with inclusion and exclusion criteria.

### **3.3) INCLUSION AND EXCLUSION CRITERIA**

- As PF occurs predominantly in the older age group, with Reid (1992) stating 40 years and over, it was decided to eliminate the young adult's age group and that the minimum age of participants be 25.
- A ceiling of age 50 was chosen to eliminate or try to reduce the possibility of patients presenting with heel pain due to causes other than PF, consistent with the older age group. Young, *et al.* (2001) state that in elderly adults, PF is more biomechanical and compounded by a decrease in the body's healing capacity. In addition conditions such as rheumatoid arthritis, degenerative joint disease and gout present in the fourth or fifth decades of life (Yochum and Rowe, 1996) and form part of the exclusion criteria (see below).

#### **3.3.1) Inclusion Criteria**

- 1) Participants had to be between the ages of 25 and 50 years (Reid, 1992:196; Young, *et al.* 2001:467).
- 2) Participants had to have a diagnosis of PF based on:

- maximal pain located at the antero-medial aspect of the plantar surface of the calcaneus (Brantingham, et al. 1992:75) (this also aimed to differentiate between PF and an entrapment neuropathy (Brown, 1996:877)).
- aggravation of pain by passive dorsiflexion of the big toe.
- aggravation of pain when standing or walking on toes.
- pain that was worse on the first few steps in the morning (Reid, 1992:196; Wolgin, *et al.* 1994:98; Barrett and O'Malley, 1999:2201; Young, *et al.* 2001:467).

Patients were also checked for excessive pronation during gait, joint dysfunction and myofascial strain (Pollard and So, 1999:93, Brantingham, et al.1992:75).

- 3) Participants received a letter of information (Appendix B) and all suitable subjects were required to complete an informed consent form (Appendix C) in order to be accepted into the study.
- 4) When looking at the natural history, it was important to avoid the acute inflammatory phase (approximately one week) of the condition, which reacts more readily to treatment than a more chronic PF (Vizniak and Carnes, 2004:221), in order to maintain group homogeneity and therefore to maintain the patient who was within the remodeling phase of collagen, where a reaction to conservative treatment may still be possible and is of a similar nature. This period extends to an average 12 months (Vizniak and Carnes, 2004:306). Silverman, *et al.* (2003) and Brown (1996) give similar guidelines. Therefore for purposes of this study patients were required to present with discomfort for a minimum of four weeks and a maximum of 24 months, based on these guidelines and the delimitations noted earlier. ( section 3.2 and 3.3)
- 5) At the telephonic interview, patients were asked the distance they ran in a week and whether they completed at least five kilometers per week, for participation in this study as per Warren (1990).

### **3.3.2) Exclusion Criteria**

- 1) Participants were excluded from the study if they received any form of therapy, manual or medicinal, for their PF during the course of the research period (Poul, *et al.*, 1993)
- 2) Participants with a history of foot or ankle fracture, dislocation (Reid, 1992:196; Polkinghorn, 1995:45; Pollard and So, 1999:94) surgery, peripheral neuropathy, nerve root entrapment, tarsal tunnel syndrome, or any other condition other than PF causing foot pain were excluded from the study (Wolgin, *et al.* 1994:98).
- 3) Participants suffering from systemic disease causing foot pain were excluded from the study. This included ankylosing spondylitis, Reiter's disease, psoriatic arthritis, rheumatoid arthritis and gout (Ambrosius and Kondracki, 1992:31; Reid, 1992:196)
- 4) Subjects accepted into the study were asked not to change their lifestyle, daily activities; regular medication and exercise programs in order to avoid being excluded from the study.
- 5) Patients who had type I or type II diabetes, due to the tissue changes and slow healing rates associated with the disease (Carey-Loghmani, 2004), were also excluded.

### **3.4) RANDOMISATION**

The study consisted of one sample size group of 36 subjects between the ages of 25-50 years of age as suggested by Hammond (2000), Du Plessis (2002) and Blake (2003). They were allocated to 2 sub groups, by drawing letters out of a box i.e. drawing an 'A' denoted being allocated to Group A, and 'B' to Group B.

Group A, the treatment group, received treatment with the GISTM only, while Group B, the control group, received a placebo treatment of detuned ultrasound only.

### 3.5) INTERVENTIONS

The 36 participants were equally randomised into Group A or Group B, thus totaling 18 participants in each group.

#### Group A

The GISTM is affected through the use of stainless steel instruments which are able to detect and treat soft tissue lesions by using a variety of multidirectional stroke techniques. The rationale behind this technique is to increase blood flow and tissue heating to the area and to break up soft tissue restriction (Carey-Loghmani, 2002:13).

The treatment sequence employed was as suggested by Carey-Loghmani (2002);

- Patients were prone with their feet slightly off the end of the examination table, while the examiner was seated on a chair at the end of the table.
- The Scanner (GISTM-4) and Boomerang (GISTM-5) instruments were used (Appendix I a).
- An emollient was applied to the area being treated to decrease the friction between the skin surface and the beveled edge of the instruments.
- A two hand hold grip ensured that the researcher held the instruments at the required 30-60° angle to the treatment surface.
- The two strokes employed were those of Sweeping and Fanning:

Sweeping stroke - characterised by the instrument contact points moving in one direction at the same rate in a linear or curvilinear path.

Fanning stroke – instrument contact points move at different rates in an arched path. One end of the instrument is stabilised, serving as a fulcrum of motion while the other end is

moving, with the resistance at the end of the instrument that is moving

- The treatment time totaled five minutes: four minutes for the tissue warm-up over the entire fascia, and one minute over the specific lesion which, depending on the participant, was at/near the medial calcaneal tubercle.

Soft tissue dysfunctions were detected and treated when the clinician manually applied brush strokes to the affected area. The angled or beveled edge of the stainless steel instrument contacts the skin over the affected area, at an angle of 30-60° and the clinician proceeds to use a series of strokes over the area (Carey-Loghmani, 2003:14,17).

### Group B

As described by Beecher (1955), the use of a placebo medicine is more to please than to benefit the patient.

In order that the specific and non-specific effects of the experimental treatment (GISTM) can be distinguished, sham treatment was administered to the control group (Dorland, 1994:1298).

A placebo of detuned ultrasound was thought to be the most appropriate intervention tool to use due to the nature of the study, which is to see the effects that the GISTM has on the plantar fascia.

If a placebo of e.g. cross frictions was to be used, the object of the study would be defeated due to the cross frictions also treating the PF and therefore not being an adequate 'control' to use as a point of reference.

### **3.5.1) Interventions frequency**

The average treatment time for PF ranges from a few weeks to months (Vizniak and Carnes, 2004:220) and as this is a pilot study into the efficacy of

GISTM, the time period allocated in this study was 6 weeks. (This time frame is less than the estimated natural history of PF.)

In a study by Brantingham, *et al.* (1992) an average of eight treatments over a three to five week time period was applied. The treatment consisted of physiotherapy, orthotics and manipulation. Ninety percent of patients reported a favourable outcome. In a further case study, PF was relieved by five treatments over a two-week period, when the patient returned to work with no pain (Brantingham, *et al.* 1992: 79).

With the use of the GISTM, an average improvement in patients is thought to occur with PF between four to eight treatment sessions, with an average of six sessions (Carey-Loghmani, 2003).

Therefore, the treatment regime consisted of:

- An initial consultation by a peer-researcher (in week one), thus blinding the researcher of this study to the initial readings that were taken at the initial consultation. This was done in order to minimize researcher bias.
- three treatment sessions per week over a two-week period (weeks two and three)
- a single treatment in week four.

A follow-up non-treatment session was scheduled with a peer-researcher in week five in order to ensure that the readings taken at the conclusion of the study were not taken by the researcher of this study (as the researcher applied the treatment) in order to reduce researcher bias in the recording of the results. The peer-researcher was blinded as to whether the patient received GISTM or placebo, further enhancing the outcomes.

### **3.6) MEASUREMENTS**

Subjective and objective measurements were recorded before the first, fourth and at the seventh consultations. This data was used for inter- and intra-group analysis, and the correlation between the two groups, to determine the efficacy of the GISTM in the treatment of PF.



### **3.6.1) Subjective Measurements**

#### **3.6.1.1) The Numerical Rating Scale (NRS)-101**

The NRS Pain Rating Questionnaire (Appendix D) was used to record the patients' perception of their foot pain. Jensen, *et al.* (1986:117-125) compared the NRS-101 with five similar pain intensity measures. Although it was discovered that all six scales may be considered useful in the measure of subjective pain intensity, the NRS has several practical advantages over the others, in that it is easy to administer and score, it is not limited by age and it has specific response categories.

The scale is comprised of two separate horizontal lines, measuring from 0 to 100, with zero being no pain and 100 being the worst pain experienced. Patients were asked to rank their worst pain as a percentage on one scale, and their least pain as a percentage on the other at each of the three recording points.

An average of the worst and least pain was then taken as the score of the NRS as recorded before the first, fourth and at the seventh consultations.

#### **3.6.1.2) The Foot Function Index (FFI)**

The FFI (Appendix E) was used to obtain information on the impact of the patients' foot pain on their daily activities and to note any improvement in their functional ability with regards to treatment. Saag, *et al.* (1996) state that this is a validated and reliable measurement scale for use in orthopedic interventional trials.

The FFI comprised 14 questions, which the patients were required to read and answer. The answers to the questions were recorded on a scale from 0 to 10, with zero representing no pain and 10 being the worst pain.

### **3.6.2) Objective Measurements**

#### **3.6.2.1) Algometer**

The algometer was used to measure the minimum pressure inducing pain or discomfort (pressure threshold) (Fischer, 1987:207). This method has been proven to be useful for diagnosis of tender spots and trigger points (Fischer, 1987:207).

1. The procedure of increasing pressure as the algometer pressure gauge would be positioned over the fascia's most tender region was explained to the patient.
2. The examiner then palpated the plantar fascia, starting at the insertion at the medial calcaneal tubercle and moving distally until the most tender spot/lesion was identified by the patient.
3. The pressure gauge was then placed perpendicularly to the skin over the tender area and patients were instructed to inform the examiner as soon as the increasing pressure from the gauge produced pain / discomfort.
4. The reading was then taken and recorded in kg/cm<sup>2</sup> (Appendix F b)  
The higher the reading, the less tender the tissue (Fischer, 1987)

The algometer used in this study was a force dial manufactured by Wagner Instruments: P.O. Box 1217, Greenwich, CT 06836, U.S.A.

#### **3.6.2.2) Weight-bearing ankle dorsiflexion**

The method used to measure weight bearing ankle dorsiflexion was as per Blake (2003):

1. Participants stood on the involved leg and dorsiflexed the ankle while flexing the knee, up to a point where no further dorsiflexion would take place without lifting the heel from the ground.
2. A large set square was used to measure the vertical distance (y) from the front of the knee to the ground, and the horizontal distance (x) from this point to the back of the heel was measured similarly.
3. The degree of dorsiflexion was calculated using simple trigonometry:  
 $\tan \theta = y / x$  (Appendix H) and recorded on a separate data sheet (Appendix F a).

### **3.7) STATISTICAL ANALYSIS**

#### **3.7.1) Methods**

Data were captured in MS Excel. SPSS version 11.5 was used to analyse the data (SPSS Inc, Chicago, Ill, USA).

Demographics were compared between treatment groups using chi-squared tests for categorical variables and independent sample t-tests for quantitative variables.

Repeated measures ANOVA was used to examine changes in quantitative outcomes over the time points, and for a treatment effect (time\*group interaction). To control for the partial pairing (i.e. the six participants with bilateral PF) in the intergroup analysis, a variable that classified each subject as paired (both left and right feet used in study) or non-paired (only used once in study) was used as a factor in the model. Profile plots were generated to visually assess group and time changes.

Correlations between the intragroup changes in the various outcome variables were assessed using Pearson's correlation coefficients.

A two-tailed p value of <0.05 was considered as statistically significant.

## **Chapter 4**

### **RESULTS**

This chapter presents statistical analysis of the results and the discussion there-of under the following headings:

- Demographic data
- Objective clinical findings
- Subjective clinical findings
- Intra-group correlation between changes in objective and subjective findings
- Summary of the results

#### **Key:**

**Graston:** as represented in the tables and on the graph, refers to the GISTM group

**n:** number of people in the sample group

**p:** the probability that the null hypothesis is correct. The lower the p value, the greater the chance of rejection. Therefore if the p value is  $<0,05$ , the null hypothesis is rejected and the test is significant.

**Sig.:** significance

#### **4.1) DEMOGRAPHIC DATA**

Thirty subjects between the ages of 25 and 50 years were enrolled into the study. Six participants with bilateral disease were used twice (left and right foot in each treatment group), thus there were a total of 36 feet used in the study. They were randomized into two equal treatment groups with  $n=18$  in each group.

To ensure an identical distribution of demographic factors (which could possibly confound the outcome of treatment) in the two treatment groups, this was checked statistically.

#### **4.1.1) Gender**

**Table 1: Group by gender cross-tabulation**

		GENDER		Total	
		male	female		
<b>GROUP</b>	<b>Graston</b>	Count	12	6	18
		Row %	66.7%	33.3%	100.0%
	<b>Placebo</b>	Count	14	4	18
		Row %	77.8%	22.2%	100.0%
<b>Total</b>		Count	26	10	36
		Row %	72.2%	27.8%	100.0%

Fisher's exact p value 0.711

Table 1 shows the distribution of group by gender in which there was no significant difference between the groups in the proportions of males and females ( $p = 0.711$ ). This is important as it indicates that the 2 groups in this study are homogenous with respect to male and female representations, therefore the conclusions drawn can be of a general nature (Mouton, 1996).

Of the 36 feet incorporated in the study, 26 (72.2%) were male and 10 (27.8%) were female.

This differs from the South African studies by Blake (2003) and Du Plessis (2002), each with sample sizes of 40 subjects, and by Hammond (2000) and Morris (2000), each with sample sizes of 30, which reported a slight female predominance.

This study further differs from these previous studies in that it focused on a select population group with PF. (i.e. runners). There are more male than female runners in South Africa and in the KwaZulu-Natal province ([www.comradessa.co.za](http://www.comradessa.co.za)). This study concurs with the male predominance despite the small sample size.

#### 4.1.2) Race / Ethnicity

**Table 2: Group by racial group cross-tabulation**

		RACE			Total	
		White	Indian	Black/Coloured		
<b>GROUP</b>	<b>Graston</b>	Count	13	5	0	18
		Row %	72.2%	27.8%	.0%	100.0%
	<b>Placebo</b>	Count	10	7	1	18
		Row %	55.6%	38.9%	5.6%	100.0%
<b>Total</b>		Count	23	12	1	36
		Row %	63.9%	33.3%	2.8%	100.0%

Pearson's chi square 1.725 , p = 0.422

Table 2 shows the racial distribution by group. There was also no significant difference in these proportions by group (p = 0.422). This is important as the different cultural and racial perceptions of the intervention and the measurement tools may have been affected by lack of homogeneity within the groups. Therefore the fact that the presentation of the groups is homogenous even in view of the fact that the allocation was random, allows for comparison of the results of this study without the need to account for lack of homogeneity variables (Mouton, 1996).

The race distribution comprised of 23 (63.9%) of the patients being White, 12 (33.3%) being Indian and 1 (2.8%), Black/Coloured. This ethnic distribution is not representative of the demographics in KwaZulu-Natal, where the Black / Coloured group is the largest of the ethnic group distributions, comprising half the province's population, followed secondly by the Indian race and thirdly by the White race group. (<http://statssa.gov.za/>).

Reasons for this could be due to a lack of understanding by the non-English speaking population who, unlike most of the English-speaking population, are unfamiliar with the scope and practice of Chiropractic. Traditional and allopathic medicines have dominated in South Africa and minimal exposure to a Western discipline such as Chiropractic may have been causative in the non-English speaking populations' involvement being reduced.

### 4.1.3) Sidedness of the PF

**Table 3: Group by left or right side cross-tabulation**

		FOOT		Total	
		right	left		
<b>GROUP</b>	<b>Graston</b>	Count	9	9	18
		Row %	50.0%	50.0%	100.0%
	<b>Placebo</b>	Count	11	7	18
		Row %	61.1%	38.9%	100.0%
<b>Total</b>		Count	20	16	36
		Row %	55.6%	44.4%	100.0%

Fisher's exact p value 0.738

In Table 3 the side of foot used by group is shown. There was no significant difference in group by side proportions ( $p = 0.738$ ). The right foot was affected in 20 (55.6%) of the participants, while 16 (44.4%) left feet were affected.

This is significant, as there could have been a difference between the causative etiologies between the dominant and non-dominant feet (Chandler and Kibler, 1993:346). However, with the groups showing homogeneity between the left and right feet between the 2 groups, these variables have been accounted for and shown to be statistically insignificant in respect of the outcomes of this study (Mouton, 1996).

This is in contrast to studies by Blake (2003) and Davis, *et al.* (1994), who both found a predomination in left feet rather than right feet detailed as follows:

- In her study with a sample size of  $n=40$ , Blake (2003) reported involvement of the left foot in 50% of the cases, right foot involvement in 37.5%, and 12.5% having bilateral PF.
- Davis, *et al.* (1994) reported left foot involvement in 45% of the cases, right foot in 29% and 26% bilaterally.

#### **4.1.4) Mean age, weight and height differences between groups**

**Table 4: Independent t-test and group statistics for the difference in mean age, weight and height by group**

	GROUP	N	Mean	Std. Deviation	Std. Error Mean	p value
AGE	Graston	18	36.67	6.987	1.647	1.000
	Placebo	18	36.67	7.388	1.741	
WEIGHT (kg)	Graston	18	73.56	13.963	3.291	0.500
	Placebo	18	76.60	12.833	3.025	
HEIGHT (M)	Graston	18	1.7239	.07237	.01706	0.530
	Placebo	18	1.7411	.08963	.02113	

Independent t-tests were used to assess mean differences between groups in terms of age, weight and height. There were no significant differences in any of these variables (see Table 4).

Again the homogeneity of the groups allows for comparison of the groups without confounding variables (Mouton, 1996). This was achieved randomly as the participants were randomly allocated to the groups without any stratification.

In this study the youngest participant was 25 while the oldest was 50, with the average age being 36.67 years. This is congruent with Brantingham et al (1992) who found the average to be 36 years, while Blake (2003) reported an average age of 40.75 years. This also concurs with the literature where there is a predominance of older patients that are reported to suffer with PF (Ambrosius and Kondracki, 1992:29, Davis, *et al.* 1994:532, Gill and Kiebzak, 1996:527, Young, *et al.* 2001:467).

Furthermore the average weight of the participants was 75.1kg, with the lowest being 55kg and the highest, 98kg and the height of the participants was found to range from 1.55m to 1.87m with an average of 1.7325m.

No literature could be found with which to compare these data and therefore to ascertain whether this is indeed the norm for PF patients.



In concurrence with Blake (2003), these results should not be interpreted on the same level as other studies that were specifically structured to investigate the demographics of the population suffering from PF, as this was not the primary purpose of the study. These data were taken in order to establish a group profile for each of the groups in this study so as to ascertain that the groups, at baseline, were comparable.

#### **4.2) OBJECTIVE CLINICAL FINDINGS**

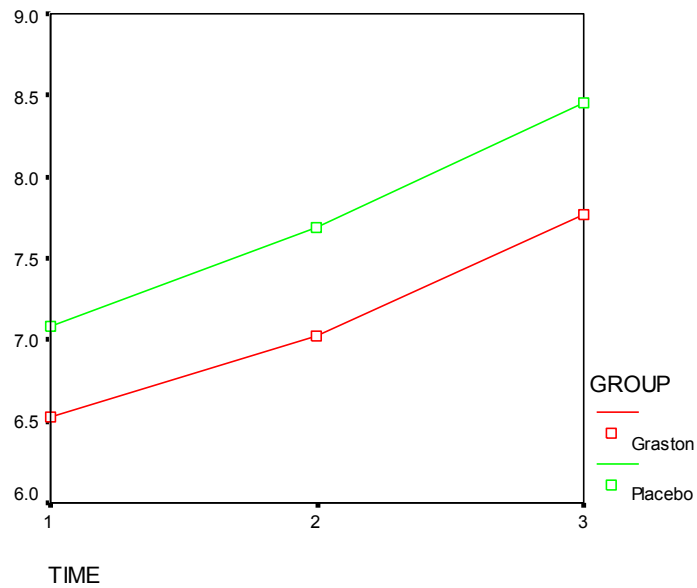
In this section the objective tests that were used as outcomes to assess the effect of the intervention were assessed using repeated measures ANOVA. In all analyses the effect of partial pairing (see section 3.7) was taken into account.

##### **4.2.1) Algometer**

There was a highly significant change in mean algometer values over time regardless of the group ( $p < 0.001$ ). However, there was no evidence of a treatment effect ( $p = 0.953$ ). When one examines the profile plot in Figure 1, it is obvious that the profiles of the two groups are parallel, and both increased in value over time to the same extent. Thus the GISTM treatment was equally as effective as the placebo for this outcome.

**Table 5: Within and between subjects' effects for algometer**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.520	<0.001
<b>Group</b>	F 1.078	0.307
<b>Time*group</b>	Wilk's Lambda 0.997	0.953



**Figure 1: Profile plot of mean algometer readings over time by group**

When one examines the profile plot in Figure 1, it is obvious that the profiles of the two groups are parallel. They both increased in value over time and to the same extent.

When one regards Fischer (1987), who indicates that an increase in algometer readings are indicative of decreased pain experienced by the patients, these results indicate that the algometer can be used effectively to quantify tender spots. Thus the increase in algometer readings is concomitant with pain decrease in both the placebo and the GISTM group.

**Both groups:**

Could have improved as a result of:

- The natural history of the condition (Lachmann and Jenner, 1994:28):
  - This however is not likely, as the natural history of the condition has been noted as self-limiting, taking from three to 12 months to recover (Young, *et al.* 2001:467). The time parameter for this study was such that it ensured that the patient recovery should have occurred prior to natural history becoming evident.
  - On the other hand it may have been beneficial to track the patients over a further time period in order to establish whether

this trend of improvement would have held for both groups as the repair of collagen has been noted to take up to 100 days (Vizniak and Carnes, 2004:306).

- The Hawthorne Effect or observer effect (Mouton 1996:152)
  - This effect was the purpose of the placebo group. The placebo group in research is responsible for ensuring that effects like the Hawthorne effect do not give skewed results in an uncontrolled environment. With the current set of results it could be inferred that the Hawthorne effect seems equally present in both groups.
- The gate control theory effect
  - In both the placebo and the GISTM groups the patients received the application of a gel / emollient as well as the sensory tactile stimulation of a metal object. Both of these entities could have been responsible for activating the gate control theory as proposed by Melzack and Wall (1965). Melzack and Wall (1965:971) proposed that increasing large fiber input to the substantia gelatinosa (SG), decreases pain experienced by patients. Friction massage and similarly the GISTM stimulate the large fibers, which have a facilitatory effect on the SG and a resultant decrease in pain (Lynch and Kessler, 1990:48) over time. This decrease in pain allows the patient more freedom in range of motion and motion generally, assisting with the resolution of the PF.

### **GISTM Group**

It was expected that the GISTM group would have had a greater increase in the pressure threshold (algometer group), based on the effects of the GISTM, which is consistent with Carey-Loghmani (2003) and Hammer (2003) stating that once scar tissue, adhesions and restrictions are released by use of the GISTM, the progress of healing escalates with a subsequent reduction in pain.

A reason for the lack of difference between the groups may also be related to the degree of inflammation that is caused by the Graston

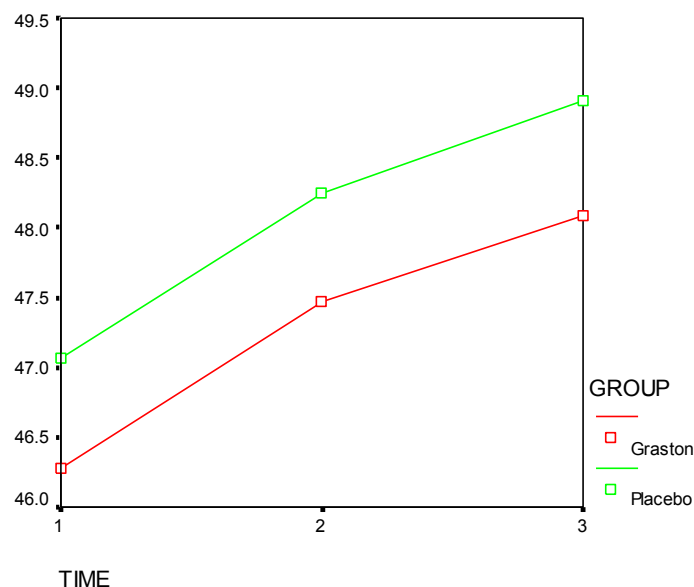
instruments, which is not apparent in the placebo group. Thus the degree to which the algometer changes with time for the GISTM group may not be an effective measure of clinical improvement in those patients receiving GISTM, as the technique by virtue of its application induces further inflammation and therefore possibly a change for the negative in the readings taken with the algometer could become apparent.

#### **4.2.2) Weight bearing ankle dorsiflexion**

For ankle dorsiflexion, there was no significant change in values over time ( $p = 0.142$ ), although Figure 2 shows a general increase in mean scores over time.

**Table 6: Within and between subjects' effects for ankle dorsiflexion**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.882	0.142
<b>Group</b>	F 0.235	0.631
<b>Time*group</b>	Wilk's Lambda 1.000	0.999



**Figure 2: Profile plot of mean ankle dorsiflexion readings over time by group**

There was also no indication of a treatment effect ( $p = 0.999$ ). Figure 2 shows that the two groups increased in parallel over time. Thus for ankle dorsiflexion there was no evidence or trend of a treatment effect.

The principle effect that could have shadowed these results is that of the clinical effect of the gate control theory effect:

- In both the placebo and the GISTM groups the patients received the application of a gel / emollient as well as the sensory tactile stimulation of a metal object. Both of these entities could have been responsible for activating the gate control theory as proposed by Melzack and Wall (1965). In this respect Melzack and Wall (1965:971) proposed that increasing large fiber input to the substantia gelatinosa (SG), decreases pain experienced by patients. Friction massage and similarly the GISTM stimulate the large fibers, which have a facilitatory effect on the SG and a resultant decrease in pain (Lynch and Kessler, 1990:48) over time.

This decrease in pain through mechanical stimulation would have allowed the patient more freedom in range of motion (due to decreased pain) generally assisting with the resolution of the PF. This would have therefore been apparent in both groups and not just the GISTM group.

On the converse the runners that participated in this study were not instructed to rest or stop running, or to change any aspect of their training routines, like stretching, while participating in the research. Participants thus continued to run their usual distances through out the duration of the study and as is expected after exercise, post-exercise muscular stiffness and increased morning pain in the plantar fascia were experienced periodically.

These factors may have hindered the ankle dorsiflexion measurement being a true reflection of the mobility in the ankle joint, thus rendering insignificant results even though the ankle dorsiflexion measurement has been promoted

as a measure of PF improvement (Blake, 2003:80). It is at best an indirect measure, measuring primarily the degree of stretch within the triceps surae muscles (Blake, 2003:80), which have been indirectly linked to PF (Blake, 2003:80). However it must also be noted that this occurred in both the groups and therefore should the GISTM group have had a significant improvement in the results related to ankle dorsiflexion these results should still have reflected in the above Figure 2.

Another factor that could have contributed to the context of the above results is the method of measure (i.e. the standing method to measure the ankle dorsiflexion), which was susceptible to examiner error in that the set square used may not have always been perfectly perpendicular and / or vertical to the ground in its dimensions. This however would have been a systemic error in both groups and therefore negates this as an influencing factor in the results.

From the discussion above and in the experience of the examiner the most likely effect on the ankle dorsiflexion measures was that of post exercise stiffness. Due to the lengthy time frame of the research, participants were instructed to not break from their usual training routines. Participants were thus still doing training during the week and competing in marathons (25 and 52 kilometers) on the weekends. As treatment sessions were three times per week, it was inevitable that days that the participants were to receive treatment (GISTM or placebo) would coincide with, or follow training days.

#### **4.3) SUBJECTIVE CLINICAL FINDINGS**

In this section the subjective tests were used as outcomes to assess the clinical effect of the interventions using repeated measures ANOVA. In all analyses the effect of partial pairing was taken into account.

The NRS and FFI lend themselves to bias especially when patients are able to remember, for various reasons, positive or negative investigated correlations (Mouton, 1996:152). Therefore patients are generally not allowed to see the original scores that they reported in order to take advantage of an

effect known as memory decay (Mouton, 1996:152), where patients report only the score in their current circumstances without the influence of previous reported scores.

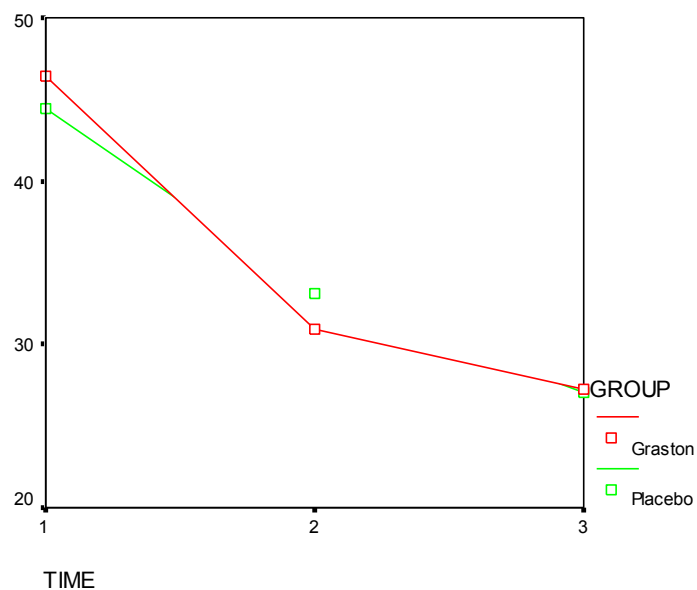
Thus the chance exists that the reporting by the patients may show an improvement, a score identical to the original, or a regression of the score to a point worse than the original score.

### **4.3.1) The Numerical Rating Scale (NRS)**

Although both groups decreased in NRS score significantly over time ( $p < 0.001$ ), there was little difference in the rate of decrease by treatment group ( $p = 0.490$ ).

**Table 7: Within and between subjects' effects for NRS**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.391	<0.001
<b>Group</b>	F 0.000	1.000
<b>Time*group</b>	Wilk's Lambda 0.955	0.490



**Figure 3: Profile plot of mean NRS readings over time by group**

Figure 3 suggests a trend towards an interaction (crossing over of profiles) between time 1 and time 2. This suggests that the GISTM group decreased at a faster rate than the placebo group, but overall the interaction was not significant as the two groups ended up at time 3 with approximately the same mean NRS score. Therefore there was a non-significant positive trend in the short term for NRS which did not persist to time 3.

The reason for the GISTM's plateau after time 2 can be substantiated by, and is in concurrence with the findings of Carey-Loghmani (2003) reporting that patients' symptoms significantly decrease after two to four sessions of GISTM and continue to decrease progressively until pain free functioning is obtained. This 'pain free' state may not have been reached (Fig 3), due to the time parameters of this study.

The placebo graph shows a more consistent, gradual decrease in pain which could be attributed to:

- The doctor-patient interaction. Ventegodt, *et al.* (2005) states that holistic treatment is facilitated when the element of touch is combined with therapeutic work on the mind and feelings. Both the placebo and GISTM groups could have been affected by this and it could certainly have influenced the results.
- The contact of the ultrasound head on the skin which may have produced an analgesic effect (neuronal response) or could have stimulated the large fiber input to the gate control mechanism, with resultant decrease or abolition of pain (Melzack and Wall, 1965:971). This could also be said for the GISTM group as the contact of the instruments on the skin could have a similar impact. However, it must be remembered that although slight pressure was applied through the sound head of the detuned ultrasound unit, the amount of pressure applied, and thus depth of tissue penetration was still more superficial in the placebo group than the GISTM group.

This, coupled with the fact that natural healing occurs over time (Lachmann and Jenner, 1994:28) is the most likely reason for the placebo group improving over time.



### **4.3.2) The Foot Function Index (FFI)**

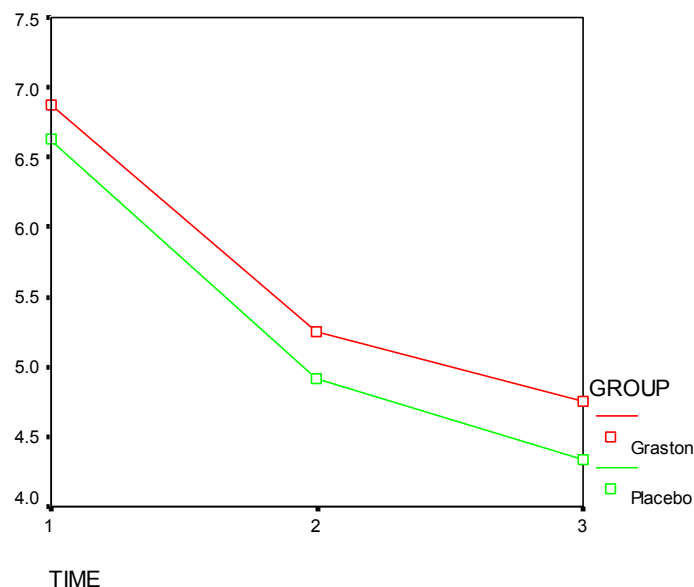
The FFI was used to obtain information on the impact of the patients' foot pain on their daily activities and to note any improvement in their functional ability with regards to treatment. Although originally tested on patients with rheumatoid arthritis (Saag, *et al.* 1996:506), the design of the questions are non-specific enough to be used for measurement on patients who suffer from other types of foot pain.

#### **4.3.2.1) FFI: Worst pain**

Both groups showed a significant decrease in worst pain over time ( $p < 0.001$ ). However, there was no difference between the two groups in the rate of decrease ( $p = 0.970$ ), and Figure 4 shows that the profiles are parallel. Thus for worst pain there was no evidence or trend of a beneficial effect of GISTM treatment.

**Table 8: Within and between subject's effects for worst pain**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.386	<0.001
<b>Group</b>	F 0.598	0.445
<b>Time*group</b>	Wilk's Lambda 0.998	0.970



**Figure 4: Profile plot of mean worst pain scores over time by group**

This profile of change in the reported pain correlates well with the pain reporting on the numerical pain rating scale. Therefore it could be stated that the hypothesis in respect of pain reduction in the placebo group, is more closely related to the mechanisms of the gate control theory (Melzack and Wall, 1965:972) and that of natural history (Lachmann and Jenner, 1994:28).

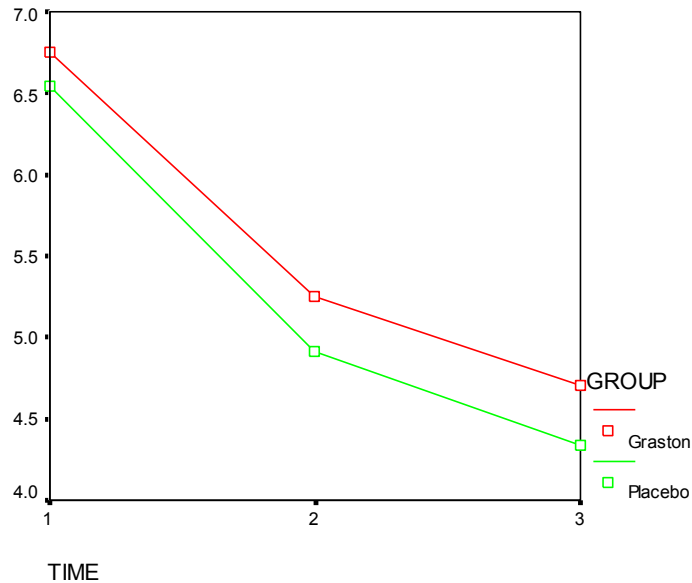
The decrease in pain in the GISTM group may not be an accurate measure of clinical improvement, as the inflammation initiated by the treatment (Carey-Loghmani, 2003: 31) may have masked clinical results in the short term. As neither the placebo nor the GISTM group received ice directly post-treatment, the inflammatory response in the GISTM group was uncontrolled. This could have a negative effect on the outcome measures.

#### **4.3.2.2) FFI: Morning pain**

As in the case of worst pain, morning pain decreased significantly in both groups, irrespective of treatment received ( $p < 0.001$ ), and treatment did not have any effect on change over time ( $p = 0.962$ ). This is shown by the parallel profiles of the two groups in Figure 5. Thus morning pain was not significantly influenced by placebo nor was there any trend of faster improvement in the GISTM group.

**Table 9: Within and between subjects' effects for morning pain**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.386	<0.001
<b>Group</b>	F 0.397	0.533
<b>Time*group</b>	Wilk's Lambda 0.998	0.962



**Figure 5: Profile plot of mean morning pain scores over time by group**

The outcome in the placebo group again supports the theory proposed around the Melzack and Wall (1965) pain reduction through the gate control theory, whereby the patients have less limitation of movement (through pain inhibition). This increase in movement assists with the further reduction in pain as more mechanoreceptors are stimulated as the movement stimulates the larger A-fibers and limits the communication of the C-fibers (nociceptive fibers) to the central nervous system. The effect of natural healing (Lachmann and Jenner, 1994:28) can once again, not be negated.

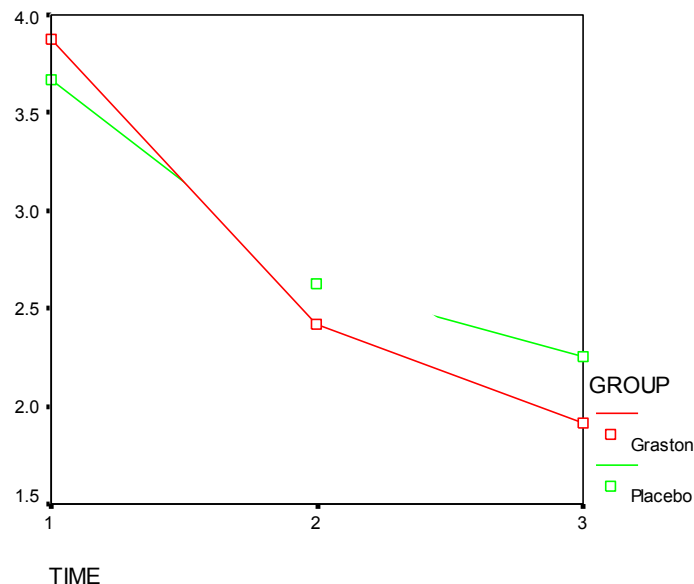
The GISTM group's relative insignificant decline could be due to the fact that participants were instructed not to change their training schedules (as per the lengthy nature of the study). Thus, the GISTM treatment effects of inducing an inflammation which would reduce the previously formed adhesions and increase the rate of normal healing (Carey-Loghmani, 2003:31), could have been slowed as there was not an active period of rest during the research period.

#### **4.3.2.3) FFI: Pain when walking barefoot**

This outcome showed a significant time effect ( $p < 0.001$ ) regardless of group, and group did not influence the change over time significantly ( $p = 0.755$ ). However, Figure 6 shows that the profiles are not parallel and tend to cross over between time 1 and 2, indicating an interaction or treatment effect. The GISTM group seems to decrease at a faster rate than the placebo group initially, and between time 2 and 3 the two groups seem to decrease in parallel. Thus there was a non-significant trend towards a treatment effect in favour of GISTM, which was only visible between the first two time points.

**Table 10: Within and between subjects' effects for pain when walking barefoot**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.584	<0.001
<b>Group</b>	F 0.028	0.869
<b>Time*group</b>	Wilk's Lambda 0.982	0.755



**Figure 6: Profile plot of mean pain when walking barefoot scores over time by group**

The result presented in Figure 6 is an important one as this indicates that there is indeed an improvement in the flexibility of the plantar fascia in the

GISTM group, which improved both in time 1 and then also in time 2 over the placebo group. In time 1 there is a noted interception indicating that there is a treatment effect that is more effective in one group than the other.

This therefore indicates that the GISTM treatment does have an effect on the plantar fascia which is not related to the degree of pain that is reported by the patient, as it can be seen there is no difference between the NRS, worst pain and the morning pain FFI measures.

One possible reason for this is that the GISTM has the ability to detect and remove adhesions (Carey-Loghmani, 2003:13) from within the plantar fascia that have developed as a result of the low grade chronic inflammation that characterizes the symptomatology of the PF (Vizniak and Carnes 2004:221).

This process is not present in the placebo group where the adhesions within the plantar fascia are not affected, by the therapy employed.

Thus, the removal of the adhesions and therefore the increased flexibility of the plantar fascia would allow for increased mobility especially in positions where the plantar fascia has to accommodate increased weight of the body or increased biomechanical load that results in increased stretch of the plantar fascia (Reid, 1992: 131). One such example is that of the patient walking barefoot, where there is no support of the plantar fascia (as in a shoe or orthotic in the shoe) and the plantar fascia therefore is taken into an anatomical stretch.

It can be therefore said that the GISTM has a definitive effect in allowing for plantar fascia stretch and align. It could thus be inferred that the GISTM has an effect on restoring the alignment and strength of the collagen fibers irrespective of pain perceived by the patient. This could in turn strengthen the fascia, and improve its ability to withstand repetitive forces imparted during running and decrease the chronicity of the condition.

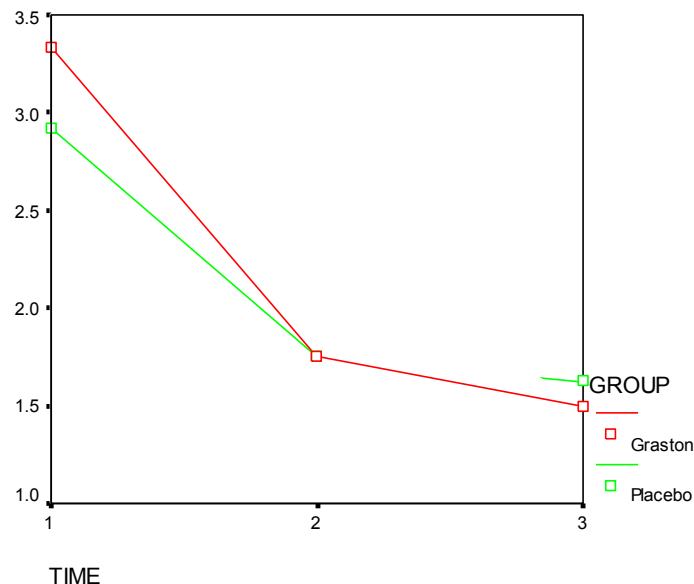
#### **4.3.2.4.) FFI: Pain when walking with shoes**

Although there was no statistical evidence of a treatment effect ( $p = 0.819$ ), Figure 7 shows that the GISTM group decreased in mean score at a faster rate than the placebo group overall. The profiles cross-over at time 2, and the GISTM group ended up at time 3 with lower scores than the placebo group even though they started with higher scores.

Thus, for this outcome there was evidence of a trend towards a beneficial effect of the GISTM over placebo, but no statistical evidence.

**Table 11: Within and between subjects' effects for pain when walking with shoes**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.674	0.002
<b>Group</b>	F 0.044	0.834
<b>Time*group</b>	Wilk's Lambda 0.987	0.819



**Figure 7: Profile plot of mean pain when walking with shoes scores over time by group**

This result follows logically from the results that were presented for patients walking barefoot, as the only change that is facilitated by walking with shoes

is the support that the shoe presents both under and on either side of the foot (Batt and Tanji, 1995:83). In addition to this, an orthotic may have been present adding further support (Ambrosius and Kondracki, 1992:39).

Nonetheless, the weight of the patient (Brantingham, *et al.* 1992:80) as well as the mechanics of walking (Reid, 1992:131) are still present. This would also be the case in barefoot walking where activities like toe-off (“windlass” effect) and full foot load where the entire weight of the body is distributed over the surface of the foot, depressing the arch and inducing a pronation (and therefore a plantar fascia stretch) just before heel raise in the gait cycle, is necessitated (Reid, 1992:131). These are all positions in which the plantar fascia is stretched and in which a tethered, adhesion bound plantar fascia would not be able to perform.

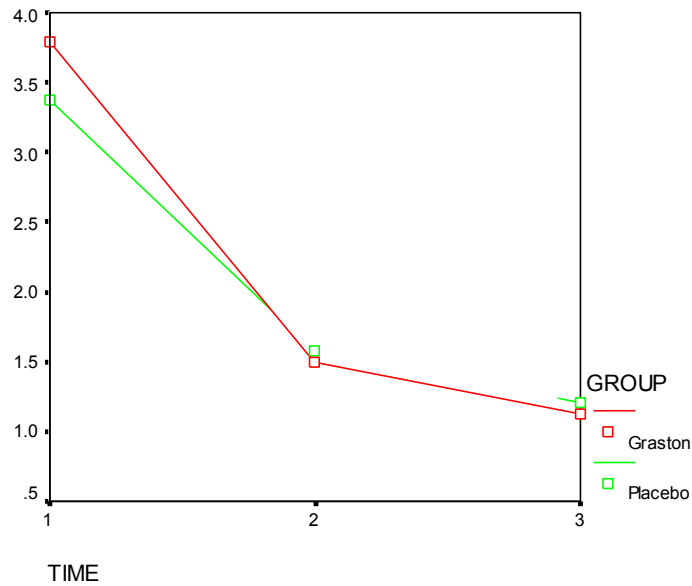
It would be of interest to note whether the further results of toe raise and stair descent would support this finding as they also employ the mechanics above with and without the presence of a shoe (Reid, 1992:131). This however will be discussed later under the respective sections.

#### **4.3.2.5. ) FFI: Pain when standing with shoes**

Similarly, for pain when standing with shoes, there was a significant change over time in both groups, but a non significant trend towards an interaction by treatment group ( $p = 0.841$ ) where the GISTM group appears to decrease in score at a faster rate than the placebo group (Figure 8). Although the mean scores of the two groups are relatively similar, the GISTM group ended up below the placebo group, whereas they started with higher mean scores. Thus there was a non-significant trend towards a beneficial effect of the GISTM group in this outcome.

**Table 12: Within and between subjects' effects for pain when standing with shoes**

	Statistic	p value
<b>Time</b>	Wilk's Lambda 0.517	<0.001
<b>Group</b>	F 0.018	0.894
<b>Time*group</b>	Wilk's Lambda 0.898	0.841



**Figure 8: Profile plot of mean pain when standing with shoes scores over time by group**

These results reflect the same outcomes as patients walking with shoes as found under point 4.3.2.4. (above) and the same discussion is presented.

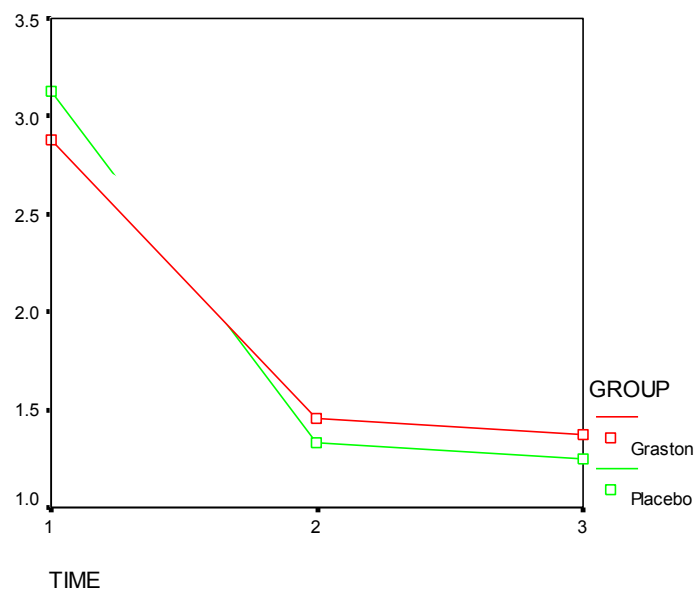


#### **4.3.2.6.) FFI: Pain when walking in the house**

There was a significant decrease in score over time for both groups ( $p < 0.001$ ) and no treatment effect evidence ( $p = 0.881$ ). However, there was a trend displayed in Figure 9 showing that the placebo group decreased at a faster rate than the GISTM group. Thus for this outcome there may have been a detrimental effect of the GISTM treatment compared to the placebo, however, the mean differences were very small.

**Table 13: Within and between subjects' effects for walking in the house**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.614	0.001
<b>Group</b>	F 0.000	1.000
<b>Time*group</b>	Wilk's Lambda 0.992	0.881



**Figure 9: Profile plot of mean pain when walking in the house scores over time by group**

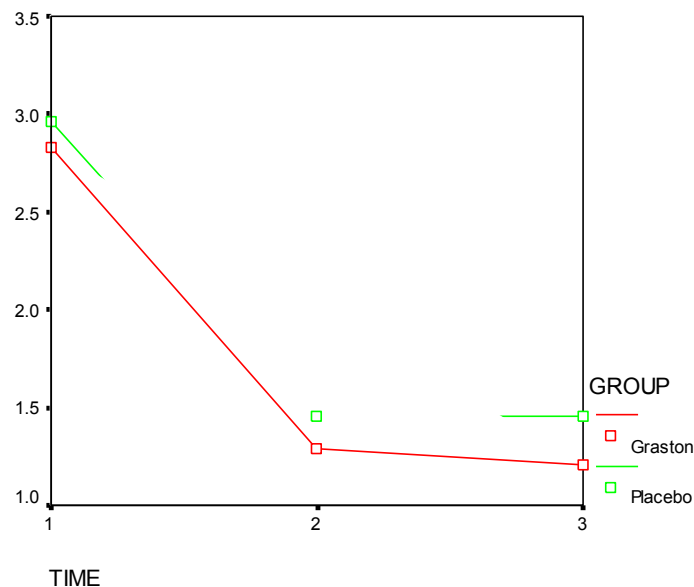
Please note this is discussed after the analysis 4.3.2.7 as the results speak to the same theory and have similar presentation.

#### **4.3.2.7.) FFI : Pain when walking outside**

There was a significant decrease in scores over time ( $p = 0.002$ ), but no interaction between time and treatment group ( $p = 0.980$ ). Figure 10 shows that the profiles of the two groups were parallel, thus there was no trend towards a beneficial effect of the GISTM technique for this outcome.

**Table 14: Within and between subjects' effects when walking outside**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.663	0.002
<b>Group</b>	F 0.114	0.738
<b>Time*group</b>	Wilk's Lambda 0.999	0.980



**Figure 10: Profile plot of mean pain when walking outside scores over time by group**

It would seem from these results that the degree of resistance offered by the surface on which the patient walked has some bearing on the degree of improvement or lack thereof noted over the time period of the treatment.

The results seem to suggest that the patients in the GISTM group are worse on hard surfaces and prefer surfaces that are either yielding or are undulating in nature whereas the patients in the placebo group prefer the hard (possibly cool) surfaces.

The following could be inferred:

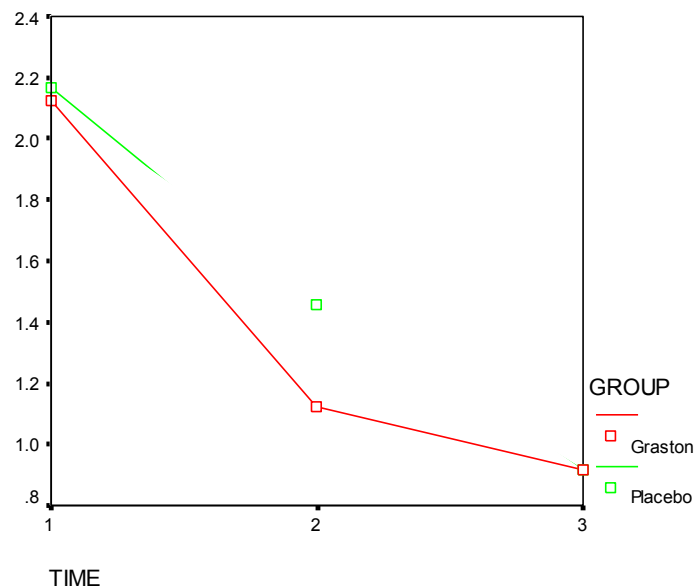
- The patients that received GISTM as a form of intervention seemed to prefer those surfaces that allow for the stretch of the plantar fascia, as has already been seen with walking (section 4.3.2.4) with and without shoes (section 4.3.2.3) as well as standing with shoes (section 4.3.2.5). Thus these results further support the increased pliability of the plantar fascia.
- Also note that if we are inducing inflammation, hard indoor surfaces do not give and may produce more pain than the yielding / softer or undulating ground outside. This was not the case in the placebo group.
- The patients receiving placebo seemed to favour maximal support from the surface on which they are walking, and possibly also the fact that the hard indoor surfaces tend to be cooler than the less forgiving outdoor terrain.

#### **4.3.2.8.) FFI: Pain when climbing stairs**

Pain when climbing stairs decreased significantly in both groups over time ( $p < 0.001$ ) but there was no significant intervention effect ( $p = 0.724$ ). Figure 11 shows that the GISTM group may have initially improved at a faster rate than the placebo group, but by time 3 the groups' means were approximately equal. Thus GISTM may have an initial or immediate non-significant benefit for this outcome.

**Table 15: Within and between subjects effects for pain when climbing stairs**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.601	<0.001
<b>Group</b>	F 0.065	0.800
<b>Time*group</b>	Wilk's Lambda 0.979	0.724



**Figure 11: Profile plot of mean pain when climbing stairs scores over time by group**

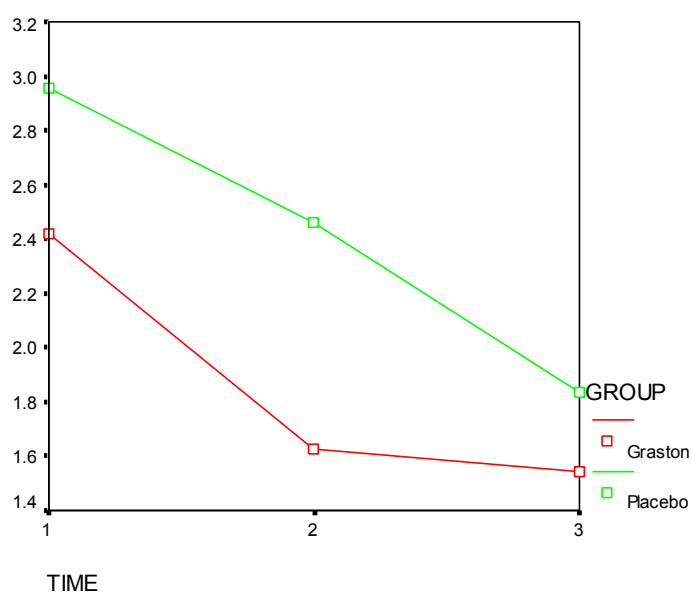
This is discussed after 4.3.2.9. (below) as these movements are opposing movements.

#### **4.3.2.9.) FFI: Pain when descending stairs**

There was no significant treatment effect for this outcome ( $p = 0.460$ ) and both groups showed a mean decrease over time which was statistically significant ( $p = 0.019$ ). Figure 12 shows that the scores in the GISTM group decreased between time 1 and time 2 at a faster rate than the placebo group, but thereafter leveled off. The placebo group decreased in an almost linear fashion throughout. Thus there was a non-significant trend towards a faster decrease in the GISTM group initially, but overall no difference in the rate of decrease between the groups.

**Table 16: Within and between subjects' effects for pain when descending stairs**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.773	0.019
<b>Group</b>	F 1.184	0.285
<b>Time*group</b>	Wilk's Lambda 0.951	0.460



**Figure 12: Profile plot of mean pain when descending stairs scores over time by group**

The difference between the ascent and descent of stairs lies in the fact that, with ascent of stairs the degree of stretch of the plantar fascia is not as great as there is greater reliance on the triceps surae for propulsion (as opposed to the “windlass” effect). Thus there is a decrease reliance on plantar fascia stretch and weight bearing (Reid, 1992:131). This is in opposition to the descent of stairs where maximal great toe dorsiflexion is required to descend the stair, with maximal weight bearing and stretch of the plantar fascia. ([www.orthoteers.co.uk/Nrujp~ij33lm/Orthfootmech.htm](http://www.orthoteers.co.uk/Nrujp~ij33lm/Orthfootmech.htm)).

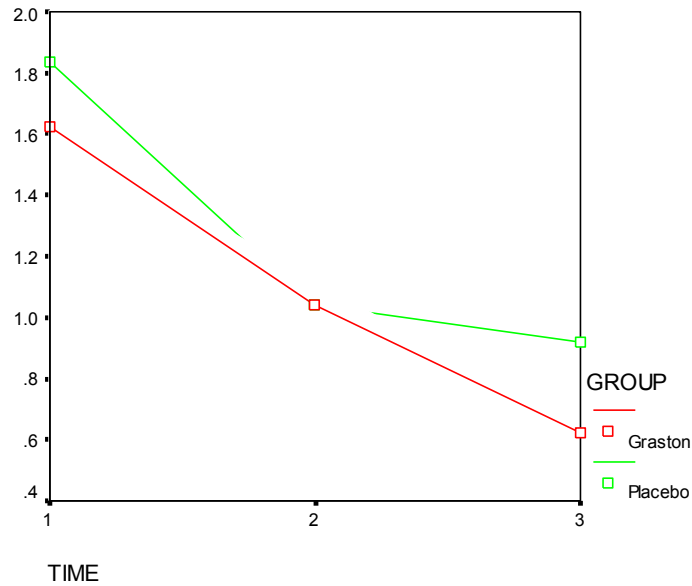
This would define the differences in the responses to the 2 actions whereby the GISTM group showed greater improvement in the descent of the stairs and there is no marked difference between the GISTM and placebo group with reference to the ascent of the stairs.

**4.3.3.0.) FFI: Pain when standing on tiptoe**

Although there was no evidence of a treatment effect ( $p = 0.772$  for this outcome, Figure 13 shows that the overall outcome may be a faster rate of decrease in the GISTM group compared with the placebo group. The placebo group initially decreased at a faster rate between time 1 and time 2, and thereafter leveled off, while the GISTM group showed a linear decrease over time. There was a significant change over time in both groups combined ( $p = 0.014$ ).

**Table 17: Within and between subjects’ effects for pain when standing on tiptoe**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk’s Lambda 0.758	0.014
<b>Group</b>	F 0.104	0.750
<b>Time*group</b>	Wilk’s Lambda 0.983	0.772



**Figure 13: Profile plot of mean pain when standing on tiptoe scores over time by group**

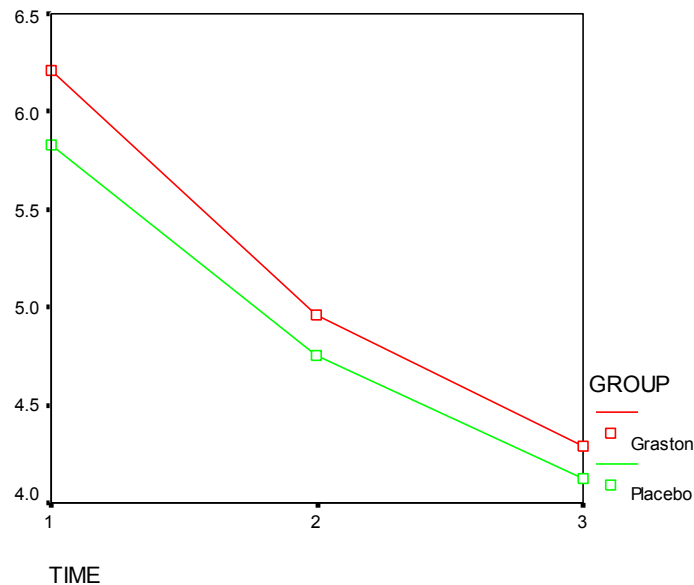
Based on the discussion of the walking with and without shoes, the terrain as well as the ascent and descent of stairs, this result follows a similar discussion.

**4.3.3.1.) FFI: Pain when getting up from a chair**

Pain when getting up from a chair decreased significantly in both groups ( $p < 0.001$ ). However, there was no statistical evidence nor trend suggestion of a treatment effect ( $p = 0.947$ , Figure 14). The profiles of the two treatment groups were parallel over time.

**Table 18: Within and between subjects' effects for pain when getting up from a chair**

	Statistic	p value
<b>Time</b>	Wilk's Lambda 0.511	<0.001
<b>Group</b>	F 0.196	0.661
<b>Time*group</b>	Wilk's Lambda 0.996	0.947



**Figure 14: Profile plot of mean pain when getting up from a chair scores over time by group**

It is pathognomonic for PF sufferers to experience pain in the fascia after periods of immobility, e.g. after a night's sleep or after sitting in a chair for a prolonged period (Reid, 1992:196; Krivickas, 1997:169).

In keeping with previous discussion of the placebo group's favourable outcomes, reduction in pain in this group would most likely have been due to the mechanism of the gate control theory Melzack and Wall (1965:971), although the natural history of a condition healing over time (Lachmann and Jenner, 1994:28) cannot be negated.

The most likely reason for the GISTM group's more rapid clinical improvement than the placebo group, is that the breakdown of adhesions and scar shrinkage resulted in promoting fibre alignment and fascia extensibility (Carey-Loghmani, 2003:31). The increased pliability of the fascia allows for periods of immobility to be less incapacitating as well as more active ability to reduce the swelling when waking, as the function of the plantar fascia approximates normal function and ability due to decreased scar tissue.

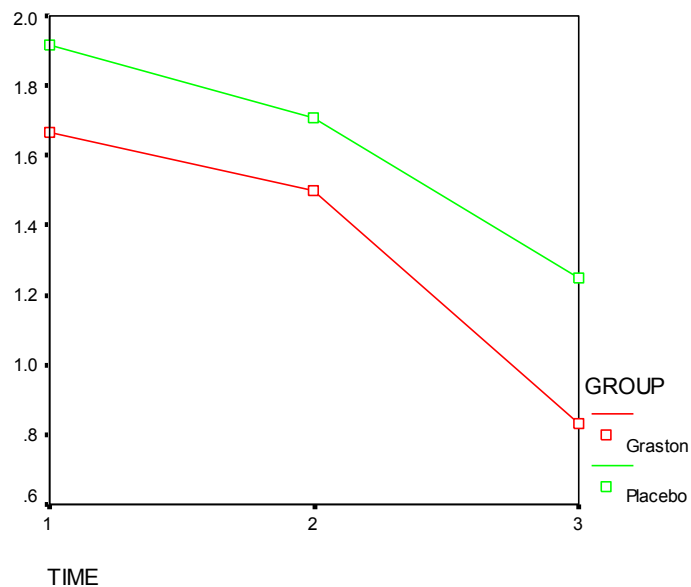


#### **4.3.3.2.) FFI: Pain when climbing curbs**

There was a significant change over time in both groups ( $p = 0.011$ ), but no treatment effect ( $p = 0.871$ ). Figure 15 shows that the two groups decreased at the same rate over time.

**Table 19: Within and between subjects' effects for pain when climbing curbs**

	<b>Statistic</b>	<b>p value</b>
<b>Time</b>	Wilk's Lambda 0.746	0.011
<b>Group</b>	F 0.202	0.656
<b>Time*group</b>	Wilk's Lambda 0.991	0.871



**Figure 15: Profile plot of mean pain when climbing curbs scores over time by group**

This follows the argument as presented with respect to walking with and without shoes, terrain type, descending and ascending stairs as well as toe standing.

**4.4) INTRA-GROUP CORRELATIONS BETWEEN CHANGES IN OBJECTIVE AND SUBJECTIVE FINDINGS.**

**4.4.1) GISTM group**

**Table 20: Pearson correlation between changes in subjective and objective outcomes in the GISTM group**

		Change in NRS	Change in algometer	Change in ankle dorsiflexion	Change in FFI worst pain	Change in FFI morning pain	Change in FFI getting up from chair pain
<b>Change in NRS</b>	Pearson Correlation	1	-.026	.108	.767(**)	.629(**)	.318
	Sig. (2-tailed)	.	.918	.668	.000	.005	.198
<b>Change in algometer</b>	Pearson Correlation	-.026	1	-.474(*)	.026	-.147	-.461
	Sig. (2-tailed)	.918	.	.047	.917	.561	.054
<b>Change in ankle dorsiflexion</b>	Pearson Correlation	.108	-.474(*)	1	.025	.077	.471(*)
	Sig. (2-tailed)	.668	.047	.	.921	.762	.049
<b>Change in FFI worst pain</b>	Pearson Correlation	.767(**)	.026	.025	1	.684(**)	.299
	Sig. (2-tailed)	.000	.917	.921	.	.002	.229
<b>Change in FFI morning pain</b>	Pearson Correlation	.629(**)	-.147	.077	.684(**)	1	.560(*)
	Sig. (2-tailed)	.005	.561	.762	.002	.	.016
<b>Change in FFI getting up from chair pain</b>	Pearson Correlation	.318	-.461	.471(*)	.299	.560(*)	1
	Sig. (2-tailed)	.198	.054	.049	.229	.016	.

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

Table 20 shows that there was a significant positive correlation between **change in NRS score** and **change in worst pain** ( $r=0.767$ ,  $p<0.001$ ) and **morning pain** ( $r=0.629$ ,  $p = 0.005$ ). This is to be expected as all three of these measures measure pain subjectively and thus a correlation would be

expected. The lack of a correlation would indicate an inconsistency in patient response should this result have come up any differently.

**Change in algometer** was negatively correlated with ankle dorsiflexion, morning pain and getting up from a chair outcomes, but significantly correlated with change in ankle dorsiflexion ( $r = -0.474$ ,  $p = 0.047$ ). It is expected that with decreased reported pain on getting up in the morning and with getting up from a chair, there would be an increase in the algometer reading as both these activities are weight bearing and would induce a similar “algometer” like pressure on the plantar fascia.

With **increased ankle dorsiflexion**, it is expected that there is an increase in mobility of the foot (plantar fascia), with increased mobility, there should be a decreased level of edema (due to increased movement) and pain (due to the gate control theory), thereby implying that there should be an increase in the algometer reading. As the algometer readings were increased, indicative of a decrease in pain, the result is representative of this argument.

In addition the **change in ankle dorsiflexion** was significantly correlated with change in pain associated with getting up from a chair ( $r=0.471$ ,  $p =0.049$ ). This could be attributed to the fact that at rest, such as being seated for any length of time, the plantar fascia shortens (Reid, 1992:131), which results in pain being experienced with the first few steps taken due to lengthening of the fascia (Krivickas, 1997: 169). This inhibitory response could hinder optimal ankle dorsiflexion, as indicated by the results.

**Change in worst pain** and **morning pain** were significantly positively correlated ( $r = 0.684$ ,  $p =0.002$ ). This is expected as this indicates that the patients gave accurate and true readings for the reporting of pain and supports the work of Jensen, *et al.* (1986:117-125) in respect of the NRS being a valid and reliable tool.

**Morning pain** and pain associated with **getting up from a chair** were significantly positively correlated ( $r = 0.560$ ,  $p = 0.016$ ). These movements are similar in that they both occur after a period of immobility, thus the degree of

pain noted should be similar, as exact replication of pain is improbable. This again notes the accuracy with which the patients reported their pain. The researcher observed a common trend in that patients that received GISTM reported a significant decrease in heel pain immediately following treatment. This was reassuring to the patients, as their initial skepticism of the GISTM instruments efficacy, despite lengthy explanation by the researcher, was put asunder

#### **4.4.2) Placebo group**

**Table 21: Pearson correlation between changes in subjective and objective outcomes in the placebo group**

		Change in NRS	Change in algometer	Change in ankle dorsiflexion	Change in FFI worst pain	Change in FFI morning pain	Change in FFI getting up from chair pain
<b>Change in NRS</b>	Pearson Correlation	1	.024	.052	.776(**)	.811(**)	.876(**)
	Sig. (2-tailed)	.	.923	.837	.000	.000	.000
<b>Change in algometer</b>	Pearson Correlation	.024	1	.245	-.142	-.093	-.151
	Sig. (2-tailed)	.923	.	.328	.575	.712	.550
<b>Change in ankle dorsiflexion</b>	Pearson Correlation	.052	.245	1	-.114	-.119	.035
	Sig. (2-tailed)	.837	.328	.	.654	.638	.889
<b>Change in FFI worst pain</b>	Pearson Correlation	.776(**)	-.142	-.114	1	.968(**)	.731(**)
	Sig. (2-tailed)	.000	.575	.654	.	.000	.001
<b>Change in FFI morning pain</b>	Pearson Correlation	.811(**)	-.093	-.119	.968(**)	1	.820(**)
	Sig. (2-tailed)	.000	.712	.638	.000	.	.000
<b>Change in FFI getting up from chair pain</b>	Pearson Correlation	.876(**)	-.151	.035	.731(**)	.820(**)	1
	Sig. (2-tailed)	.000	.550	.889	.001	.000	.

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Change in NRS** was highly positively correlated with changes in **worst pain** ( $r=0.776$ ,  $p < 0.001$ ), **morning pain** ( $r=0.811$ ,  $p < 0.001$ ) and **getting up from chair** ( $r=0.876$ ,  $p < 0.001$ ). It is expected that these responses be similar in that the worst pain experienced by PF sufferers occurs after periods of immobility such as morning pain and getting up from a chair (Vizniak and Carnes 2004:221). This, as for the GISTM group, indicates the accuracy with which the patients reported their pain and the consistency of reporting for different actions.

**Changes in the algometer** were not significantly correlated with any outcome. Although, it is seen that there are negative correlations between the algometer and the worst pain, morning pain and the pain on arising from a chair. This means that as the algometer readings increased, the pain on these actions decreased, which is to be expected as per the validation of the instrument by Fischer (1987:207).

**Changes in ankle dorsiflexion** were not significantly correlated with any outcome. Although it is noted that there is an inverse relationship with worst pain and morning pain, indicating that with increased dorsiflexion the patient experienced a decrease in pain. This is normal as with increased movement there is decreased edema, increased large A-fiber stimulation and decreased pain (Melzack and Wall, 1965, 975).

**Worst pain** and **morning pain** ( $r=0.986$ ,  $p < 0.001$ ) and **getting up from a chair** ( $r=0.731$ ,  $p < 0.001$ ) were highly correlated, as were **morning pain** and **getting up from a chair** ( $r = 0.820$ ,  $p < 0.001$ , see Table 21). The reasons that explain the logical outcome of these results are as for those found in the GISTM group (See section 4.4.1).

#### **4.5) SUMMARY OF RESULTS**

This study did not demonstrate a statistically significant beneficial effect of the GISTM over the placebo ultrasound for any outcome measured. However, this could have been due to lack of statistical power from a small sample size, or due to the fact that this study's allocated time frame of 6 weeks was shorter than the natural history of PF. As a result this study focused on trends that were apparent, as clinically important differences or effects might be missed if statistical significance is the only focus.

The trends exhibited could be due to 2 possible mechanisms:

1. The gate control theory as proposed by Melzack and Wall (1965), in which the large fiber input from cutaneous stimulation has a facilitatory effect on the SG, which decreases pain experienced by patients.

Although both the GISTM and placebo groups showed a decrease in NRS, worst pain and morning pain readings, the decrease by the GISTM group was no more significant than the placebo group. This is suggestive of the GISTM not working primarily through this mechanism, but rather through the inflammation model discussed in 2 (below).

2. As stated by Carey-Loghmani (2003) and Hammer (2003), the GISTM is used to detect and treat soft tissue lesions. The application of the GISTM initiates the inflammatory process, which allows for healing and scar tissue remodeling to take place (Carey-Loghmani, 2003:32). The remodeling of the collagen increases the elasticity of the scar tissue, breaks down fibrotic adhesions and increases functional capability or pliability of the tissue.

The trends, which were suggested by the data, showed a possibly beneficial effect of the GISTM for the following subjective outcomes:

- NRS,
- Walking barefoot,
- Walking with shoes,
- Standing with shoes,
- Descending stairs, and
- Standing on tiptoe.

However, for most of these outcomes the trend disappears after time 2. For the outcome of pain associated with walking in the house, the GISTM group decreased at a non-significantly slower rate than the placebo group. Thus the treatment effect may be detrimental to the outcome measure although the GISTM group did show an overall decrease in this outcome.

The above information suggests that the GISTM had the greatest effect on those activities in which the plantar fascia was in a dynamic, flexible state. Despite the fact that the mechanism of the gate control theory held for both the placebo and GISTM, there was no inflammation induced in the placebo group as there was in the GISTM group.

It can be concluded that the GISTM works by the second mechanism, the inflammatory model, as decreasing the adhesions leads to an increased pliability of the fascia, with resultant increased ability to engage in the aforementioned activities, with a reduction in pain.

Thus GISTM treatment is at least as good as the placebo for many outcomes.

Thus in terms of the hypotheses made at the outset of the study:

#### **4.5.1) The first hypothesis**

It was hypothesized that the Graston Technique Instrument-assisted Soft Tissue Mobilization (GISTM) would be effective in the treatment of PF in terms of subjective clinical findings

The above hypothesis is accepted with respect to those readings that reflect a reduction in the NRS and FFI scores brought about by the GISTM over the treatment period, which is indicative of decrease pain perception.

#### **4.5.2) The second hypothesis**

It was hypothesized that the Graston Technique Instrument-assisted Soft Tissue Mobilization (GISTM) would be effective in the treatment of PF in terms of objective clinical findings.

Both the ankle dorsiflexion and the algometer measures were no more significant in the placebo group than the treatment group. The above hypothesis is rejected, despite the fact that increased algometer readings are indicative of a decrease in pain perceived by the patients (Fischer, 1987:207).

#### **4.5.3) The third hypothesis**

It was hypothesized that the Graston Technique Instrument-assisted Soft Tissue Mobilization (GISTM) would be effective in the treatment of PF in terms of subjective and objective clinical findings.

The above hypothesis is accepted with reservation as only the Plantar Fascia stretch measures (see sections 4.3.2.3, 4.3.2.4, 4.3.2.5, 4.3.2.9, 4.3.3.0) were positively affected.



## Chapter 5

### CONCLUSIONS AND RECOMMENDATIONS

#### **5.1) CONCLUSIONS**

This study was to determine the efficacy of the Graston Technique Instrument –assisted soft tissue mobilisation in the treatment of Plantar Fasciitis.

In terms of objective data:

1. A statistically significant improvement in patients' algometer measurements was seen in both the GISTM and the placebo groups.
2. Ankle dorsiflexion measures were neither significant in the GISTM group nor in the placebo group.

In terms of subjective data:

1. The GISTM group's FFI scores of walking barefoot, walking with shoes on, standing with shoes on, descending stairs and standing on tiptoe, improved over the course of the treatment.
2. Although the GISTM and placebo groups NRS scores both decreased, the GISTM did so at a faster rate than the placebo.

In conclusion, the results of this study demonstrate that the GISTM is useful in the treatment of Plantar Fasciitis in runners with particular emphasis on restoring the mobility of the plantar fascia and allowing for increased load bearing. This increased pliability of the plantar fascia will ensure optimal strength and function, especially during load bearing activities, of the "windlass mechanism", which in turn will ensure optimum propulsion of body weight without injury during the gait-cycle.

## 5.2) RECOMMENDATIONS

1. The age limit should be increased to 60+; many runners were unable to qualify for the study as they were over 50 years of age. This however would increase the likelihood of other conditions being the cause of the PF. Ideally, two separate studies on younger and older individuals would be beneficial.
2. A larger sample size (e.g. 60+) is suggested for results to be more statistically significant.
3. Lack of blinding could have resulted in researcher bias. Having a peer intern or clinician to take objective and subjective measures may have blinded the study more.
4. The treatment protocol for this study was six treatments over a two-week period, with a final treatment in the third week: data was captured at the beginning of every week i.e. first, fourth and seventh visits. It is suggested that further research include treatment combinations of either enforcing an active rest period during the treatment time, which is impractical, or combining stretch or cryotherapy with the GISTM to facilitate healing and doing follow up maintenance treatments at monthly intervals.
5. While thorough efforts to advertise and recruit patients were made, many runners were spoken to who had suffered from PF previously. It is suggested that future researchers include a small retrospective questionnaire on the incidence, prevalence and duration of PF, perhaps including the most popular treatment sought, in addition to clinical outcomes measured, thereby looking for correlations between improvement and previous history.
6. As this study was conducted in conjunction with a peer researcher, who conducted research on the same participants in the 3 weeks directly following this study, the total time of involvement per participant was 6 weeks. This was a deterrent for participants whose occupations would not permit time off for a lengthy commitment as was required. It is suggested that future research include the full GISTM protocol of cardio warm-up, GISTM, stretching / strengthening exercises and post treatment ice to see if a shorter treatment time is reached.



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**Appendix A** SOAPE note

**DURBAN INSTITUTE OF TECHNOLOGY**

<i>Patient Name:</i>		<i>File #:</i>	<i>Page:</i>
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	<i>Signature:</i>
<i>Attending Clinician:</i>			
<i>S: Numerical Pain Rating Scale (Patient) Intern Rating A:</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>			
<i>O:</i>		<i>P:</i>	
		<i>E:</i>	
<i>Special attention to:</i>		<i>Next appointment:</i>	
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	<i>Signature:</i>
<i>Attending Clinician:</i>			
<i>S: Numerical Pain Rating Scale (Patient) Intern Rating A:</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>			
<i>O:</i>		<i>P:</i>	
		<i>E:</i>	
<i>Special attention to:</i>		<i>Next appointment:</i>	
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	<i>Signature:</i>
<i>Attending Clinician:</i>			
<i>S: Numerical Pain Rating Scale (Patient) Intern Rating A:</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>			
<i>O:</i>		<i>P:</i>	
		<i>E:</i>	
<i>Special attention to:</i>		<i>Next appointment:</i>	

<i>Patient Name:</i>		<i>File #:</i>	<i>Page:</i>
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	
<i>Attending Clinician:</i>		<i>Signature:</i>	
<i>S: Numerical Pain Rating Scale (Patient) Intern Rating A:</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>			
<i>O:</i>		<i>P:</i>	
		<i>E:</i>	
<i>Special attention to:</i>		<i>Next appointment:</i>	
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	
<i>Attending Clinician:</i>		<i>Signature:</i>	
<i>S: Numerical Pain Rating Scale (Patient) Intern Rating A:</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>			
<i>O:</i>		<i>P:</i>	
		<i>E:</i>	
<i>Special attention to:</i>		<i>Next appointment:</i>	
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	
<i>Attending Clinician:</i>		<i>Signature</i>	
<i>S: Numerical Pain Rating Scale (Patient) Intern Rating A:</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>			
<i>O:</i>		<i>P:</i>	
		<i>E:</i>	
<i>Special attention to:</i>		<i>Next appointment:</i>	

## **Appendix B**

### **LETTER OF INFORMATION**

Dear patient,

Welcome to my research.

#### **Title of study:**

The efficacy of the Graston Technique Instrument-assisted Soft Tissue Mobilisation in the treatment of Plantar Fasciitis in runners.

**Names of supervisors:** Dr. C. Korporaal (031) 2042611 /2042094

**Name of research student:** Kirsten Maartens (031) 2042205

**Name of institution:** Durban Institute of Technology

**Purpose of this study:** It is thought that the effects of the Graston instrument-assisted soft tissue mobilisation (GISTM) technique are similar to that of cross frictions. Due to the fact that we have no placebo study to know whether GISTM shows any clinical improvement, we need to establish this before we compare GISTM with cross frictions and hence, the purpose of the study. Thus, this study employs the use of 2 treatment modalities, namely, placebo & GISTM.

#### **Procedures:**

You will be asked to fill out a questionnaire on your first visit.

All subjects in the study will then undergo a number of clinical testing measurements. The treatment will follow the following format: two groups consisting of 30 subjects in each, the first group will be treated with GISTM to the plantar fascia, the second group will undergo another the form of placebo ultrasound.

Data collection, objective and subjective measurements will take place at the initial consultation, at the end of each week (i.e. every two treatments) and then at a one-month follow up appointment.

#### **Benefits:**

You will receive treatment for your plantar fasciitis. This is expected to benefit you according to current hypotheses.

#### **Risks:**

Slight bruising, pain &/or discomfort of the area being treated, may be experienced-all these effects are of a temporary nature.

Or, no improvement may be seen.

**New findings:**

You will be made aware of any new findings during the course of this research.

Your contribution to this study will help us as Chiropractors to build on our reserve of knowledge. This will benefit you as a patient as we will be able to provide you with more effective health care in the future.

AS A VOLUNTARY PARTICIPANT IN THIS RESEARCH STUDY, YOU ARE FREE TO WITHDRAW FROM THE STUDY AT ANY TIME, WITHOUT GIVING A REASON FOR DOING SO.

**Remuneration / Costs:**

You will **NOT** receive a travel allowance or any monetary remuneration for your participation in the study. You will, as a participant in the study, not be charged for your consultations, as long as the consultations are within the parameters of this study.

**Confidentiality:**

All patient information is confidential. The results from this study will be used for research purposes only. Only individuals that are directly involved in this study (Dr. Korporaal and myself) will have access to these records.

**Persons to contact should you have any problems or questions:**

Should you have any questions you would preferred answered by an independent individual, you can contact my supervisor on the above given numbers. Should you have any queries or complaints in respect of this study you are also welcome to contact a representative from the Faculty of Health Sciences Research and Ethics Committee – Mr. Vikesh Singh – on 031-2042701.

Thank you for participating in my research study.

.....  
Kirsten Maartens  
Researcher

.....  
Dr. Korporaal  
Supervisor

**Appendix C**

**INFORMED CONSENT FORM**  
(To be completed by patient / subject )

**Date:**

---

**Title of research project:**

The efficacy of the Graston Technique Instrument-assisted Soft Tissue Mobilisation in the treatment of Plantar Fasciitis in runners.

---

**Name of supervisor : Dr. C. Korporaal**

**Tel : (031) 204 2611**

---

**Name of research student: Kirsten Maartens**

**Tel : (031) 204 2205**

---

**Please circle the appropriate answer**

- |    |   |     |    |
|----|---|-----|----|
| 1. | Have you read the research information sheet?                         | Yes | No |
| 2. | Have you had an opportunity to ask questions regarding this study?    | Yes | No |
| 3. | Have you received satisfactory answers to your questions?             | Yes | No |
| 4. | Have you had an opportunity to discuss this study?                    | Yes | No |
| 5. | Have you received enough information about this study?                | Yes | No |
| 6. | Do you understand the implications of your involvement in this study? | Yes | No |
| 7. | Do you understand that you are free to withdraw from this study?      |     |    |
|    | at any time   | Yes | No |
|    | without having to give any a reason for withdrawing, and              | Yes | No |
|    | without affecting your future health care.                            | Yes | No |
| 8. | Do you agree to voluntarily participate in this study                 | Yes | No |
| 9. | Who have you spoken to?   |     |    |

---

**Please ensure that the researcher completes each section with you**  
**If you have answered NO to any of the above, please obtain the necessary**  
**information before signing**

**Please print in block letters:**

Patient /Subject Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Parent/ Guardian: \_\_\_\_\_

Signature: \_\_\_\_\_

Witness Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Research Student Name: \_\_\_\_\_

**Appendix D**

**Numerical Rating Scale - 101 Questionnaire**

**Date:** \_\_\_\_\_ **File no:** \_\_\_\_\_ **Visit no:** \_\_\_\_\_

**Patient name:** \_\_\_\_\_

Please indicate on the line below, the number between 0 and 100 that best describes

the pain you experience **when it is at its worst**. A zero (0) would mean “no pain at

all”, and one hundred (100) would mean “pain as bad as it could be”.

Please write only **one** number.

0 \_\_\_\_\_ 100

Please indicate on the line below, the number between 0 and 100 that best describes

the pain you experience **when it is at its least**. A zero (0) would mean “no pain

at all” and one hundred (100) would mean “pain as bad as it could be”.

Please write only **one** number.

0 \_\_\_\_\_ 100

## Appendix E

### FOOT FUNCTION INDEX

**INSTRUCTIONS:** Please fill in a value somewhere between **0** and **10** describing your pain  
**0** indicates no pain and **10** indicates the worst pain  
 If the question is not applicable then indicate this by writing **N/A** next to it

<b>Section A:</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>N/A</b>
Worst pain												
Morning Pain												
Pain walking barefoot												
Pain walking with shoes												
Pain standing with shoes												

<b>Section B :Can you</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>N/A</b>
Walk in the house												
Walk outside												
Climb stairs												
Descend stairs												
Stand on tip toe												
Get up from a chair												
Climb curbs												

<b>Section C: Do you have to?</b>	<b>Yes</b>	<b>No</b>
Stay inside all day		
Stay in bed all day		



**Appendix F a**

**Weight Bearing Ankle Dorsiflexion Readings**

Patient: \_\_\_\_\_ Date: \_\_\_\_\_

	1)	2)	3)	<u>Mean</u>
Initial consultation(wk 1)	_____	_____	_____	_____
Before treatment 4 (wk 3):	_____	_____	_____	_____
Before treatment 7 (wk 4):	_____	_____	_____	_____
At clinical assessment 8 (wk 5):	_____	_____	_____	_____

**Appendix F b**

**Algometer Readings**

Patient: \_\_\_\_\_ Date: \_\_\_\_\_

	1)	2)	3)	<u>Mean</u>
Initial consultation (wk 1)	_____	_____	_____	_____
Before treatment 4 (wk 3):	_____	_____	_____	_____
Before treatment 7 (wk 4):	_____	_____	_____	_____
At clinical assessment 8 (wk 5):	_____	_____	_____	_____

## Appendix G Advertisement



**ATTENTION RUNNERS**  
Age:25-50

**Do you suffer from pain in the soles of your feet, heel pain and arch pain?**  
FREE TREATMENT available to those who qualify to take part in this study.

For further information on the research being conducted with respect to this condition, please contact Shoshanna Dunn or Kirsten Maartens on (031) 204 2205/2512.

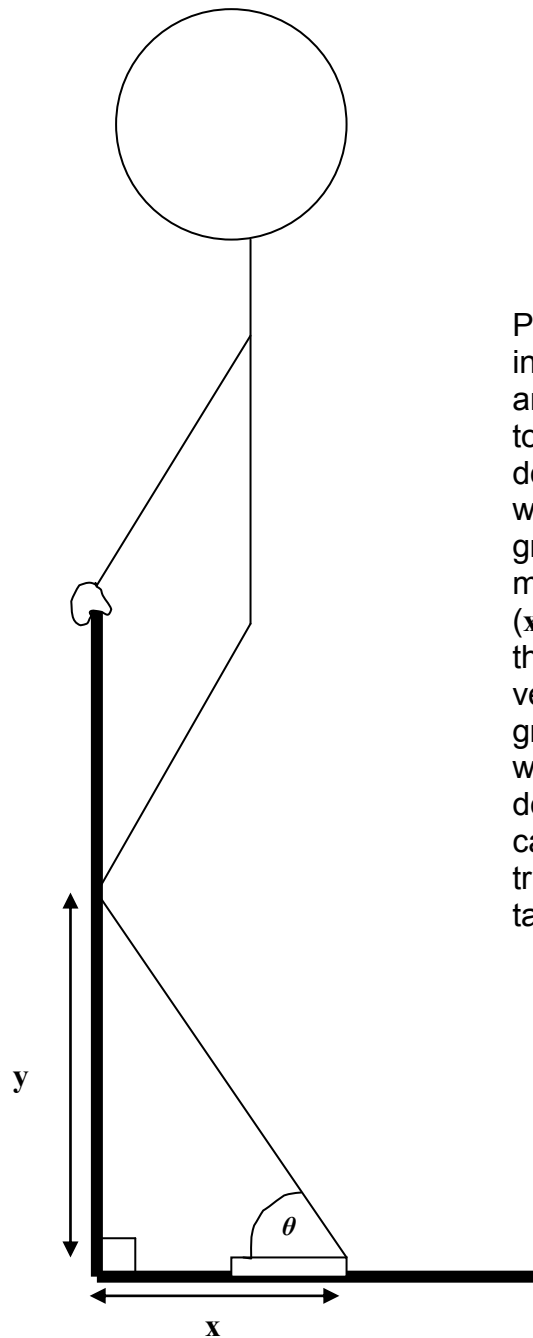
**DURBAN INSTITUTE OF TECHNOLOGY - CHIROPRACTIC DAY CLINIC**



**DURBAN**  
INSTITUTE *of*  
TECHNOLOGY

## Appendix H

How the ankle dorsiflexion was calculated:



Participants will stand on the involved leg and dorsiflex the ankle while flexing the knee, up to a point where no further dorsiflexion will take place without lifting the heel from the ground. A ruler will be used to measure the horizontal distance (x) from the back of the heel to the front of the knee. The vertical distance (y) from the ground to the front of the knee will be measured similarly. The degree of dorsiflexion will be calculated using simple trigonometry:

$$\tan \theta = y/x$$

## **Appendix I a**

### **GRASTON INSTRUMENTS**

Graston tools (GT) 4 and 5 were used in the treatment of Plantar Fasciitis.

#### **GT-4 (Half moon or Scanner)**

Particularly useful in concave tissue surfaces, it is used to scan regions in order to locate restrictions during an assessment.

#### **GT-5 (Boomerang)**

Although the GT-5 is also used as a scanning tool, it can also be used for a more aggressive treatment for releasing restrictions.

(Carey-Loghmani 2003:22-25)

## **Appendix I b**

### **Patents**

The Graston Technique has been awarded five patents. Please refer to the chart below for U.S. Patent Numbers and descriptions:

<b>NUMBER</b>	<b>TITLE</b>
5,231,977	Tools and method for performing Soft-Tissue Massage
5,366,437	Tools for performing Soft-Tissue Massage
5,441,478	Tools and method for performing Soft-Tissue Massage
5,707,346	Systems and method for performing Soft Tissue Massage
6,126,620	Systems and method for performing Soft-Tissue Massage