

THE RELATIVE EFFICACY OF CHIROPRACTIC MANIPULATIVE THERAPY COMPARED TO PLACEBO IN PATIENTS WITH PLANTAR FASCIITIS.

by

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*I, Sarah Louise Hammond, do hereby declare that this dissertation represents my own work both in conception
and execution.*



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DEDICATION

To my parents, my father who has always guided, encouraged and supported me and my mother, whose unfailing belief in me, allows me to reach for my dreams.

With all my love and appreciation to you both for all that you have done in order to make this possible.

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ABSTRACT

The purpose of this study is to investigate the relative efficacy of chiropractic manipulative therapy as opposed to placebo ultrasound, in terms of objective and subjective clinical findings, in the treatment of plantar fasciitis.

This was a randomised, controlled, clinical trial consisting of two groups. Group A received chiropractic manipulative therapy as their treatment protocol and Group B received placebo treatment in the form of detuned ultrasound as their treatment protocol. Each group consisted of fifteen subjects between the ages of 21 and 68 years who were randomly assigned to their respective groups. It is hypothesised that chiropractic manipulative therapy will be effective in the treatment of plantar fasciitis. Subjects diagnosed with plantar fasciitis were included in the study.

The treatment regime consisted of a course of nine treatments spread over a three week time period with a follow-up consultation one month after the final treatment consultation. Subjective and objective measurements were taken at the initial, final and one-month follow-up consultations. Subjective data consisted of the short-form McGill Pain Questionnaire, the Numerical pain Rating Scale - 101 and the Foot Function Index. The objective data was collected by means of Algometer measurements.

The data was analysed statistically using the non-parametric Mann-Whitney unpaired U-test for the categorical variables and the parametric two-sample unpaired t-test for the continuous variables for the inter-group comparison. For the intra-group comparison the non-parametric Wilcoxon's signed rank test was used for the categorical variables and the parametric two-sample paired t-test was used for the continuous variables.

From the results of this analysis it was revealed that both groups showed a subjective, statistically significant improvement as a result of their respective treatments but that only Group A continued to show subjective, statistically significant differences during the one-month follow-up period.

Objectively, Group A - CMT appeared to show a significant statistical improvement during the treatment period as well as over the one-month follow-up period although the inter-group comparisons of the Algometer readings (objective data) showed no statistically significant difference between the two groups.

Clinically, the analysis of the subjective data at various stages showed that Group A appeared to respond more effectively than Group B. At other stages Group B appeared to respond more effectively than did Group A. Group A also showed a positive clinical response in terms of the objective data.

It can be noted that objectively and clinically CMT appears to be a reliable intervention in the treatment of plantar fasciitis but that CMT of the foot and ankle joints appears to be no more effective than placebo in the treatment of plantar fasciitis.

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CHAPTER ONE - INTRODUCTION

Plantar fasciitis, also called 'the painful heel syndrome', was first described by Wood in 1812 (Leach et al. 1986:156) although at the time he thought that it was caused by tuberculosis. Although it is a well-documented overuse injury, resulting in the inflammation of the plantar fascia of the foot, there is still a wide consensus of opinion with regard to the anatomical features, signs and symptoms, underlying disease process and the natural evolution of this condition (Crawford et al. 1997; Ambrosius and Kondracki 1992).

The history of chiropractic management of the foot dates back to the beginning of the twentieth century with chiropractic's founder, D.D. Palmer, firmly believing that chiropractic adjustive techniques could have profound effects in the treatment of foot disorders (Brantingham et al. 1992:75; Keating et al. 1992:92). In a retrospective review of plantar fasciitis patients treated with manipulation, Brantingham et al. (1992), concluded that plantar fasciitis can be effectively treated by chiropractors.

In fact biomechanical factors are well presented in the literature as possible causes of plantar fasciitis (Ambrosius and Kondracki 1992). Most authors believe that minor anatomical and biomechanical abnormalities within the foot can produce plantar fasciitis, especially during demanding activities (Brody 1980; Brantingham et al. 1992).

Although the idea of biomechanical factors being involved in the aetiology of plantar fasciitis has been widely discussed, no conclusive study has yet been conducted in this regard. Most authors agree upon a conservative approach to the treatment of plantar fasciitis but there is a lack of conclusive evidence with respect to the most effective treatment protocol. In fact only two controlled, randomised studies have been conducted into the treatment of painful heel

syndromes. One investigated the effects of ultrasound and the other of corticosteroid injections on this condition. Neither trial found any evidence of therapeutic benefits. (Crawford et al. 1997.)

As there is so little conclusive evidence with respect to the treatment of plantar fasciitis, the aim of this study is therefore to conduct a controlled, randomised investigation into the efficacy of chiropractic manipulative therapy of the foot in the treatment of plantar fasciitis with a view towards developing a researched alternative treatment method for this condition.

CHAPTER TWO - REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

Plantar fasciitis or painful heel syndrome is a common condition affecting the general population (Brown 1996). It typically presents as pain felt under the heel and is often termed a calcaneal spur (Cailliet 1997:181). Plantar fasciitis can present as both an acute or a chronic disorder (Batt and Tanji 1995) but little is known and much controversy exists about the underlying disease process and the natural evolution of this condition (Crawford et al. 1997).

It is a time consuming, difficult condition to treat and is often resistant to the usual therapies (Reid 1992:200). Both Reid (1992) and Tanner and Harvey (1988) advocate the use of a conservative approach in the management of this condition but resolution is usually prolonged (Brown 1996:885). According to Nicholas and Hershman (1995) the entire process takes between six and twelve weeks with the key to the effective treatment of plantar fasciitis being that of patience.

2.2 ANATOMY AND BIOMECHANICS

The plantar fascia, a continuation of the plantaris tendon (Cailliet 1997:33), is a broad band of longitudinally arranged collagen fibres that is part of the deep fascia of the foot (Brown 1996:876; Donatelli 1996:24). The plantar fascia originates from the medial tuberosity of the calcaneus and is composed of three parts, a medial, a lateral and a central part (Cailliet 1997:33; Brown 1996:876; Donatelli 1996:24). Proximally, the plantar fascia is at its narrowest but thickest (Brown 1996:876). As it passes distally the three parts divide to form five tracts.

Each tract is composed of a superficial and a deep portion. The superficial portions act to anchor the skin and the deep portions continue distally to insert into the proximal phalanges of the toes. (Cailliet 1997:33; Brown 1996:876).

The plantar fascia's functions are to give attachment to the overlying skin and to protect the underlying structures (Ambrosius and Kondracki 1992:30). It also plays a significant role in the normal biomechanics of the foot and ankle as its design allows it to absorb and direct the forces that are occurring during the gait cycle (Brown 1996:876). The normal biomechanics of the foot during the gait cycle starts at heel strike with the foot in slight supination. The foot then moves into pronation for foot flat and midstance. (Ambrosius and Kondracki 1992:32.) As the metatarsophalangeal joints become dorsiflexed prior to toe-off, a windlass tightening effect of the plantar fascia occurs (Cailliet 1997:182). This causes the foot to supinate once again, stabilising the foot for toe-off (Brown 1996:876). It can be seen that supination occurs to lock the foot allowing for stabilisation at heel strike and toe-off and pronation occurs to unlock the foot allowing for surface adaptation and shock absorption (Ambrosius and Kondracki 1992:32).

2.3 PREVALENCE

Plantar fasciitis is a common condition (Brown 1996:876; Batt and Tanji 1995:77; Nicholas and Hershman 1995:452; Wolgin et al. 1994:97; Brantingham et al. 1992:75). It is a well-documented overuse injury (Ambrosius and Kondracki 1992:29; Kibler et al. 1991:66; Tanner and Harvey 1988:39) estimated to affect 10% of the general population (D'Maio et al. 1993:137).

It is particularly prevalent in runners and athletes especially those who participate in sports that require running and jumping such as running, jogging, tennis, squash, soccer and gymnastics

(Batt and Tanji 1995:77; Nicholas and Hershman 1995:452; Reid 1992:196; Tanner and Harvey 1988:39). Plantar fasciitis is thought to be the fourth most common overuse injury of the lower limb presenting at sport's clinics worldwide (Leach et al. 1986:156). According to Brody (1980) and D'Maio et al. (1993) it accounts for between 8.5 and 10% of all presenting injuries. The large number of people affected by this condition appears to be related to the large number of people indulging in these sports. This prevalence is expected to rise as people's awareness of sports and fitness increases. (Ambrosius and Kondracki 1992:29.)

According to Cailliet (1997) and Ambrosius and Kondracki (1992) plantar fasciitis can also be occupationally related and can occur in people whose activities involve prolonged standing or walking, for example, 'Policeman's heel'.

Brown (1996) states that two separate groups of heel pain sufferers are likely to present to practitioners. Firstly the athlete with overuse injuries and secondly the non-athletic older generation of plantar fasciitis sufferers. Wolgin et al. (1994), Ambrosius and Kondracki (1992) and Reid (1992) agree with Brown (1996) when he goes on to state that plantar fasciitis is more common in people over the age of forty.

Plantar fasciitis affects both sexes (Klenerman 1991:100) but whereas Brown (1996) states that the majority of plantar fasciitis patients are women, Cailliet (1997) and Ambrosius and Kondracki (1992) disagree, stating that it is more common in males than in females. Ambrosius and Kondracki (1992) state that this may be due to the possibility that there are more male athletes than female or that it may be a reflection of the populations previously studied.

2.4 AETIOLOGY

The exact cause of the condition is still uncertain although many theories have been proposed. The majority of these theories can be divided into three groups; environmental, anatomical and biomechanical. (Wolgin et al. 1994:97; Ambrosius and Kondracki 1992:29.)

2.4.1 Environmental

This can be training related, in the athlete or occupationally related in the athlete and the non-athlete (Ambrosius and Kondracki 1992:29; Kibler et al. 1991:67). In the athlete it is estimated that 60% of all overuse injuries occur as a result of training errors, usually 'too much, too soon'. This happens with a sudden increase in either intensity or duration of exercise. The athlete has either rapidly increased their mileage or suddenly implemented steep-hill running into their training schedule. (Ambrosius and Kondracki 1992:34.) The training error may have to do with the athlete's equipment. Faulty or ill-fitting footwear may be a cause of plantar fasciitis. This involves factors such as inadequate heel counters, poor arch supports and a lack of flexibility of the shoes. (Ambrosius and Kondracki 1992:34; Kibler et al. 1991:67.)

Occupations that depend upon the employee standing or walking for prolonged periods could also cause plantar fasciitis. This has led to such terms as the 'Policeman's heel'. (Ambrosius and Kondracki 1992:29.)

2.4.2 Anatomical

Various anatomical abnormalities have been noted in plantar fasciitis patients. These include, excessively high arched feet or pes cavus, flat feet or pes planus, tight Achilles tendons and leg length discrepancies. It is postulated that these conditions although of no significance whilst

walking, could result in plantar fasciitis during running or during other demanding activities.

(Ambrosius and Kondracki 1992:33.)

A controversy exists over the possible role of body weight as a cause of plantar fasciitis. It appears that it is of little significance in athletes but in the non-athlete being overweight may be a factor. (Ambrosius and Kondracki 1992:35; Kibler et al. 1991:67.)

A deficiency of vitamin D, leading to osteomalacia may predispose people to plantar fasciitis. It causes weakness of the muscles of the foot and softening of the bones. This can lead to excessive strain being placed on the plantar fascia resulting in a traction injury to it. (Ambrosius and Kondracki 1992:35.)

Sero-negative arthritides, particularly Ankylosing Spondylitis, Psoriatic Arthritis and Reiter's Syndrome as well as Rheumatoid Arthritis and Gout have all been linked to plantar fasciitis (Batt and Tanji 1995:78; Ambrosius and Kondracki 1992:31; Bateman 1991:1380; Tanner and Harvey 1988:42). All of these conditions can have as their initial symptom that of plantar heel pain. In most instances however, the general nature of the disorder is apparent, with lesions occurring elsewhere prior to the heel lesion. In general, young patients that present with bilateral heel pain should be assessed with the possibility of a general systemic disorder in mind. It is important that a correct diagnosis is attained, as these conditions require specific treatment regimes. (Bateman 1991:1380.) Blood tests for the erythrocyte sedimentation rate, rheumatoid factor and uric acid levels are necessary to accurately diagnose these conditions (Brown 1996:879; Tanner and Harvey 1988:42).

2.4.3 Biomechanical

The consideration of biomechanical factors as an aetiology of plantar fasciitis is well presented in the literature with most authors placing great importance on it, even though there is no conclusive evidence. The reason why biomechanical factors have such strong support is based upon the functioning of the plantar fascia during the normal gait cycle. According to Ambrosius and Kondracki (1992) any abnormal biomechanics that result in prolonged pronation can cause the load forces that occur during gait to be imposed upon the ligaments and joints instead of upon the rigid, bony structures. They state that the plantar fascia is therefore subjected to greater forces than those to which it is normally exposed. Brantingham et al. (1992) agreed, stating that hypomobile, dysfunctional foot and ankle joints appear to play a role in the pain and pathology of plantar fasciitis.

A study performed by Kibler et al. (1991) examined the strength and flexibility of the foot and ankle muscles, responsible for controlling the forces occurring within the foot and ankle during stance and push-off, when put under tensile loading during running. People suffering with plantar fasciitis showed a high incidence of plantar flexor muscle strength deficits as well as a high incidence of dorsiflexion range of motion deficits. As only a relatively small percentage of affected athletes showed anatomical hyperpronation, Kibler et al. (1991) postulated that these strength and flexibility deficits become a weak link between the posterior calf, ankle and foot. Tightened posterior calf musculature results in decreased flexibility of the foot and ankle and keeps the heel in a valgus position at heel strike and push-off. This then causes a restriction in mid-foot supination and ankle dorsiflexion. A weakness within the plantar flexor muscles results in a decrease in the propulsion force at push-off. This causes an increase in tensile loading of the foot and ankle muscles and ligaments at their attachments and particularly, during prolonged activity, can result in more tensile strain being placed upon the plantar fascia.

Whether these deficits are the primary cause of plantar fasciitis or are a contributing factor to the condition or are possibly secondary effects of plantar fasciitis is unclear. However, when added to other factors, they can become pathological and result in the clinical presentation of plantar fasciitis. (Kibler et al. 1991:69.)

In all probability, plantar fasciitis is multifactorial in aetiology (Kibler et al. 1991:70). Ambrosius and Kondracki (1992) concluded that plantar fasciitis occurs in susceptible individuals, these being people who have a predisposition to plantar fasciitis due to biomechanical malfunction, training errors, faulty footwear, obesity, certain systemic or metabolic disorders or any combination of the above.

2.5 PATHOLOGY

The characteristic lesion of plantar fasciitis is an enthesitis, namely inflammation at the bone-ligament or fascial interface (Batt and Tanji 1995:78).

Repetitive microtrauma to the plantar fascia produces micro-tears near the plantar fascia's attachment to the medial calcaneal tubercle (Ambrosius and Kondracki 1992:30). These tears, as well as the healing process initiated by the body, result in inflammation (Ambrosius and Kondracki 1992:30; Brantingham et al. 1992:75). Periostitis occurs with possible subperiosteal bone proliferation or spur formation. Inflammation of the overlying bursa can occur too. (Brantingham et al. 1992:75.)

2.6 CLINICAL PRESENTATION

Patients with plantar fasciitis usually complain of unilateral heel or arch pain (Reid 1992:196; Tanner and Harvey 1988:40). The pain has been described as a pinpoint, knifelike pain (Kibler et al. 1991:66), a sharp, dull, constant or intermittent pain (Wolgin et al. 1994:97) or like a 'stone bruise' at the heel, similar to the pain experienced from treading on a sharp stone (Ambrosius and Kondracki 1992:30).

Brown (1996) states that the pain is hard to localise. It is typically felt on the plantar aspect of the heel pad, at the site of the insertion of the plantar fascia onto the medial calcaneal tubercle (Batt and Tanji 1995:78; Kibler et al. 1991:66).

The pain of plantar fasciitis is insidious in onset (Brown 1996:877; Batt and Tanji 1995:78; Wolgin et al. 1994:97; Tanner and Harvey 1988:40) and develops for no obvious reason (Batt and Tanji 1995:78; Klenerman 1991:100). At first the symptoms are noticed only with activity (Kibler et al. 1991:66; Noakes and Granger 1990:132). The pain then becomes noticeable during initial weight bearing when getting out of bed in the morning or when rising after sitting (Wolgin et al. 1994:97; Kibler et al. 1991:66; Noakes and Granger 1990:132). Kibler et al. (1991) state that this phenomenon is probably due to the plantar fascia becoming cold and contracted during periods of rest. The patient may limp or hobble with the first initial steps upon rising (Klenerman 1991:100; Noakes and Granger 1990:132) but gradual improvement occurs with warm-up and use (Reid 1992:196; Kibler et al. 1991:66). After this initial improvement there is gradual deterioration so that the pain worsens again towards the end of the day (Brown 1996:877; Wolgin et al. 1994:66).

In the athlete, the pain is usually severe at the onset of running but most athletes find that they can 'run through the pain' with it becoming bearable after a few minutes. The pain normally recurs, gradually intensifying either later during exercise or post-exercise. (Ambrosius and Kondracki 1992:30; Tanner and Harvey 1988:40.)

The pain can become severe enough to affect gait and stride patterns causing the patient to bear weight on the lateral aspect of the foot (Ambrosius and Kondracki 1992:31; Reid 1992:196; Tanner and Harvey 1988:40) and eventually resulting in a permanent limp (Reid 1992:196; Tanner and Harvey 1988:40).

With continuation of the problem the pain can become constant, even present at rest and can interfere with daily living activities (Reid 1992:196; Tanner and Harvey 1988:40). The pain may now be experienced more distally, along the medial aspect of the plantar fascia (Batt and Tanji 1995:79; Ambrosius and Kondracki 1992:30). This arch pain is typically burning in nature (Batt and Tanji 1995:79; Tanner and Harvey 1988:40).

A rapid onset of pain usually follows a history of trauma and occurs as a result of a complete or partial rupture of the fascia (Brown 1996:877; Batt and Tanji 1995:80). This condition is viewed as separate to actual plantar fasciitis and is discussed further under differential diagnoses.

Plantar fasciitis is a clinical diagnosis (Batt and Tanji 1995:78-79). On inspection the foot appears normal and there is no visible change (Klenerman 1991:100). On examination though, an exquisite area of local tenderness is found on firm palpation just over and slightly distal to the medial calcaneal tubercle (Batt and Tanji 1995:78-79; Reid 1992:196; Klenerman 1991:100; Tanner and Harvey 1988:40). Diffuse tenderness may exist along the entire medial plantar

aspect of the foot, over the rest of the heel and the plantar fascia. There is usually considerable discomfort on weight bearing. (Batt and Tanji 1995:196; Reid 1992:78-79; Tanner and Harvey 1988:40.) Passive dorsiflexion of the toes exacerbates the pain at the insertion site of the plantar fascia as does walking or hopping on the toes (Brown 1996:878; Batt and Tanji 1995:79; Ambrosius and Kondracki 1992:31; Reid 1992:196; Tanner and Harvey 1988:40).

2.7 DIFFERENTIAL DIAGNOSES

Subcalcaneal heel pain is a common manifestation of many conditions. Those other than plantar fasciitis need to be excluded prior to commencing treatment. (Reid 1992:197.)

2.7.1 Tarsal Tunnel Syndrome

This is the entrapment of the posterior tibial nerve, or one of its three branches, within the fibro-osseous tarsal tunnel, posterior to the medial malleolus of the tibia and is analogous to the carpal tunnel syndrome of the hand and wrist (Batt and Tanji 1995:80; Nicholas and Hershman 1995:452-453). The symptoms of this condition are usually described as burning dysaesthesias on the plantar aspect of the foot, in the distribution of the affected nerve. The pain is typically aggravated by exercise and nocturnal pain may be experienced. Sensory changes and later motor weakness and atrophy may be seen. For diagnosis of this condition a positive Tinel's sign is noted over the tarsal tunnel. Electromyographic and nerve conduction tests can be performed. (Batt and Tanji 1995:80; Nicholas and Hershman 1995:452-453; Tanner and Harvey 1988:42.)

2.7.2 Calcaneal Bursitis

This is a common overuse disorder that occurs as a result of inflammation of the bursa that lies between the calcaneus and the heel fat pad. The pain is described as a mild posterior heel pain.

Upon examination of the area, the posterior superior calcaneal tuberosity may appear swollen, erythematous and show tenderness to palpation. (Cailliet 1997:194.)

2.7.3 Calcaneal Stress Fractures

This condition is often overlooked so it's true frequency is difficult to assess. It is typically seen in ballet dancers, jumpers and runners, particularly those runners who maintain a high weekly mileage or who have had a sudden increase in their mileage. (Batt and Tanji 1995:80; Reid 1992:194.) The condition is described as a diffuse pain over the entire heel and is not localised only to the plantar aspect of the heel as is the case in plantar fasciitis (Pfeffer and Baxter 1991:1398). Typically the pain worsens with activity, unlike that of plantar fasciitis but for an accurate diagnosis to be made either a lateral x-ray of the foot or a bone scan can be performed (Reid 1992:194; Pfeffer and Baxter 1991:1398).

2.7.4 Fat Pad Syndrome or Painful Heel Pad Syndrome

This condition mimics plantar fasciitis with respect to the presence of pain upon rising, especially initial weight bearing when getting out of bed in the morning. Pain is felt over the entire heel pad area, which, unlike plantar fasciitis, worsens with activity as well as with walking barefoot. It occurs as a result of thinning of the fat pad on the plantar aspect of the calcaneus. (Reid 1992:194; Pfeffer and Baxter 1991:1397.) Contributing factors include excessive body weight, poorly cushioned shoes and excessive or suddenly altered training methods in the athlete. A diagnosis is reached on clinical examination. Soft, flattened heel pads will be noted upon examination. Compression to the central portion of the heel by the examiner will reproduce the patient's pain. There is no radiation of the pain and the plantar fascia is not tender. (Cailliet 1997:187; Pfeffer and Baxter 1991:1397.)

2.7.5 Calcaneal Apophysitis or Sever's Disease.

This painful condition occurs in children prior to closure of the epiphyses and is most common in active males between the age of eight and thirteen years. Stress is placed on the Achilles tendon as a result of excessive trauma occurring from jumping activities. A diagnosis is reached clinically, taking into consideration the age of the patient and the presence of pain and tenderness at the back of the heel below the attachment of the Achilles' tendon. There may be swelling and redness over this area. The condition is usually unilateral. It is often aggravated by standing on tiptoe or by jumping. In the early phase, x-rays are non-diagnostic but the inflammation site is usually revealed by bone scanning. (Cailliet 1997:194.)

2.7.6 First Sacral Nerve Radiculopathy

Entrapment or injury to the first sacral nerve root at the spinal level, as the nerve emerges from the spinal cord, can occur due to disc herniation, tumor formation or spondylolisthesis. As the first sacral nerve innervates the plantar aspect of the foot, injury or compression at that level can result in radicular pain in the dermatomal distribution of the nerve, in this case the plantar aspect of the heel. Accurate diagnosis relies upon a comprehensive examination of the lumbar-sacral spine as well as the utilisation of x-rays, CT scans, MRI's and myelograms. (Cailliet 1997:222-223.)

2.7.7 Complete Rupture of the Plantar Fascia

This is an uncommon occurrence but appears to happen more frequently in patients who have previously had steroid injections into the heel (Batt and Tanji 1995:80; Tanner and Harvey 1988:42; Leach et al. 1978:538). It is an acute event, with a rapid onset of pain; usually associated with the patient hearing a 'pop' or sensing a 'snap' on the plantar aspect of the foot (Batt and Tanji 1995:80; Nicholas and Hershman 1995:452; Tanner and Harvey 1988:42). The

rupture usually follows an intense running or jumping activity (Leach et al. 1978:438). Swelling of the medial aspect of the foot and subsequent bruising occurs. Later, as the swelling reduces, it may be possible to detect upon palpation a firm, painful, nodule or an obvious defect on the plantar aspect of the foot. (Batt and Tanji 1995:80; Nicholas and Harvey 1995:452; Tanner and Harvey 1988:42; Leach et al. 1978:438.)

2.7.8 Co-existent Systemic Disorders

The sero-negative arthritides, such as Reiter's Syndrome, Ankylosing Spondylitis and Psoriatic Arthritis, as well as Rheumatoid Arthritis and Gout, can all cause plantar fasciitis. They should therefore be considered as aetiologies and not differential diagnoses. (Ambrosius and Kondracki 1992:35.)

2.7.9 Calcaneal or Heel Spurs

The pain that occurs with plantar fasciitis is often mistakenly attributed to the presence of calcaneal or heel spurs. Much has been discussed within the literature and from that it appears that the presence of spurs is not usually the cause of the pain but can contribute to it. Reid (1992) states that between 10 and 30% of the asymptomatic population have heel spurs and of those patients who have painful heels, only 75% show the presence of calcaneal spurs. Most authors agree that the presence of calcaneal spurs is due to a traction enthesiopathy occurring as a result of mechanical stresses applied via the plantar fascia's attachment at its origin on the medial tubercle of the calcaneus resulting in the formation of a traction spur (Nicholas and Hershman 1995:453; Ambrosius and Kondracki 1992:38; Reid 1992:196). Both Batt and Tanji (1995) and Reid (1992) state that a large downward-pointing spur, often seen in association with conditions such as Ankylosing Spondylitis, Reiter's Syndrome, Rheumatoid Arthritis and Gout,

may be the primary source of pain. In these cases the spur usually appears different, looking larger and fluffy as opposed to the usual, smaller looking traction spur.

2.8 DIAGNOSTIC TESTING

The role of radiographic imaging in the evaluation of plantar fasciitis is controversial. If x-rays are performed, they may appear normal especially in the early stages. Later they may show the occurrence of 'fluffy' changes at the enthesis. (Batt and Tanji 1995:79.) X-rays may confirm the presence of calcification, a calcaneal spur, projecting from the calcaneus in the area of the plantar fascia attachment but as heel spurs also occur in asymptomatic patients their presence may not be helpful in the assessment. Bone scans, although not routine, may show inflammatory abnormalities at the plantar fascia insertion site and can be useful in the diagnosis of difficult cases. (Brown 1996:878-879; Tanner and Harvey 1988:40-41.)

2.9 TREATMENT

In the management of plantar fasciitis it is important to recognise that this condition can be a short lived inflammatory condition or can develop into a more chronic lesion (Batt and Tanji 1995:83).

2.9.1 Conservative Treatment

Most authors agree that the majority of cases respond to conservative management, particularly acute (seen within the first six weeks), uncomplicated cases (Batt and Tanji 1995:83; Wolgin *et al.* 1994:102; Ambrosius and Kondracki 1992:36). Authors also agree that relative rest plays an important role in the effectiveness of the treatment programme (Batt and Tanji 1995:83;

Nicholas and Hershman 1995:453; Tanner and Harvey 1988:42). Brantingham et al. (1992) state that all excessive weight bearing activities should be limited during the treatment period. Athletes should decrease their mileage by 25 to 75% (Reid 1992:197; Tanner and Harvey 1988:42). They should avoid uphill running and keep sprinting or speedwork to a minimum (Noakes and Granger 1990:133; Tanner and Harvey 1988:42). This means that the athlete will have significant time lost from training and competitions (Ambrosius and Kondracki 1992:36). Therefore it is important that they maintain their conditioning, particularly their cardiovascular fitness, through non-weight bearing activities. The most effective ways to achieve this being either water or pool running and cycling. (Nicholas and Hershman 1995:453; Reid 1992:197; Tanner and Harvey 1988:42,44.)

Initial treatment focuses on the pain and inflammation associated with this condition (Batt and Tanji 1995:83). This includes the use of cryotherapy, ultrasound and anti-inflammatories (Batt and Tanji 1995:83; Brantingham et al. 1992:81; Reid 1992:197; Kibler et al. 1991:67).

Cryotherapy involves vigorous ice massage to the area of tenderness (Tanner and Harvey 1988:42). Nicholas and Hershman (1995) recommend this to be performed three times a day for ten to twelve minutes and Tanner and Harvey (1988) recommend that the athlete use ice massage for twenty to forty minutes after a workout.

Ultrasound may be helpful in the conservative approach to treatment of plantar fasciitis (Ambrosius and Kondracki 1992:35). Brantingham et al. (1992) advocated its use, followed by ice massage, to reduce the pain and inflammation of the condition.

Leach et al. (1986) however reported mixed results from the use of ultrasound and believed that it may actually be harmful in treating plantar fasciitis. A randomised, controlled trial conducted by

Crawford and Snaith (1996) found no evidence of any therapeutic benefits from the use of ultrasound (the machine was calibrated to deliver a dose of ultrasound at 0.5 w/cm², 3 MHz, pulsed 1:4) in the treatment of painful heels.

Anti-inflammatory drugs are used for pain relief and inflammatory control. Tanner and Harvey (1988) recommend a seven to ten day course of either aspirin or other non-steroidal anti-inflammatories.

Treatment focusing on the countering of any inciting factors must be considered. Athletes should consider a change, if they have been training on a hard surface, to one that is softer (Tanner and Harvey 1988:44). The use of appropriate footwear, for both everyday activities and for sport, is also important. In general a patient's shoes should have firm heel counters, good heel cushioning, adequate longitudinal arch support, loose fitting toe-boxes and their shoes should not be worn out. (Ryan 1995:895; Reid 1992:198; Tanner and Harvey 1988:44.) Athletes can purchase antipronatory shoes that should be flexible at the ball of the foot but not in the middle of the arch (Batt and Tanji 1995:83).

Foot orthotics can be beneficial in the management of this condition (Brantingham et al. 1992:82). Batt and Tanji (1995) advocated the use of heel orthoses or heel lifts, a simple heel cushion, that can provide weight redistribution and shock absorption at heel strike. According to Ryan (1995) these heel pads may be of greatest benefit to the older patients, as the fat pad tends to become thinner with age. They may also benefit those patients who stand on hard surfaces for extended periods. Batt and Tanji (1995) state that the heel lift reduces the tightness within the triceps surae. This tightness can cause hindfoot valgus at heel strike, increasing stress on the supporting structures of the foot. Leach et al. (1986) advocated the use of heel

cups or the 'UC-BL' shoe insert, stating that ordinary arch supports are less effective due to their 'bow-stringing' effect. However Brantingham et al. (1992) and Batt and Tanji (1995) state that patients with adverse foot biomechanics, especially hyperpronation, may benefit from the use of full orthoses. Brantingham et al. (1992) state that orthotics restore optimal foot alignments and support the plantar tissue. Reid (1992) adds that orthotic devices reduce abnormal compensation that results from pain or basic alignment problems of the foot. He states that orthotic devices can reduce the point pressure over the tender spots on the plantar aspect of the foot, contain the calcaneal fat pad so as to increase its shock absorbing capabilities, raise the longitudinal arch to reduce the stresses occurring within it and to provide supplemental shock absorbing facilities to shoes.

There are three main kinds of orthotics. Rigid orthotics that are non-accommodating, contain the heel and reduce excessive pronation. These are necessary with marked forefoot deformities but can be painful to wear in some patients. Semi-rigid orthoses are semi-accommodative and easy to modify but still maintain the foot in subtalar neutral. Soft orthoses or supports are accommodative and are useful in patients with severe pain such as with painful degenerative joint disease of the foot. (Brantingham et al. 1992:82.)

Taping of the foot is advocated by Brantingham et al. (1992), Reid (1992) and Tanner and Harvey (1988). The method of choice is that of the modified 'low-dye' procedure, using one-inch tape (MacDonald 1994:28). This method stabilises the head of the first metatarsal during plantarflexion of the foot and decreases pronation (Tanner and Harvey 1988:44). Tanner and Harvey (1988) recommend continuous taping for three to four days. Reid (1992) states that care should be taken when applying the tape so as to avoid skin breakdown with repeated applications. It is for this reason that Brantingham et al. (1992) advocate the use of underwrap.

Taping can be used experimentally, to see whether the patient would benefit from such support and as Brantingham et al. (1992) state, it can be used in the interim whilst waiting for orthotics to be made.

Ambrosius and Kondracki (1992) postulated that as the joints and ligaments of the foot are its shock absorbing mechanism, when the foot unlocks during pronation, fixations in the joints of the foot and ankle could subject other tissues in the area, and hence the plantar fascia, to excessive strain. As Brantingham et al. (1992) state, hypomobile joints do not adequately absorb weight bearing stresses. These stresses can shift to the soft tissues resulting in microtrauma, inflammation and fibrotic tissue formation in these tissues. In a retrospective study performed by Brantingham et al. (1992) twenty-nine patients' files (sixteen women and thirteen men), who were managed and treated for plantar fasciitis by two of the authors over a three year period, were reviewed. All twenty-nine patients had evidence of joint dysfunction within the foot and ankle joints. Restrictions in joint motion and joint dysfunction were detected with motion palpation as set out by Schafer and Faye (1990). Manipulation and mobilisation of the affected joints were used to restore joint play and motion. They performed this in conjunction with the use of soft tissue manipulation or massage, physiotherapy modalities and orthotics and found that the majority of the patients reported a significant reduction of pain in an average of eight treatments. They concluded that plantar fasciitis could adequately be treated by chiropractors. Brantingham et al. (1992) made no mention of average length or chronicity of the sample group's condition prior to commencement of treatment by the above mentioned two authors. Adequate rehabilitation is essential in the management of plantar fasciitis and should commence as soon as the acute symptoms of pain and inflammation have subsided. This time period may vary from a few days to a few weeks. Initially the rehabilitation focuses on the stretching of the Achilles tendon, the triceps surae and the plantar fascia. The importance of this stretching

programme must be emphasised, especially to those patients who are athletes. As soon as the patient can tolerate it, the muscles of the posterior calf and the intrinsic muscles of the foot need to be strengthened. This should occur initially through isometric and then later through isotonic training methods. (Batt and Tanji 1995:83; Ryan 1995:895.) These stretching and strengthening programmes reduce the weakness and inflexibility of the posterior calf, ankle and foot, helping to keep the foot in its normal position during gait, thereby reducing strain on the plantar fascia. A balance or wobble board can be used to help improve proprioception which may decrease the likelihood of future injury. (Ryan 1995:895.)

The athlete should avoid the temptation to return to vigorous activity too soon as this can cause an acute situation to develop into a chronic disability. Activity can be resumed with the loss of tenderness over the plantar fascia, the loss of morning stiffness and the loss of pain upon weight bearing. (Nicholas and Hershman 1995:453.)

If significant pain is not alleviated after initial interventions, a night splint can be made and worn (Ryan 1995:897). Whether the patient lies supine or prone whilst sleeping, the foot adopts a plantarflexed position. In this position the Achilles tendon and the plantar fascia are relaxed and are allowed to contract during the night. Upon awakening the patient's first steps are painful as this tissue is stretched. (Batt and Tanji 1995:83; Wapner and Sharkey 1991:136.) The use of a molded night splint maintains the foot in a position of five degrees dorsiflexion (Wapner and Sharkey 1991:136). The patient is instructed to wear the splint upon retiring each evening so that, whilst sleeping, the Achilles tendon and the plantar fascia are prevented from stiffening and contracting (Ryan 1995:897; Wapner and Sharkey 1991:136). The splint is removed in the morning. Its use significantly reduces morning pain. (Batt and Tanji 1995:84.)

In a study performed by Wapner and Sharkey (1991) symptom intensity throughout the day was markedly decreased with the use of the night splint and complete resolution of symptoms occurred in less than four months. As symptoms resolve, the patient should be gradually weaned off the night splint by using it only on alternate nights (Batt and Tanji 1995:84). Ryan (1995) states that rehabilitation programmes should however be maintained whilst using the night splint. The night splint offers a low risk, low cost alternative to invasive therapies such as injections and surgery (Ryan 1995:897; Wapner and Sharkey 1991:136).

In the conservative treatment of plantar fasciitis Nicholas and Hershman (1995) state that the key to the resolution of plantar fasciitis is patience as the entire process may take from six to twelve weeks. Ambrosius and Kondracki (1992) state that the average recovery time was six weeks but that it could persist for three to six months. In a follow-up survey conducted by Wolgin et al. (1994) in which they tried to determine the natural history of the condition when being treated conservatively, they found that of the one hundred patients who were followed up for an average of forty-seven weeks, 82% of the patients had complete resolution of their symptoms. Those patients who had a higher risk of continued pain were those who were overweight, those with bilateral symptoms and those with a prolonged duration of symptoms (> six months) before they sought medical attention.

2.9.2 Steroid Injection

If conservative treatment fails then the use of steroid injections is usually the next step taken (Batt and Tanji 1995:84; Nicholas and Hershman 1995:453; Ambrosius and Kondracki 1992:37). A mixture of cortisone and local anaesthetic is injected into the area of maximal tenderness (Ambrosius and Kondracki 1992:37). Batt and Tanji (1995) suggest injection from either the

medial or the lateral side of the heel. Brown (1996) and Nicholas and Hershman (1995) both suggest injection from the medial side with Ryan (1995) advising the medial approach, as it is better tolerated by the patient. Care should be taken to avoid injecting into the plantar fat pad as there is a risk that steroids injected into the heel pad may result in heel pad atrophy (Brown 1996:884; Batt and Tanji 1995:84; Nicholas and Hershman 1995:453). Brown (1996) states that the aim is to deposit the steroid deep into the plantar fascia itself but recommends no more than two to three injections to be given. Leach et al. (1978) believe that repeated steroid injection into the plantar fascia may have deleterious effects upon the collagen tissue leading to possible rupture of the plantar fascia and stated that such injections should be avoided, a point that was agreed with by Brown (1996). Reid (1992) however states that rupture of the plantar fascia is not a disastrous complication and that the symptoms of an acute rupture usually resolve within three to six weeks. Reid (1992) feels that the reservations against the use of cortisone injections are unwarranted.

2.9.3 Surgical Intervention

Chronic heel pain is time consuming and difficult to treat and is often not amenable to the usual therapies. In severe intractable plantar fasciitis, surgical intervention is a possible option. (Reid 1992:200.) Ambrosius and Kondracki (1992) state that surgery should be considered as a last resort, performed only when conservative treatment has failed. Surgical treatment is only needed in about 5 to 10% of patients with painful heel syndrome (Brown 1996:885; Tanner and Harvey 1988:47). Candidates for surgery are those patients who remain symptomatic for six to nine months, possibly up to one year, after initiation of conservative care (Nicholas and Hershman 1995:453; Noakes and Granger 1990:133; Tanner and Harvey 1988:47).

Guidelines, prior to embarking on a surgical solution, are given by Reid (1992).

- A correct diagnosis must have been established.
- The patient must have had adequate non-operative treatment.
- Adequate supporting diagnostic tests must have been performed such as a nerve conduction study, a bone scan and blood screens for systemic diseases.
- The clinician must have a familiarity with the detailed anatomy of the area and have made an appropriate choice of an incision site and decided upon the extent of dissection.
- The patient must have been given an understanding with regards to the recovery and in the case of the athlete, the fact that a full return to high performance activity may not be possible.

A number of surgical options have been used. The usual treatment is that of the release of the plantar fascia at its posterior attachment, a plantar fasciotomy, that can be partial or complete as well as the excision of heel spurs, if present. Possible neurolysis of the motor branch of the nerve to the digiti quinti may be performed, specifically if there is an indication that the inflammatory process has affected the nerve or if the symptoms may be related to the entrapment of this nerve. (Brown 1996:885; Nicholas and Hershman 1995:453; Reid 1992:200; Tanner and Harvey 1998:47.)

Post operative management is recommended and starts with two to three weeks of immobilisation with avoidance of weight bearing (Brown 1996:885). A return to activity must be gradual. In the athlete, running on land is prohibited for the first six weeks. Cycling and water-running can commence from the second week. Hill-work, stairs and jumping routines are

introduced on an alternate-day regime. Rehabilitation involves the implementation of a stretching and strengthening programme along with proprioceptive techniques. (Reid 1992:200.) The time required for full recovery following surgery is prolonged and additional treatment during this period may be required. Surgery may not be the final solution and is not without its problems (Brown 1996:885.) Success rates are placed between 60 and 100% (Brown 1996:885; Batt and Tanji 1995:86; Reid 1992:200). Some abnormalities of the foot can persist. Complete plantar releases can result in flattening of the longitudinal arch. Other complications of the surgery can be heel pad numbness, neuroma formation, deep vein thrombosis, infection, delayed wound healing and possible fractures to the os calcis particularly following vigorous excision of the heel spur. (Brown 1996:885.)

2.10 CONCLUSION

Although a relatively common condition, the exact nature of plantar fasciitis appears to be poorly understood. There is little conclusive evidence to substantiate most of the information currently known about this condition. Biomechanical factors appear to be considered of great importance in the aetiology of this condition but again, although well presented in the literature, this remains inconclusive. Most authors agree that the best approach to the treatment of plantar fasciitis is a conservative one. The disadvantage of this approach however is that the recovery period is rather slow. Although fixations within the foot and ankle joints can result in faulty biomechanics, possibly subjecting the plantar fascia to excessive strain, no research that focuses on the removal of these fixations by using chiropractic manipulation and mobilisation has as yet been performed.

CHAPTER THREE - MATERIALS AND METHODS

3.1 STUDY DESIGN AND PROTOCOL

3.1.1 The Object Of The Study

This study was designed as a prospective, randomised, placebo controlled study. It proposed to investigate the effects of chiropractic manipulative therapy of the foot and ankle in patients presenting with plantar fasciitis. Each of the two treatment groups, those patients who received chiropractic manipulative therapy (CMT) and those who received placebo or "sham" treatment, were first analysed for intra-group improvement. Once this had been achieved, an inter-group statistical analysis determined which of the two treatments, if any, was more effective. The object of this study was to establish the efficacy of chiropractic manipulative therapy on plantar fasciitis.

3.1.2 The Subjects

During the year 1999 extensive advertising was undertaken to acquire subjects for the study. Adverts were placed around campus and in local newspapers. The sample of patients was drawn from the greater Durban area to eliminate the possibility of poor compliance due to traveling or transport problems. All interested subjects were initially screened for their suitability for the study. This consisted of the presentation of heel pain on the plantar aspect of the foot, the availability of time and transport considerations. The sample size was set at thirty patients which was divided into two groups of fifteen by random allocation. The method of random allocation of patients was as follows. Thirty pieces of paper were taken. Fifteen pieces had the letters "CMT" written upon them and fifteen pieces had the letters "U/S" written upon them. All thirty pieces of paper were folded to prevent the words being visualised and were placed in a

box. After shaking the box, each paper was drawn individually and corresponded to a patient number from one to thirty. The word on the drawn piece of paper was recorded next to the corresponding patient number. After each paper was drawn, it was discarded and not replaced in the box. This ensured that each patient number had only one piece of paper assigned to it. Patients were allocated a number, starting at one, in the order in which they presented to the clinic. The patients that corresponded to the numbers that had the words "CMT" ascribed to them received chiropractic manipulative therapy and the patients that corresponded to the numbers that had the words "U/S" ascribed to them received placebo ultrasound. Patients that withdrew from the study were randomly replaced by new patients.

3.1.3 Inclusion And Exclusion Criteria

Patients that passed the initial screening were scheduled for a one and a half hour initial consultation. During this consultation a full case history (Appendix 1), physical examination (Appendix 2) and regional examination of the foot and ankle (Appendix 3) were completed.

Patients were diagnosed with plantar fasciitis if they had localised pain on the plantar aspect of the heel in the region of the medial calcaneal tubercle. For inclusion into the study, this pain had to be aggravated with at least three of the following:

- initial weight bearing upon rising, either when getting out of bed or standing up after being seated for a while
- passive dorsiflexion of the toes
- standing or walking on the toes
- firm palpation of the medial calcaneal tubercle on the affected side.

Patients that were excluded from the study were:

- younger than eighteen years of age
- receiving other treatment for heel pain or plantar fasciitis, whether it was medicinal or manual therapy
- people who were suffering from a systemic disease
- people who were pregnant or who suspected that they may be pregnant
- patients who fell ill during the study

X-rays were taken only if indicated after the initial consultation had been performed. Indications for x-raying the patients included a history of trauma to the foot or ankle or information regarding the possibility of the presence of fractures, systemic arthritides and tumors. The x-ray views taken were an antero-posterior, a lateral and a medial oblique view of the foot.

All subjects accepted onto the study had their diagnosed condition as well as the study procedure explained to them and were asked to complete an informed consent form (Appendix 4) prior to their initial treatment.

3.1.4 Interventions

All the patients were informed as to which treatment modality they would be receiving i.e. chiropractic manipulation or ultrasound. The experimental group received authentic treatment in the form of chiropractic manipulative therapy to the foot and ankle as specified by Kirk et al. (1991). Manipulation and mobilisation of the ankle mortise, subtalar, midtarsal and intermetatarsal joints were performed depending on the presence of restricted joint motion or dysfunction as detected by motion palpation of the foot and ankle joints.

The placebo group received a "sham" treatment in the form of detuned ultrasound. The timer of the ultrasound machine was set to five minutes but the intensity was set at zero prior to the treatment beginning so in this way the patients believed that they were actually receiving treatment. The patients lay supine with their feet in slight plantar flexion whilst the author applied placebo ultrasound to the plantar aspect of the heel, over the site of the pain, for five minutes.

In order to limit the number of variables in the study, neither group of patients were given other treatments or exercises to do at home. Both groups were instructed not to change their activities and to otherwise continue as they had been doing prior to their initial consultation.

Each patient was treated a maximum of nine times over a period of three weeks. This is in accordance with Brantingham et al. (1992) who reported a significant reduction of pain in patients with plantar fasciitis who were treated conservatively, including chiropractic manipulative therapy, in an average of eight treatments over an average period of three and a half weeks. Each patient was re-assessed at a follow-up consultation that took place one month after the final treatment session. If the patient was asymptomatic before the completion of all nine treatments, the investigator obtained the relevant objective and subjective data and the patients no longer received treatment. Should these patients have become symptomatic again within their initial three week treatment period then they would be entitled to receive their remaining treatments. No patients were treated during the interval between the final treatment session and the one month follow-up consultation.

3.1.5 Ethical Considerations

This research study was conducted in accordance with the standards of the Responsible Committee on Human Experimentation. Patients were informed beforehand that they would be

taking part in a research study. They were also informed that they had a fifty/fifty chance of receiving "sham" or placebo treatment. They were given a chance to withdraw from the study prior to it commencing and were informed that they could leave at any time during the study. As stated previously, each patient was asked to complete and sign an informed consent form (Appendix 4) prior to treatment commencing.

3.2 MEASUREMENTS AND OBSERVATIONS

3.2.1 The Location Of The Data

This study incorporated both primary and secondary data as defined below.

3.2.1.1 PRIMARY DATA

The primary data incorporated both the subjective and the objective findings.

a) The Subjective Findings

The short-form McGill Pain Questionnaire (SF - MPQ) (Appendix 5), the Numerical Pain Rating Scale - 101 (NRS - 101) (Appendix 6) and the Foot Function Index (FFI) (Appendix 7) were used in this study to record the patient response, through written communication, in a subjective manner. These questionnaires were completed prior to the treatment at both the first and final treatment sessions and again at the one month follow-up consultation.

b) The Objective Findings

The algometer or force gauge was used in this study to record the patient response in an objective manner. The algometer readings were taken prior to treatment at both the first and final treatment sessions and again at the one month follow-up consultation.

All consultations were conducted at the Technikon Natal Chiropractic Day Clinic and all treatments were conducted by the author.

3.2.1.2 THE SECONDARY DATA

Secondary data, containing information relevant to the research being conducted, was collected from journals, text books, the Internet and the CD - Medline facility at the Technikon Natal, Allan Pittendrigh Library. Literature that was unavailable there was located through the inter-library loan service.

Secondary data also included the information gained from the completed case history, physical examination and foot and ankle regional examination forms that are used at the Technikon Natal Chiropractic Day Clinic.

3.2.2 Measurement Methods

3.2.2.1 SUBJECTIVE MEASUREMENTS

a) The short-form McGill Pain Questionnaire (Appendix 5)

The short-form McGill Pain Questionnaire (SF-MPQ), used in this study, was derived from the McGill Pain Questionnaire (Melzack 1987). The SF-MPQ was used to gather information concerning the sensory, affective and overall intensity of the patient's pain. Its use, along with confirmation of its reliability, validity and consistency is provided by Melzack and Katz (1992). Melzack (1987) states that the SF-MPQ is sensitive to traditional clinical therapies and is capable of discriminating among different pain syndromes.

The SF-MPQ contains fifteen representative words or descriptors divided into two sections. Section one contains questions one to eleven and represents the sensory dimension of pain experienced. Section two contains questions thirteen to fifteen

and represents the affective dimension of pain experienced. Each word or descriptor is ranked on an intensity scale. None = 0, mild = 1, moderate = 2, severe = 3.

The sum of all the completed sections was calculated and was given as a percentage of the highest possible score that being forty-five. (Melzack 1987.)

b) The Numerical Pain Rating Scale - 101 (Appendix 6)

The Numerical Pain Rating Scale - 101 (NRS - 101) was based on the example set by Jensen et al. (1986). It was chosen for its ease of application when providing subjective information on the levels of pain as well as it's established validity and reliability (Jensen et al. 1986:125).

Patients were asked to rank their perceived level of maximum and minimum pain intensity, over the previous few days, on a numerical scale from 0 to 100. 0 represented one extreme, namely "no pain" and 100 represented the other extreme, namely "pain as bad as it could be". Scores were given as percentages and were used to monitor the patients progress.

c) The Foot Function Index (Appendix 7)

The Foot Function Index was used to provide subjective information as to the impact of the patient's pain on their normal daily activities. It is a validated and reliable scale for measuring foot pain, disability and activity restriction (Saag et al. 1996). Patients marked each of nine items along a ten centimeter visual analogue scale, anchored by "no pain" at one end of the scale and "worst pain imaginable" on the other end. The items were scored from 0 -10 and were then divided by the maximum total possible for all of the items that the patient had indicated were applicable. Any item that was marked "not applicable" was excluded from the study.

3.2.2.2 OBJECTIVE MEASUREMENTS

a) The Algometer

An algometer is a device that is used for the measurement of pain sensitivity caused by pressure. It is a force gauge that is attached to a metal rod fitted with a rubber disc that has a surface area of one centimeter squared (cm^2). (Fischer 1986.) According to Fischer (1987) the algometer has been proven to be adequate for quantification of tenderness in soft tissues as well as to quantitatively assess the reaction of a patient to different treatment modalities. The reliability of the use of the algometer between different investigators, occasions and sites has been established (Fischer 1986).

The algometer used in this study was a force dial (model fdk20) manufactured by Wagner instruments and supplied by Activator Methods Inc. (Appendix 8A, 8B and 8C) The procedure in which the pressure reading was taken by the researcher is as follows. The patients were first instructed as to how the algometer works and its function within the study. The area of maximum tenderness around the medial calcaneal tubercle of the affected foot was then located through palpation. A permanent marker was used to mark this point on the patient's skin. The algometer gauge was set to zero.

The rubber disc was then placed on this mark with the gauge facing away from the patient. The patients were instructed that the pressure applied would increase slowly and that they were to inform the author when they first began to sense pain produced by the pressure. This reading was recorded. It represented the patient's pressure-pain threshold, namely the minimum pressure that causes pain or discomfort.

Each time these readings were taken, the point of maximum tenderness was located by palpation and remarked. The patients were not informed as to what their readings were so as to prevent patient bias affecting the results.

3.2.3 Data Admissibility Criteria

The following were criteria that governed the admissibility of the data:

- Only data was collected from patients who, by satisfying all the conditions, were eligible for the study.
- Only data from the relevant questionnaires, that were completed under the supervision of the researcher, was accepted.
- Only objective data collected from reputable mechanical devices was used. This was the data collected from the algometer readings which was determined solely by the researcher.
- Only data obtained from references of high academic repute were used.

3.3 Statistical Analysis

3.3.1 Procedure One : Comparison Between Two Unpaired (independent) Samples

3.3.1.1 For Categorical Variables

The Mann-Whitney unpaired U-test will be used to compare two independent samples with respect to the categorical variables i.e. those variables that are measured in nominal or ordinal scales and include the FFI (Appendix 7). In each test, the null hypothesis states that there is no significant difference between groups one (CMT) and two (placebo) with respect to the variable in charge, at the $\alpha = 0.05$ level of significance. The alternative hypothesis states that there is a significant difference.

3.3.1.2 For Continuous Variables

The two-sample unpaired t-test will be used to compare the two independent samples with respect to the continuous variables and include the SF - MPQ, the NRS - 101 and the Algometer readings. In each test, the null hypothesis states that there is no significant difference between group one (CMT) and group two (placebo) with respect to the variable in charge, at the $\alpha = 0.05$ level of significance. The alternative hypothesis states that there is a significant difference.

3.3.1.3 Decision Rule

The null hypothesis is rejected at the α level of significance if $p < \alpha$ where p is the observed significance level or p -value. Otherwise, the null hypothesis is accepted at the same level.

3.3.2 Procedure Two : Comparison Between Two Related Samples Within Group One

3.3.2.1 For Categorical Variables

For the categorical variables, the Wilcoxon's signed rank tests will be used to compare results from related samples. In each test, the null hypothesis states that there is no significant improvement between the two related samples being compared, at the α level of significance. The alternative hypothesis states that there is a significant improvement.

3.3.2.2 For Continuous Variables

For the continuous variables, the two-sample paired t-test will be used to compare the results from the related samples. In each test, the null hypothesis states that there is no significant improvement between the two related samples being compared, at the α level of significance. The alternative hypothesis states that there is a significant improvement.

3.3.2.3 Decision Rule

The null hypothesis is rejected at the α level of significance if $p < \alpha$ where p is the observed significance level or p -value. Otherwise, the null hypothesis is accepted at the same level.

3.3.3 Procedure Three : Comparison Between Related Samples Within Group Two

Procedure Two is repeated within group two with the same decision rule.

3.3.4 Procedure Four : Summary Statistics

3.3.4.1 Means And Variances For Categorical Variables

Frequencies and percentages will be computed for categorical variables only.

3.3.4.2 Means And Variances For Continuous Variables

Averages and variances will be computed for continuous variables only and will be used for power analysis and the construction of barcharts. Power analysis will be done for continuous variables only.

3.3.5 Procedure Five

Visual summaries of the analytical findings will be given by the use of barcharts to compare groups one and two with respect to the continuous variables. Average (mean) readings will be used to construct barcharts.

3.3.6 Procedure Six

The power of each two-sample unpaired t-test will be computed using the following UCLA web site: <http://www.stat.ucla.edu/calculators/powercalc/normal>

Each test is two-sided and the variable involved is continuous.

3.3.7 Statistical Package

The data collected from the first, final and one month follow-up consultation will be collated on to spreadsheets. The information obtained from the data entry will be statistically analysed using the statistical package SPSS for data entry and analysis (SPSS Inc. 1999) at the Research Development Department of the Technikon Natal under the supervision of Dr G Worku.

CHAPTER FOUR - THE RESULTS

4.1 INTRODUCTION

The purpose of the results chapter is to present the findings obtained through the statistical analysis of the primary data. At the initial consultation (1), the final consultation (9) and the one month follow-up consultation (10) the patients were asked to complete three questionnaires. At the same consultations, readings were taken of the patients' sensitivity to pressure by means of an algometer. This primary data included the following measurement criteria:

Subjective Measurements

- The short-form McGill Pain Questionnaire (SF-MPQ)
- The Numerical Pain Rating Scale - 101 (NRS - 101)
- The Foot Function Index (FFI)

Objective Measurements

- The Algometer Readings (ALG.)

Once these recordings had been rated they were then collated onto a spreadsheet from which the data was statistically analysed. Both parametric and non-parametric tests were used for the statistical analysis of the data. For the continuous variables, namely the SF-MPQ, the NRS - 101 and the Algometer readings, the two-sample unpaired t-test and the two-sample paired t-test were used and in the case of the categorical variables, namely the FFI, the Mann-Whitney unpaired U test and the Wilcoxon's signed rank test were used. The null (H0) and alternate hypotheses (H1) were either rejected or accepted based on the statistical criteria for each

measurement parameter. In each test, the null hypothesis (H_0) states that there is no significant improvement between the two related samples being compared, at the α level of significance and the alternate hypothesis (H_1) states that there is a significant improvement at the α level of significance.

In addition, the power of the tests performed on the continuous variables in the study, was used to determine the sensitivity of those tests.

KEY FOR ABBREVIATIONS

S.D = Standard Deviation

S.E = Standard Error

4.2 DEMOGRAPHICAL DATA

The demographical data was collected from the pre-treatment questionnaires of both the Group A - CMT and the Group B - Placebo groups.

Table 1 : Demographical data; patient data.

	Group A - CMT	Group B - Placebo
Age of Patient	average: 44 years youngest: 21 years oldest: 64 years	average: 52 years youngest: 32 years oldest: 68 years
Gender Distribution		
Female	8	9
Male	7	6
Race Distribution		
Black	1	0
Coloured	0	0
Indian	2	2
White	12	13

Table 2 : Demographical data; patient history.

	Group A - CMT	Group B - Placebo
Length Of Condition At Commencement Of Research Programme	average: 15 months shortest: 0.25 months longest: 60 months	average: 20 months shortest: 1 month longest: 120 months
Side Affected		
Left Foot	8	6
Right Foot	7	8
Both Feet	0	1

4.3 The Non-parametric Mann-Whitney Unpaired U-test For Categorical Variables

This statistical method was used to compare results from two independent samples with respect to the categorical variable i.e. the FFI.

4.3.1 Subjective Data

Table 3 : Statistical results comparing the response to treatment of
Group A - CMT and Group B - Placebo after each consultation in terms of
subjective measurements.

	CONSULTATIONS	P - value
FFI	Initial A with Initial B	0.838
	Final A with Final B	0.744
	Follow-up A with Follow-up B	0.056

There was no statistically significant difference between the subjective data of Group A - CMT and Group B - Placebo at the initial, final or follow-up consultation, leading to the acceptance of the null hypothesis and indicating that the two groups were similar in terms of pain, disability and activity restriction at the initial, final and follow-up consultations.

4.4 The Parametric Two-sample Unpaired T-test For Continuous Variables

4.4.1 Subjective Data

Table 4 : Statistical results comparing Group A - CMT and Group B - Placebo in terms of subjective measurements from the initial consultation.

Group A - CMT				Group B - Placebo			
Initial Consultation				Initial Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SF - MPQ	35.800	18.948	4.892	0.211	28.000	14.051	3.628
NRS - 101	44.466	14.362	3.708	0.481	13.219	13.219	3.413

POWER	SF - MPQ	0.226
	NRS - 101	0.102

The null hypothesis is accepted for the subjective measurements taken at the initial consultation in both groups as no statistically significant difference was evident between the groups. This indicates that, at the beginning of the study, the two groups were similar in terms of pain and disability. The power value for both questionnaires was low indicating an increased likelihood of Type II error i.e. the acceptance of a false null hypothesis.

Table 5 : Statistical results comparing Group A - CMT and Group B - Placebo in terms of the subjective measurements from the final consultation.

Group A - CMT				Group B - Placebo			
Final Consultation				Final Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	22.933	18.093	4.672	0.050	12.267	9.075	2.343
NRS101	28.133	14.867	3.839	0.802	26.700	16.059	4.146

POWER	SFMPQ	0.497
	NRS101	0.056

The null hypothesis is accepted for both the SF - MPQ and the NRS - 101 as there was no statistically significant difference between the two groups at the final consultation. This indicates that both forms of treatment were equally effective. The power value for both questionnaires was low indicating an increased likelihood of Type II error i.e. the acceptance of a false null hypothesis.

Table 6 : Statistical results comparing Group A - CMT and Group B - Placebo in terms of the subjective measurements from the follow-up consultations.

Group A - CMT					Group B - Placebo		
Follow-up Consultation					Follow-up Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	13.933	14.621	3.775	0.324	19.533	15.887	3.628
NRS101	15.467	15.338	3.960	0.095	27.333	21.681	3.413

POWER	SFMPQ	0.155
	NRS101	0.377

The null hypothesis is accepted in both instances, as there is no statistically significant difference between the subjective data of Group A and Group B at the follow-up consultation. This indicates that the two groups were similar in terms of pain intensity at the end of the study. The power value for both questionnaires was low indicating an increased likelihood of Type II error i.e. the acceptance of a false null hypothesis.

4.4.2 Objective Data

Table 7 : Statistical results comparing Group A - CMT and Group B - Placebo in terms of the objective measurements from the initial consultations.

Group A - CMT				Group B - Placebo			
Initial Consultation				Initial Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	3.127	1.115	0.288	0.580	3.347	1.036	0.267

POWER	ALG.	0.081
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The null hypothesis is accepted for the Algometer readings when comparing the initial consultations as there was no statistically significant difference between Group A and Group B indicating that the two groups were similar in terms of objective findings at the initial consultation. The power value was low indicating an increased likelihood of a Type II error.

Table 8 : Statistical results comparing Group A - CMT and Group B - Placebo in terms of the objective measurements from the final consultations.

Group A - CMT				Group B - Placebo			
Final Consultation				Final Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	4.733	1.394	0.360	0.277	4.093	1.925	0.497

POWER	ALG.	0.179
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The null hypothesis is accepted for the objective findings of both groups for the final consultation comparison, as there was no statistically significant difference in these readings. The power value was low indicating an increased likelihood of a Type II error.

Table 9 : Statistical results comparing Group A and Group B in terms of the objective measurements from the follow-up consultations.

Group A - CMT				Group B - Placebo			
Follow-up Consultation				Follow-up Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	5.373	1.687	0.436	0.520	4.120	1.697	0.438

POWER	ALG.	0.492
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There was no statistically significant difference between the objective data of Group A and Group B at the follow-up consultation leading to the acceptance of the null hypothesis and indicating that the groups were similar in terms of the objective measurements. The power value was low indicating an increased likelihood of a Type II error.

4.5 Non-parametric Wilcoxon’s Signed Rank Test For Categorical Variables

4.5.1 Subjective Data

Table 10 : Statistical results comparing initial, final and follow-up consultations in Group A - CMT in terms of subjective measurements.

	CONSULTATIONS	P - value
FFI	Initial A with Final A	0.006
	Initial A with Follow-up A	0.002
	Final A with Follow-up A	0.006

The null hypothesis is rejected for Group A, as there was a statistically significant difference in the data from the three questionnaires from the initial, final and follow-up consultations. This indicates that there was a subjective improvement as a result of the CMT.

Table 11 : Statistical results comparing initial, final and follow-up consultations in Group B - Placebo in terms of subjective measurements.

	CONSULTATIONS	P - value
FFI	Initial B with Final B	0.002
	Initial B with Follow-up B	0.01
	Final B with Follow-up B	0.892

The null hypothesis is rejected for the comparison between the initial and final consultation as well as for the comparison between the initial and follow-up consultation. This indicates that there was a statistically significant difference between these consultations indicating a subjective improvement between these consultations as a result of the placebo treatment. The null hypothesis is accepted however for the comparison between the initial consultation and the follow-up consultation indicating no statistically significant difference between these two consultations in response to the placebo treatment.

4.6 The Parametric Two-sample Paired T-test For Continuous Variables.

4.6.1 Subjective Data.

Table 12 : Statistical results comparing the initial consultation and the final consultation in Group A - CMT in terms of subjective measurements.

GROUP A - CMT							
Initial Consultation				Final Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	35.800	18.948	4.892	0.003	22.933	18.093	4.892
NRS101	44.467	14.362	3.708	0.002	28.133	14.867	3.839

POWER	SFMPQ	0.443
	NRS101	0.84

The null hypothesis is rejected when comparing the results of the first and final consultations in Group A, as there was a statistically significant difference for both questionnaires. This indicates that there was a subjective improvement as a result of CMT. The power value for the power value for the NRS - 101 questionnaire is significantly higher than the power value for the SF - MPQ, indicating less likelihood of a Type II error occurring in the NRS - 101 questionnaire than in the SF - MPQ.

Table 13 : Statistical results comparing the initial consultation and the follow-up consultation in Group A - CMT in terms of subjective measurements.

Group A - CMT

	Initial Consultation				Follow-up Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	35.800	18.948	4.892	0.000	13.933	14.621	3.775
NRS101	44.466	14.362	3.708	0.000	15.338	15.338	3.960

POWER	SFMPQ	0.926
	NRS101	0.999

The null hypothesis is rejected for Group A, as there was a statistically significant difference in the data from the questionnaires from the first and follow-up consultations. This indicates that there was a subjective improvement as a result of the CMT. The power values for both questionnaires are high indicating little likelihood of a Type II error occurring in these questionnaires.

Table 14 : Statistical results comparing the final consultation and the follow-up consultation in Group A - CMT in terms of subjective measurements.

Group A - CMT

	Final Consultation				Follow-up Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	22.933	18.093	4.672	0.004	13.933	14.621	3.775
NRS101	28.133	14.867	3.839	0.001	15.467	15.338	3.960

POWER	SFMPQ	0.294
	NRS101	0.597

The null hypothesis is rejected when comparing the final and follow-up consultations in Group A, as there was a statistically significant difference for both questionnaires. This indicates that there was a subjective improvement as a result of the CMT. Both power values are low indicating an increased likelihood of a Type II error occurring with these two questionnaires.

Table 15 : Statistical results comparing the initial consultation and the final consultation in Group B - Placebo in terms of subjective measurements.

Group B - Placebo

	Initial Consultation				Final Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	28.000	14.051	3.628	0.004	12.267	9.075	2.343
NRS101	48.067	13.219	3.413	0.000	26.700	16.059	4.146

POWER	SFMPQ	0.939
	NRS101	0.968

The null hypothesis is rejected for both questionnaires when comparing the results of the initial and final consultations in Group B, as there was a statistically significant difference between them. This indicates a subjective improvement from the placebo treatment between the initial and final consultations. The power values for both questionnaires were high indicating little likelihood of a Type II error occurring in either questionnaire.

Table 16 : Statistical results comparing the initial consultation and the follow-up consultation in Group B - Placebo in terms of subjective measurements.

Group B - Placebo

	Initial Consultation				Follow-up Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	28.000	14.051	3.628	0.135	19.533	15.887	4.102
NRS101	48.067	13.219	3.413	0.004	27.333	21.681	5.598

POWER	SFMPQ	0.31
	NRS101	0.863

The null hypothesis is accepted for the SF - MPQ, as there was no statistically significant improvement between the two consultations. The null hypothesis is rejected for the NRS - 101 as there was a significant statistical difference between the results of the initial consultation and the follow-up consultation. The power value for the NRS -101 was high indicating little likelihood of a Type II error but the power value for the SF - MPQ was low indicating an increased likelihood of a Type II error occurring.

Table 17 : Statistical results comparing the final consultation and the follow-up consultation in Group B - Placebo in terms of the subjective measurements.

Group B - Placebo							
Final Consultation				Follow-up Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
SFMPQ	12.267	9.075	2.343	0.028	19.533	15.887	4.102
NRS101	26.700	16.059	4.146	0.909	27.333	21.681	5.598

POWER	SFMPQ	0.308
	NRS101	0.051

The null hypothesis is accepted for the SF - MPQ for Group B, as there was a statistically significant difference between the results of the final consultation and the follow-up consultation. This indicates that there was subjective improvement between these two consultations. The null hypothesis is accepted for the NRS - 101 for Group B indicating no statistically significant difference between these two consultations. The power value for both questionnaires is low indicating an increased likelihood of a Type II error.

4.6.2 Objective Data

Table 18 : Statistical results comparing the initial consultations and the final consultations in Group A - CMT in terms of objective measurements.

Group A - CMT

	Initial Consultation				Final Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	3.127	1.115	0.288	0.000	4.773	1.394	0.360

POWER	ALG.	0.931
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The null hypothesis is rejected for the comparison of the objective measurements of the initial and final consultations, as there was a statistically significant difference between the two readings. This indicates an objective improvement due to the treatment administered. The power value is high indicating little likelihood of a Type II error.

Table 19 : Statistical results comparing the initial consultations and the follow-up consultations in Group A - CMT in terms of objective measurements.

Group A - CMT

Initial Consultation				Follow-up Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	3.127	1.115	0.288	0.001	5.373	1.687	0.436

POWER	ALG.	0.984
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The null hypothesis is rejected, as there was a statistically significant difference in the comparison between these two consultations for Group A indicating an objective improvement as a result of the CMT. The power analysis yields a high power value indicating little likelihood of a Type II error.

Table 20 : Statistical results comparing the final consultations and the follow-up consultations in Group A - CMT in terms of objective measurements.

Group A - CMT

Final Consultation					Follow-up Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	4.773	1.394	0.360	0.238	5.373	1.687	0.436

POWER	ALG.	0.168
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The null hypothesis is accepted, as there was no statistically significant difference between the objective measurements at the final and follow-up consultations in Group A. This indicates that there was no significant improvement during the follow-up period. The power analysis revealed that the value was low indicating an increased likelihood of a Type II error.

Table 21 : Statistical results comparing the initial consultation and the final consultation in Group B - Placebo in terms of objective measurements.

Group B - Placebo							
Initial Consultation				Final Consultation			
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	3.347	1.036	0.267	0.096	4.093	1.925	0.497

POWER	ALG.	0.238
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The null hypothesis is accepted, as there was no statistically significant difference between these two consultations in Group B. This indicates that there was no objective improvement between these two consultations in response to the placebo treatment. The power analysis indicates a low power value indicating an increased likelihood of a Type II error.

Table 22 : Statistical results comparing the initial consultations and the follow-up consultations in Group B - Placebo in terms of objective measurements.

Group B - Placebo

	Initial Consultation				Follow-up Consultation		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	3.347	1.036	0.267	0.128	4.120	1.697	0.431

POWER	ALG.	0.297
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There was no statistically significant difference between the objective data for these two consultations in Group B leading to the acceptance of the null hypothesis. This indicates no objective improvement as a result of the placebo treatment between these two consultations. The power value was low indicating an increased likelihood of a Type II error.

Table 23 : Statistical results comparing the final consultations and the follow-up consultations in Group B - Placebo in terms of objective measurements.

Group B - Placebo

	Final Consultations				Follow-up Consultations		
	MEAN	S.D	S.E	P - value	MEAN	S.D	S.E
ALGOMETER	4.093	1.925	0.497	0.936	4.120	1.697	0.438

POWER	ALG.	0.05
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The null hypothesis is accepted, as there was no statistically significant difference for the comparison of the objective measurements of the final and follow-up consultations for Group B. This indicates that there was no significant objective improvement during the follow-up period. The power value is low indicating that there was an increased likelihood of a Type II error.

4.7 Data Mean Scores

See Chapter 5 for comments on graphical comparisons.

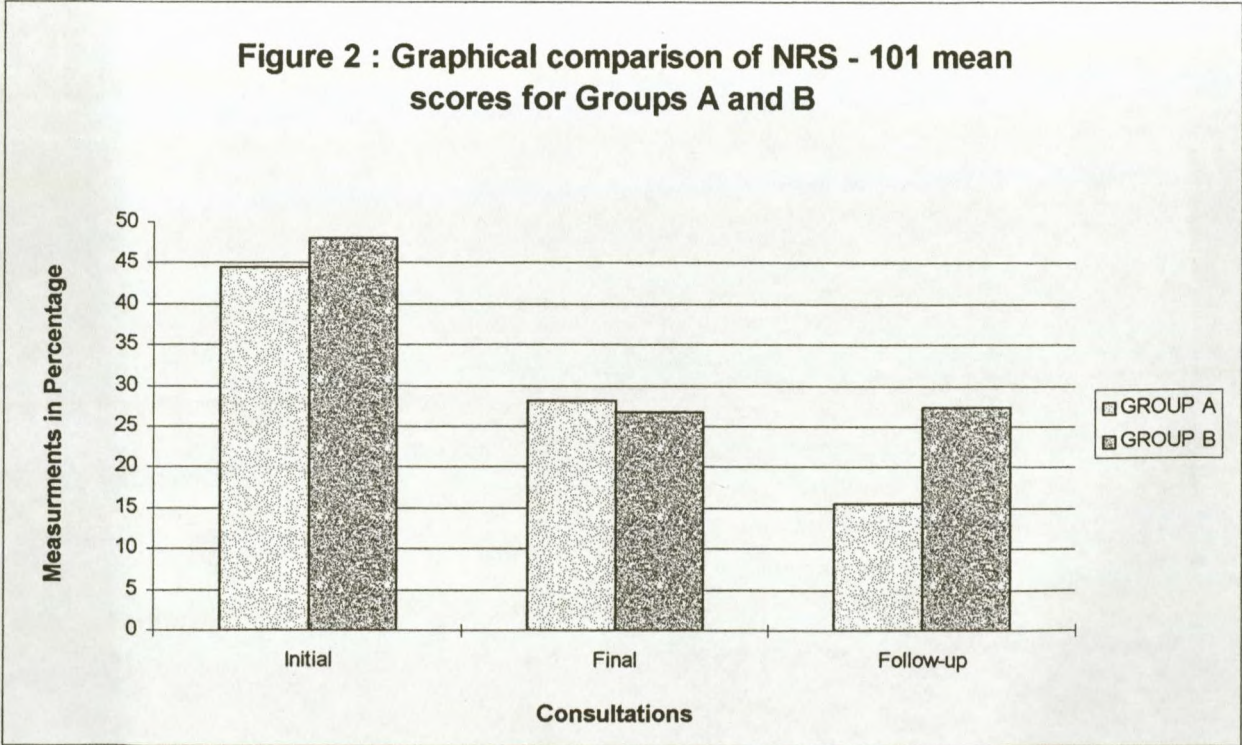
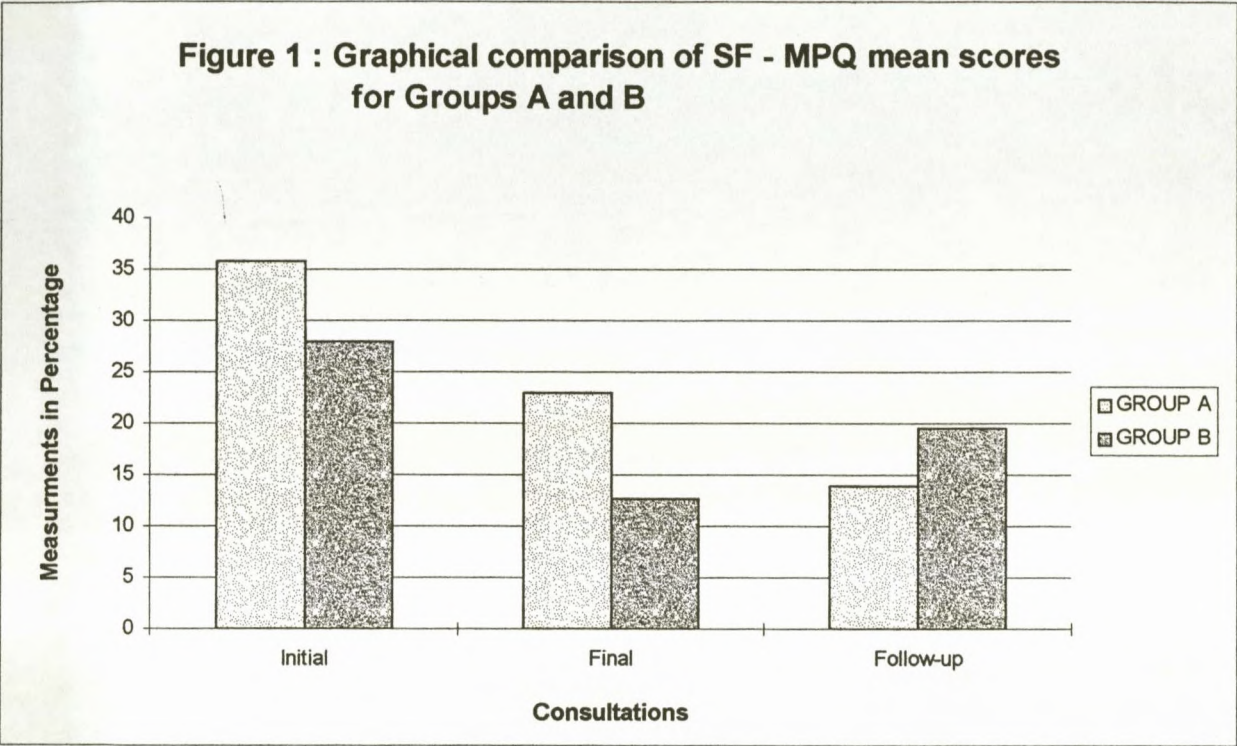
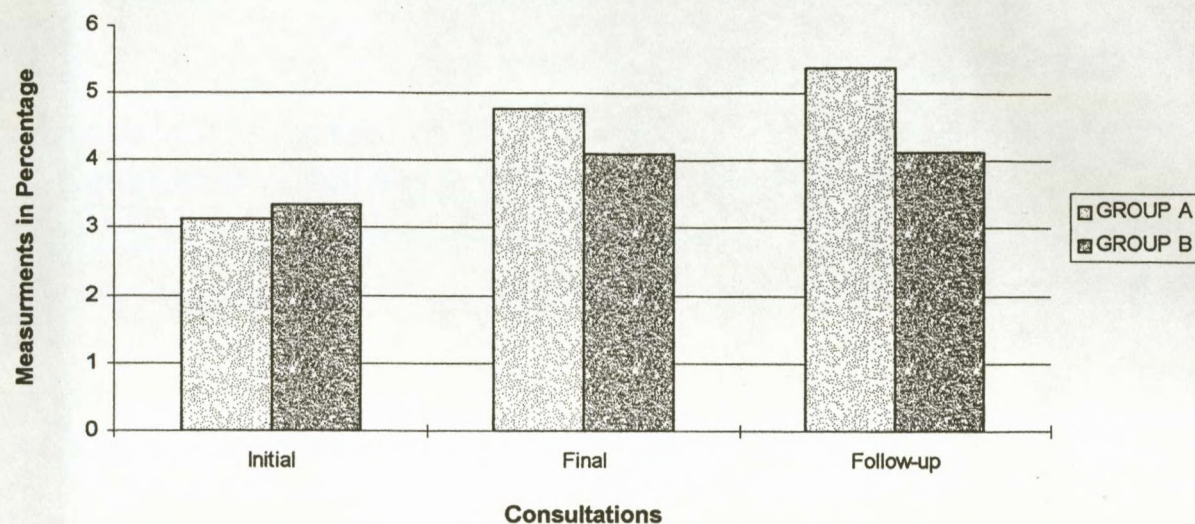


Figure 3 : Graphical comparison of the Algometer readings mean scores for Groups A and B



CHAPTER FIVE - DISCUSSION OF THE RESULTS

5.1 INTRODUCTION

This chapter involves the discussion of the results obtained from the subjective and objective data. The interpretation of the results is necessary to determine whether or not the premise that CMT is effective in the treatment of plantar fasciitis is substantiated.

5.2 INTERPRETATION OF THE DEMOGRAPHICAL DATA

At the onset of the treatment the age range was 21 - 68 years with the average age of the patients participating in the study being 48 years (Table 1). This is in keeping with Wolgin *et al.* (1994) and Brown (1996) who agree that plantar fasciitis is more common in people over the age of forty.

The gender distribution in the study was seventeen females to thirteen males (Table 1), showing that in such a small group there is no significant difference in the preponderance to plantar fasciitis of a particular sex. This is in keeping with Klenerman (1991) who states that plantar fasciitis affects both sexes equally. Other authors i.e. Brown (1996) and Cailliet (1997) however cannot agree as to which sex is more commonly affected.

This study showed that of the participating patients, twenty-five of them were White, four were Indian and one was Black (Table 1). This however is an unrealistic sample of the distribution of plantar fasciitis sufferers amongst various racial populations of South Africa. This is probably, in part, due to the fact that some of the advertising undertaken to acquire patients for the study

was done in the form of local newspapers distributed in the greater Durban and Highway areas which are areas more commonly frequented by White and Indian groups. Thus these statistics are probably deceiving and as no mention was made in the literature of a preponderance to plantar fasciitis of any particular racial group, this information has little significance in terms of this study.

The data obtained from the patient case history forms completed at the initial consultation, prior to the commencement of the treatment, showed that the average length of time that the patients had had the condition for was 17.5 months (Table 2). This is comparable to a study conducted by Crawford and Snaith (1996) in which their patients' average duration of symptoms, prior to attention being sought, was placed at 18 months.

In terms of which foot was most frequently involved, the data of this study showed little difference in tendency for right foot involvement (15 cases) as opposed to left foot involvement (14 cases). There was only one case of bilaterality of symptoms (Table 2). However, in the study conducted by Wolgin *et al.* (1994) a definite tendency for right foot involvement as opposed to left foot involvement was noted.

5.3 INTER-GROUP TREATMENT COMPARISON

The comparison of the subjective and objective data of both groups from the initial consultation will reveal any differences between the two groups in terms of their original signs and symptoms. The comparison of the results of the final consultation confirm which treatment protocol has been relatively more effective. The comparison of the follow-up consultation results

indicates which treatment protocol has been relatively more effective in maintaining a lasting result.

5.3.1 Inter-group comparison

5.3.1.1 SUBJECTIVE DATA

a) The short-form McGill Pain Questionnaire

Comparison of the first consultation of both groups showed no statistically significant difference ($p = 0.211$), indicating that both groups were relatively homogenous with respect to pain perception (Table 4). A clinical difference in response was noted with Group A - CMT responding slightly better than Group B - Placebo. Power analysis (0.226) showed an increased likelihood of Type II error.

Comparison of the final consultation of both groups showed a statistically significant difference ($p = 0.05$) between the two groups (Table 5). This indicated a difference in the pain perception of the two groups which was also noted clinically with Group A - CMT responding slightly better than Group B (Figure 1). Power analysis showed an increased likelihood of a Type II error.

The follow-up consultation comparisons showed no statistically significant difference ($p = 0.324$) indicating that both groups were similar with respect to pain perception (Table 6). Clinically though, Group B - Placebo showed a slightly better response after the one month follow-up period. Power analysis showed an increased likelihood of a Type II error.

Summary

As no significant statistical difference is evident between the two groups at the initial consultation it is evident that both treatments groups exhibited no differences between their original pain perception. No significant statistical difference was apparent between the two groups at the follow-up consultation either. This indicates that neither treatment protocol was more effective at maintaining a lasting result. The statistically significant difference noted between the two groups at the final consultation shows that Group A - CMT has been relatively more effective as a treatment protocol for plantar fasciitis.

b) The Numerical Pain Rating Scale - 101

Comparison of the first consultation of the two groups revealed no statistically significant difference ($p = 0.481$) in the inceptive degree of pain intensity, denoting a similarity between the two groups (Table 4). Power analysis (0.102) revealed that there was an increased likelihood of a Type II error occurring.

The analysis of the readings of the final consultation revealed no statistically significant difference ($p = 0.802$) between the two groups. This indicates that both treatment protocols were equally effective (Table 5). Group A - CMT showed a slightly more clinically significant improvement when compared to Group B - Placebo. This depicts that maintenance of the treatments' relative effectiveness would be slightly better in Group A - CMT (Figure 2). The power analysis of this comparison (0.056) showed an increased likelihood of a Type II error occurring

Results of data analysis of the follow-up consultations indicated similar results in both groups with no statistically significant difference ($p = 0.095$) being noted (Table 6). Group B - Placebo

showed a slight clinically significant improvement when compared to Group A -CMT (Figure 2) showing that Group B - Placebo maintained well within the period between the final and follow-up consultation. The power value (0.377) showed an increased likelihood of a Type II error occurring.

Summary

It is evident that both groups were equally effective in reducing the levels of pain experienced in both groups at the three treatment periods. The power analysis for all three comparisons showed an increased likelihood of Type II errors.

c) The Foot Function index

The inter-group comparison of the initial consultation showed no statistically significant difference ($p = 0.838$) indicating that both groups were similar in terms of pain, disability and activity restriction at the commencement of the study (Table 3).

No statistically significant difference was noted between the groups at the final consultation ($p = 0.744$). This indicates that both treatment protocols were equally effective (Table 3).

The follow-up consultation comparisons showed no statistically significant difference ($p = 0.056$) between the two groups (Table 3). This indicates no difference between the relative effectiveness of both groups during the follow-up period.

Summary

It is evident that both groups were equally effective in reducing, at the three treatment consultations, the levels of pain, disability and activity restriction experienced in both groups.

5.3.1.2 OBJECTIVE DATA

a) The Algometer Readings

The comparison of the initial Algometer readings presented no statistically significant difference ($p = 0.58$) between the two groups indicating that pain sensitivity to pressure was similar at the beginning of the study (Table 7). Power analysis revealed that there was an increased likelihood of a Type II error.

The comparison of the data from the final consultation reveals that there was no statistically significant difference ($p = 0.277$) between the two groups (Table 8). Thus it can be said that neither treatment protocol was more effective than the other in terms of pain sensitivity to pressure. Power analysis showed that there was an increased likelihood of a Type II error.

The data analysis of the follow-up consultation showed no statistically significant difference ($p = 0.52$) between the two groups (Table 9). It can be concluded that the treatments' relative effectiveness was maintained equally in both groups. Clinically however Group A - CMT showed a better maintenance of the treatments' relative effectiveness in terms of pain threshold levels (Figure 3). Power analysis revealed an increased likelihood of a Type II error.

Summary

As no statistically significant difference was noted between the two groups at all three of the treatment consultations, it can be said that both groups responded equally well to their treatment protocols in terms of the algometer readings. Power values for all three comparisons showed an increased likelihood of Type II errors.

5.4 INTRA-GROUP TREATMENT COMPARISON

The assessment of the subjective and objective intra-treatment of the initial to final consultation represents the relative effectiveness of the treatment protocol. The comparison of the final to follow-up consultation represents whether or not the treatments' relative effectiveness was maintained. The initial to follow-up period represents the long-term relative effectiveness of the treatment protocol and evaluates whether or not the condition has returned. This process was done with the data of both treatment groups.

5.4.1 Intra-group comparison

5.4.1.1 SUBJECTIVE DATA

a) The short-form McGill Pain Questionnaire

The statistical analysis of the mean values for the initial to final consultation period depicted a statistically significant improvement in both Group A - CMT ($p = 0.003$) and Group B - Placebo ($p = 0.004$) (Table 9 and 12, Figure 1). Power analysis of the first to final consultation comparison revealed that there was an increased likelihood of a Type II error in Group A - CMT (0.433) than in Group B - Placebo (0.939).

The comparison of the final to follow-up consultation showed a statistically significant difference between these consultations in both Group A - CMT ($p = 0.004$) and Group B - Placebo ($p = 0.028$) (Table 11 and 14, Figure 1). This indicates that the improvement was maintained over the follow-up period and / or additional improvement occurred. The power value for both groups was low indicating an increased likelihood of a Type II error.

Assessment of the mean value of Group A - CMT for the period between the initial and follow-up consultations revealed a statistically significant difference. This indicates a decrease of pain perception in Group A - CMT ($p = 0.000$). Group B - Placebo however, did not show a statistically significant difference ($p = 0.135$) for the same period (Table 10 and 13, Figure 1). Power analysis showed that there was little likelihood of a Type II error occurring for Group A - CMT (0.926) but that the likelihood of a Type II error occurring for Group B - placebo (0.310) was increased.

Summary

The SF - MPQ provides information regarding the sensory, affective and overall intensity of the patients' pain. In both groups there was a statistically significant improvement between the initial consultation and the final consultation. Both groups showed a continuing improvement during the one-month follow-up period from the final consultation to the follow-up consultation. There was only a significant statistical improvement in Group A - CMT between the initial consultation and the follow-up consultation. This indicates that both groups showed a diminished pain perception throughout the course of the study but that the relative effectiveness of Group A - CMT from the initial consultation to the follow-up consultation was greater than that of Group B - Placebo. The power analysis indicates that there was an increased likelihood of a Type II error for both groups during the final to follow-up consultation comparison. Group A - CMT had little likelihood of a Type II error occurring between the initial and final consultation comparison and Group B - Placebo had little likelihood of a Type II error occurring between the initial and follow-up consultation comparison.

b) The Numerical Pain Rating Scale - 101

Comparison of the initial and final consultations revealed a statistically significant difference in Group A - CMT ($p = 0.002$) and Group B - Placebo ($p = 0.000$). This indicates a decrease in the amount of pain experienced by the patients (Table 9 and 12, Figure 2). Power analysis showed that there was little likelihood of a Type II error occurring in either group.

Comparison of the final to follow-up consultations showed a statistically significant difference in Group A - CMT ($p = 0.001$) only. This indicates that only in Group A - CMT was the improvement maintained and / or additional improvement occurred during the one-month follow-up period (Table 11 and 14, Figure 2). Power analysis showed that there was less likelihood of a Type II error occurring in Group A - CMT (0.597) than in Group B - Placebo (0.051).

Analysis of the period from the initial consultation to the follow-up consultation showed a statistically significant improvement in both Groups A - CMT (0.000) and B - Placebo (0.004) (Table 10 and 13, Figure 2). This indicates that both groups had a favourable response to their respective treatment protocols in terms of pain intensity measurement. Power analysis indicates that both groups A - CMT (0.999) and B - Placebo (0.863) had little likelihood of a Type II error occurring from the initial to the follow-up consultations (Table 10 and 13).

Summary

The NRS - 101 is a questionnaire that monitors the levels of pain perception experienced by patients. Both groups in the initial to final consultation period showed a significant statistical difference, indicating a decrease in pain perception. Only Group A - CMT showed a continuation or maintenance of this improvement during the one month follow-up period from the final consultation to the follow-up one. Both groups showed a significant statistical difference

between the initial and follow-up consultations showing that pain levels were reduced in both groups as a result of their treatment protocols. Power analysis showed that all three comparisons in Group A - CMT were unlikely to have a Type II error occur whereas in Group B - Placebo the comparison of the final consultation to the follow-up consultation showed an increased likelihood of a Type II error occurring.

c) The Foot Function Index

The comparison of the initial to final consultation depicted a significant statistical difference in both Group A - CMT ($p = 0.006$) and Group B - Placebo ($p = 0.002$) (Table 16 and 17). This indicates that both groups were effective in their treatment of plantar fasciitis.

A statistically significant difference was noted between the final and follow-up consultations in Group A - CMT ($p = 0.006$) but not in Group B - Placebo ($p = 0.892$) (Table 16 and 17). This indicates that in Group A - CMT the improvement was maintained over the one-month follow-up period and / or additional improvement occurred.

Both groups A - CMT (0.002) and B - Placebo (0.010) showed a significant statistical improvement for the period from the initial consultation to the follow-up consultation (Table 16 and 17). This indicates an improvement in both groups across the study period.

Summary

The FFI provides information as to the impact of the patient's pain on their normal daily activities. Both groups showed a statistically significant difference in both the initial to final consultation comparisons and the initial to follow-up consultation comparisons. This indicates that both groups improved during the treatment period and that both groups showed a

diminished impact of their pain on their daily activities over the course of the study period. Only Group A - CMT showed a difference between the final and follow-up consultations though indicating that only this group showed a continued improvement and / or maintained the initial improvement.

5.4.1.2 OBJECTIVE DATA

a) The Algometer Readings

Analyses of the Algometer readings for the initial and final follow-up consultations revealed a statistically significant difference in Group A - CMT ($p = 0.000$) but not in Group B - Placebo ($p = 0.096$). This indicated a significant statistical objective improvement for Group A - CMT only (Table 18 and 21, Figure 3). Power analysis showed that Group A - CMT (0.931) had little likelihood of a Type II error but that Group B - Placebo (0.238) had an increased likelihood of this error occurring.

For the analysis of the final and follow-up consultations both Group A - CMT ($p = 0.238$) and Group B - Placebo ($p = 0.936$) showed no significant statistical difference (Table 20 and 23, Figure 3). This indicates that the improvement was not maintained during the one-month follow-up period. Power analysis revealed that both group A - CMT (0.168) and B - Placebo (0.050) had an increased likelihood of a Type II error occurring.

A statistically significant difference was shown between the initial and the follow-up period for Group A - CMT ($p = 0.001$). Group B - Placebo ($p = 0.128$) however showed no significant statistical difference for the same period (Table 19 and 22, Figure 3). Power analysis revealed an increased likelihood of a Type II error occurring in Group B - Placebo (0.297) than for Group A - CMT (0.984)

Summary

Group A - CMT showed a statistically significant improvement between both the initial and final consultations and the initial and follow-up consultations indicating that an statistically significant objective improvement occurred in this group as result of the treatment protocol both during the treatment period as well as across the entire period of the study. Group B - Placebo showed a statistically significant difference between the initial and final consultations only. This indicates that this group showed a significant statistical objective improvement only during the treatment period. Power analysis of Group A - CMT showed that the comparisons of the initial and final consultations as well as the comparison of the initial and follow-up consultations were unlikely to experience a Type II error. Group B - Placebo however showed an increased likelihood of a Type II error occurring with all three comparisons.

5.5 DISCUSSION

5.5.1 Inter-group Hypothesis

It was hypothesised that there would be a significant difference between the two groups with respect to the subjective and objective clinical findings, showing that CMT was effective in the treatment of plantar fasciitis. When comparing Group A - CMT and Group B - Placebo, in terms of subjective measurements, it can be seen that there was only a statistically significant difference at the final consultation (Table 5). Clinically it was evident that Group A - CMT showed a slightly better subjective response at the final consultation in terms of the sensory, affective and overall intensity dimensions of pain (Figure 1 and 2). Clinically, Group A - CMT also showed a slightly better objective improvement at both the final and follow-up consultations (Table 3).

5.5.2 Intra-group Hypothesis

It was hypothesised that there would be a significantly greater improvement in Group A - CMT than in Group B - Placebo between the initial treatment and the final treatment, the final treatment and the follow-up consultation and lastly the initial treatment and the follow-up consultation in terms of subjective and objective clinical findings showing that Group A - CMT was more effective than placebo treatment in the management of plantar fasciitis.

When comparing the initial to the final consultations it can be seen that there was a significant statistical improvement in both Group A - CMT and Group B - Placebo in terms of both subjective (Table 7 and 8, Table 9 and 12) and objective (Table 18 and 21) clinical findings. For the comparison of the final to follow-up consultations Group A - CMT showed significant statistical improvement in terms of the subjective clinical findings (Table 7 and 11) whereas Group B - Placebo showed a statistically significant objective improvement (Table 23) for the same period. Both groups showed a significant statistical subjective improvement for the period between the initial consultation and the follow-up consultation (Table 7 and 8, Table 10 and 13) but only Group A - CMT showed any significant statistical objective improvement for the same period (Table 19 and 22). In summary it can be said that both groups showed statistically significant subjective improvement for all consultation comparisons but that only Group A - CMT showed any statistically significant objective improvement and that was only during the treatment period and not during the one-month follow-up period.

Concluding, both treatment protocols were effective during the treatment period but only Group A - CMT was effective during the one-month follow-up period.

5.5.3 Power Analysis

According to Portney and Watkins (1993: 351-352) the purpose of the power analysis is to determine the probability of a Type II error i.e. the false acceptance of the null hypothesis, being committed when a non-significant finding was the result of the study. The probability of making a Type II error is denoted by beta (β). The closer the value of $1 - \beta$ is to 1, the better the power of the study. A power of 0.8 represents a reasonable protection against a Type II error.

5.5.3.1 INTER-GROUP POWER ANALYSIS

The inter-group analysis of both the subjective and objective readings revealed a poor power value for all measurements when comparing the initial, final and follow-up consultations (Table 4, 5, 6, 7, 8, and 9). This indicates an increased likelihood of a Type II error occurring.

5.5.3.2 INTRA-GROUP POWER ANALYSIS

The power analysis is high for the SF - MPQ reading for the comparison between the initial and follow-up consultations in Group A - CMT (0.926) as well as for the comparison between the initial and final consultations in Group B - Placebo (0.939).

The NRS - 101 readings show a high power value for the initial to final consultation comparison (0.840), the final to follow-up consultation comparison (0.597) and for the initial to follow-up consultation comparison (0.999) in Group A - CMT. For Group B - Placebo a high power value exists for the comparison between the initial and final consultation (0.968) and the initial and follow-up consultation (0.863) only. The high power value indicates a decreased likelihood of a Type II error occurring for these comparisons.

5.8 COMPARISON OF THE RESULTS WITH OTHER STUDIES

The results of this study are comparable to those of Crawford and Snaith (1996) as this is the only other recent, randomised, placebo-controlled evaluation of a specific treatment modality and its effects on patients suffering with plantar heel pain. The sample size was similar, in that it was relatively small (26 episodes of plantar heel pain). The treatment period was similar, eight treatments spread out over a four week period i.e. two treatments per week. Crawford and Snaith (1996) also used detuned ultrasound as their placebo control and all treatments were undertaken by the same operator, as was the case in this study. The chronicity of the subjects' condition was similar, with an average period of 18 months elapsing prior to attention being sought for the plantar heel pain.

Crawford and Snaith (1996) evaluated the therapeutic effect of ultrasound in the treatment of plantar heel pain. Significant differences between the studies are that Crawford and Snaith (1996) made no specific diagnosis for the symptom of plantar heel pain and that they had no one month follow-up period. Also, no objective measurements were analysed in their study.

As in this study, both treatment groups showed a reduction in pain, with this improvement being slightly better in the treated group as opposed to the placebo group. However, this was based on subjective measurements only and showed that the therapeutic treatment i.e. ultrasound, proved to be no more statistically effective than the placebo ultrasound in the treatment of plantar heel pain.

5.7 LIMITATIONS OF THE STUDY

There are various reasons as to why the subjective measurements may have had their limitations in terms of the condition being treated and the treatment protocol being administered.

The first limitation is that the questionnaires used in the study were not designed for the sole purpose of the study. In the future, questionnaires relating specifically to plantar fasciitis pain as well as its response to treatment should be designed and used.

The second limitation is the possible misunderstanding of the questionnaires by the patients that may have affected their response and therefore the outcome of the results. Patients may have recorded improvements that were beyond those actually felt in order to please the researcher.

There are also various reasons as to why objective measurements may have been faulty. The first such reason is that human error may occur when recording calibrations and also the possible risk of incorrect user methods. It is suggested that an independent examiner be included to ensure the correct recording of the measurements and the correct calibration of the equipment used.

The small sample size of this study is also a weakness, as this resulted in Type II errors occurring throughout the study.

The Algometer readings showed a high power value in Group A - CMT for the comparison between the initial and final consultations (0.931) as well as the comparison between the initial and follow-up consultations (0.984), indicating little likelihood of a Type II error occurring there. In Group B - Placebo the power value for the Algometer readings were low for all comparisons indicating an increased likelihood of a Type II error occurring.

In general, the power analysis of this study was poor. According to Portney and Watkins (1993: 351), when small sample sizes are used, as was the case in this study, it is expected that the power of the study will be substantially low. Portney and Watkins (1993: 352) also mention that the clinical significance of a study could be greater than suggested by the statistical outcome if the poor power analysis exists.

5.6 CONCLUSIONS

Both groups showed a subjective statistically significant improvement as a result of their respective treatments. Group A - CMT appeared to show a slightly better subjective statistically significant improvement than did Group B - Placebo during the one-month follow-up period. Objectively, only Group A - CMT showed an improvement during the treatment period. Clinically, at various stages, Group A - CMT appeared to respond more effectively than did Group B - Placebo in terms of the subjective data. At other stages Group B - Placebo appeared to respond, subjectively, more effectively than did Group A - CMT. Only Group A - CMT showed a clinical improvement in terms of the objective data.

It is the researcher's belief that with a larger sample size, a stronger statistical difference between the two groups may become evident.

CHAPTER SIX - RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

It is recommended that a larger sample size (e.g. thirty patients in each group) be used if this study is to be repeated. A small sample size makes it difficult for accurate statistical analysis to be performed.

It is recommended that the amount or grade of dysfunction be taken into account if this study is to be repeated.

The experience and reliability of the examiner and the accuracy of the measurement parameters do need to be considered. It is recommended that the use of an independent examiner be considered.

It is recommended that additional testing tools e.g. a goniometer be included to provide a more accurate assessment of the condition. It is also recommended that specific questionnaires relating to plantar fasciitis be considered, so as to provide more accurate subjective data.

6.2 CONCLUSIONS

From the results of the analysis it was revealed that both groups showed a subjective, statistically significant improvement as a result of their respective treatments. Significant statistical, subjective improvement was noted between the initial and final consultations in both groups showing that both groups responded well to their particular treatment protocols during

the treatment period. However the CMT group showed a slightly more statistically significant improvement subjectively, than did the placebo group, between the final consultation and the follow-up consultation showing that only Group A continued to show statistically significant differences during the one-month follow-up period.

Objectively, Group A - CMT appeared to show a significant statistical improvement during the treatment period as well as over the one-month follow-up period although the inter-group comparisons of the Algometer readings (objective data) showed no statistically significant difference between the two groups.

Clinically, the analysis of the subjective data at various stages showed that Group A appeared to respond more effectively than Group B. At other stages, in terms of the subjective data, Group B appeared to respond more effectively than did Group A. However, Group A also showed a positive clinical response in terms of the objective data.

It can be noted that objectively and clinically CMT appears to be a reliable intervention in the treatment of plantar fasciitis but that CMT of the foot and ankle joints appears to be no more effective than placebo in the treatment of plantar fasciitis.

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APPENDICES

APPENDIX 1:

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: _____ Date: _____
file #: _____ X-Ray#: _____
Age: _____ Sex: _____ Occupation: _____
Intern: _____ Signature: _____

FOR CLINICIAN'S USE ONLY

Initial visit clinician: _____ Signature: _____

Case History:

Examination:

Previous:

Current:

X-Ray Studies:

Previous:

Current:

Clinical Path. lab:

Previous:

Current:

Case Status:

PTT:

Conditional:

Signed Off:

Final Sign out:

Recommendations:

Intern's Case History

1. Source of History:
2. Chief Complaint: (patient's own words)

3. Present Illness:

- ▶ Location
- ▶ Onset
- ▶ Duration
- ▶ Frequency
- ▶ Pain (Character)
- ▶ Progression
- ▶ Aggravating Factors
- ▶ Relieving Factors
- ▶ Associated S & S
- ▶ Previous Occurrences
- ▶ Past Treatment and Outcome

4. Other Complaints:

5. Past Medical History:

- ▶ General Health Status
- ▶ Childhood Illnesses
- ▶ Adult Illnesses
- ▶ Psychiatric Illnesses
- ▶ Accidents/Injuries
- ▶ Surgery
- ▶ Hospitalizations

6. Current health status and life-style:

- Allergies
- Immunizations
- Screening Tests
- Environmental Hazards (Home, School, Work)
- Safety Measures (seat belts, condoms)
- Exercise and Leisure
- Sleep Patterns
- Diet
- Current Medication
- Tobacco
- Alcohol
- Social Drugs

7. Immediate Family Medical History:

- Age
- Health
- Cause of Death
- DM
- Heart Disease
- TB
- Stroke
- Kidney Disease
- CA
- Arthritis
- Anaemia
- Headaches
- Thyroid Disease
- Epilepsy
- Mental Illness
- Alcoholism
- Drug Addiction
- Other

8. Psychosocial history:

- Home Situation and daily life
- Important experiences
- Religious Beliefs

9. Review of Systems:

- General
- Skin
- Head
- Eyes
- Ears
- Nose/Sinuses
- Mouth/Throat
- Neck
- Breasts
- Respiratory
- Cardiac
- Gastro-intestinal
- Urinary
- Genital
- Vascular
- Musculoskeletal
- Neurologic
- Haematologic
- Endocrine
- Psychiatric

APPENDIX 2: TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Patient: _____ File#: _____ Date: _____
 Clinician: _____ Signature: _____
 Intern: _____ Signature: _____

1. VITALS

Pulse rate:
 Respiratory rate:
 Blood pressure: R L
 Temperature:
 Height:
 Weight:

2. GENERAL EXAMINATION

General Impression:
 Skin:
 Jaundice:
 Pallor:
 Clubbing:
 Cyanosis (Central/Peripheral)
 Oedema:
 Lymph nodes - Head and neck:
 - Axillary:
 - Epitrochlear:
 - Inguinal:

Urinalysis

3. CARDIOVASCULAR EXAMINATION

- 1) Is this patient in Cardiac Failure ?
- 2) Does this patient have signs of Infective Endocarditis ?
- 3) Does this patient have Rheumatic Heart Disease ?

Inspection - Scars
 - Chest deformity:
 - Precordial bulge:
 - Neck -JVP:

Palpation: - Apex Beat (character + location):
 - Right or left ventricular heave:
 - Epigastric Pulsations:
 - Palpable P2:
 - Palpable A2:

- Pulses:**
- General Impression:
 - Radio-femoral delay:
 - Carotid:
 - Radial:
 - Dorsalis pedis:
 - Posterior tibial:
 - Popliteal:
 - Femoral:

Percussion: - borders of heart

Auscultation:

- heart valves (mitral, aortic, tricuspid, pulmonary)
- Murmurs (timing, systolic/diastolic, site, radiation, grade).

4. RESPIRATORY EXAMINATION

1) Is this patient in Respiratory Distress ?

Inspection

- Barrel chest:
- Pectus carinatum/cavinatum:
- Left precordial bulge:
- Symmetry of movement:
- Scars:

Palpation

- Tracheal symmetry:
- Tracheal tug:
- Thyroid Gland:
- Symmetry of movement (ant + post)
- Tactile fremitus:

Percussion

- Percussion note:
- Cardiac dullness:
- Liver dullness:

Auscultation

- Normal breath sounds bilat.:
- Adventitious sounds (crackles, wheezes, crepitations)
- Pleural frictional rub:
- Vocal resonance
- Whispering pectoriloquy:
- Bronchophony:
- Egophony:

5. ABDOMINAL EXAMINATION

1) Is this patient in Liver Failure ?

Inspection

- Shape:
- Scars:
- Hernias:

Palpation

- Superficial:
- Deep = Organomegally:

- Masses (intra- or extramural)
- Aorta:

Percussion - Rebound tenderness:

- Ascites:
- Masses:

Auscultation - Bowel sounds:

- Arteries (aortic, renal, iliac, femoral, hepatic)

Rectal Examination

- Perianal skin:
- Sphincter tone & S4 Dermatome:
- Obvious masses:
- Prostate:
- Appendix:

6. G.U.T EXAMINATION

External genitalia:

Hernias:

Masses:

Discharges:

7. NEUROLOGICAL EXAMINATION

Gait and Posture

- Abnormalities in gait:
- Walking on heels (L4-L5):
- Walking on toes (S1-S2):
- Rombergs test (Pronator Drift):

Higher Mental Function

- Information and Vocabulary:
- Calculating ability:
- Abstract Thinking:

G.C.S.:

- Eyes:
- Motor:
- Verbal:

Evidence of head trauma:

Evidence of Meningism:

- Neck mobility and Brudzinski's sign:
- Kernigs sign:

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

II External examination of eye:

- Visual Acuity:
- Visual fields by confrontation:

- Pupillary light reflexes = Direct:
- Fundoscopy findings: = Consensual:

III Ocular Muscles:
Eye opening strength:

IV Inferior and Medial movement of eye:

- V
- a. Sensory
 - Ophthalmic;
 - Maxillary;
 - Mandibular;
 - b. Motor
 - Masseter;
 - Jaw lateral movement;
 - c. Reflexes
 - Corneal reflex
 - Jaw jerk

VI Lateral movement of eyes

- VII
- a. Motor
 - Raise eyebrows;
 - Frown;
 - Close eyes against resistance;
 - Show teeth;
 - Blow out cheeks;
 - b. Taste - Anterior two-thirds of tongue;

VIII General Hearing:
 Rinnes = L: R:
 Webers lateralisation:
 Vestibular function - Nystagmus:
 - Rombergs:
 - Wallenbergs:
 Otoloscope examination:

IX & Gag reflex
 X Uvula deviation:
 Speech quality:

XI Shoulder lift:
 S.C.M strength

XII Inspection of tongue (deviation):

Motor System:

- a. Power
- Shoulder = Abduction & Adduction:
 = Flexion & Extension:
 - Elbow = Flexion & Extension:
 - Wrist = Flexion & Extension:

- Forearm = Supination & Pronation:
- Fingers = Extension (Interphalangeals & M.C.P's):
- Thumb = Opposition:
- Hip = Flexion & Extension:
- = Adduction & Abduction:
- Knee = Flexion & Extension:
- Foot = Dorsiflexion & Plantar flexion:
- = Inversion & Eversion:
- = Toe (Plantarflexion & Dorsiflexion):

- b. Tone
- Shoulder:
 - Elbow:
 - Wrist:
 - Lower limb - Int. & Ext. rotation:
 - Knee clonus:
 - ankle clonus:

- c. Reflexes
- Biceps:
 - Triceps:
 - Supinator:
 - Knee:
 - Ankle:
 - Abdominal:
 - Plantar:

Sensory System:

- a. Dermatomes
- Light touch:
 - Crude touch:
 - Pain:
 - Temperature:
 - Two point discrimination:
- b. Joint position sense
- Finger:
 - Toe
- c. Vibration:
- Big toe:
 - Tibial tuberosity:
 - ASIS:
 - Interphalangeal Joint:
 - Sternum:

Cerebellar function:

- Obvious signs of cerebellar dysfunction:
- = Intention Tremor:
 - = Nystagmus:
 - = Truncal Ataxia:

Finger-nose test (Dysmetria):

Rapid alternating movements (Dysdiadochokinesia):

Heel-shin test:

Heel-toe gait:

Reflexes:

Signs of Parkinsons:

8. SPINAL EXAMINATION:(See Regional examination)

Obvious Abnormalities:

Spinous Percussion:

R.O.M:

Other:

9. BREAST EXAMINATION:

Summon female chaperon.

Inspection - Hands rested in lap:
- Hands pressed on hips:
- Arms above head:
- Leaning forward:

Palpation - masses:
- tenderness:
- axillary tail
- nipple.
- regional lymph nodes:

APPENDIX 3: Foot and ankle regional examination

Patient: _____ File no: _____ Date: _____
 Intern: _____ signature: _____
 Clinician: _____ signature: _____

Observation

Gait analysis (antalgic limp, toe off, arch, foot alignment, tibial alignment).

Swelling _____
 Heloma dura _____
 Skin _____
 Nails _____
 Shoes _____

Active movements

weight bearing:	Non weight bearing:
Plantar flexion _____	50° _____
Dorsiflexion _____	20° _____
Supination _____	
Pronation _____	
Toe dorsiflexion _____	40° (mtp) _____
Toe plantar flexion _____	40° (mtp) _____
	Big toe dorsiflexion (mtp) (65-70°) _____
	Big toe plantar flexion (mtp) 45° _____
	Toe abduction + adduction _____
	5° first ray dorsiflexion _____
	5° first ray plantar flexion _____

Resisted isometric movements:

Knee flexion _____
 Plantar flexion _____
 Dorsiflexion _____
 Supination (inversion) _____
 Pronation (eversion) _____
 Toe extension (dorsiflexion) _____
 Toe flexion (plantar flexion) _____

Passive movement motion palpation (Passive ROM quality, ROM overpressure, joint play)

Ankle joint: Plantarflexion _____ Dorsiflexion _____
 Talocrural: Long axis distraction _____
 Subtalar joint: Varus _____ Valgus _____
 First ray: Dorsiflexion _____ Plantarflexion _____

Circumduction of forefoot on fixed rearfoot:

Midtarsal: A-P glide _____ P-A glide _____ rotation _____

Tarso metatarsal joints: A-P _____

Intermetatarsal glide: _____

Metatarsophalangeal dorsiflexion (with associated plantar flexion of each toe) _____

Interphalangeal joints: long axis distraction _____ A-P glide _____
lat and med glide _____ rotation _____

Special tests

Anterior drawer test _____

Talar tilt _____

Thompson test _____

Homan sign _____

Tinel's sign _____

Subtalar neutral position _____

Balance/proprioception _____

Test for rigid/flexible flatfoot _____

Alignment

Heel to ground _____

Feiss line _____

Tibial torsion _____

Heel to leg (subtalar neutral) _____

Forefoot to heel (subtalar & Midtarsal neutral) _____

First ray alignment _____

Digital deformities _____

Digital deformity flexible _____

Palpation

Anteriorly

Medial malleoli _____

Med tarsal bones, tibial (post) artery _____

Lat. malleolous, calcaneus, sinus tarsi, and cuboid bones _____

Inferior tib/fib joint, tibia, mm of leg _____

Anterior tibia, neck of talus, dorsalis pedis artery _____

Posteriorly

Calcaneus _____

Achilles tendon _____

Musculotendinous junction _____

Plantarily

Plantar muscles and fascia _____

Sesamoids _____

APPENDIX 4:

INFORMED CONSENT FORM

To be completed in duplicate by patient / subject.

Title of research project:

Name of Supervisor:

Name of research student:

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. Who have you spoken to ? _____
7. Do you understand the implications of your involvement in this study ? YES / NO
8. Do you understand that you are free to withdraw from this study -
 - a) at any time
 - b) without having to give a reason for withdrawing, and
 - c) without affecting your future health care ? YES / NO
9. Do you agree to voluntarily participate in this study ? YES / NO

Patient / Subject Name: _____ Signature: _____

Parent / Guardian Name: _____ Signature: _____

Witness Name: _____ Signature: _____

Research Student Name: _____ Signature: _____

Date: _____

APPENDIX 5: Short-Form McGill Pain Questionnaire

Patients Name: _____

Date: _____

	NONE	MILD	MODERATE	SEVERE
Throbbing	0) _____	1) _____	2) _____	3) _____
Shooting	0) _____	1) _____	2) _____	3) _____
Sharp	0) _____	1) _____	2) _____	3) _____
Cramping	0) _____	1) _____	2) _____	3) _____
Gnawing	0) _____	1) _____	2) _____	3) _____
Hot-Burning	0) _____	1) _____	2) _____	3) _____
Aching	0) _____	1) _____	2) _____	3) _____
Heavy	0) _____	1) _____	2) _____	3) _____
Tender	0) _____	1) _____	2) _____	3) _____
Splitting	0) _____	1) _____	2) _____	3) _____
Tiring-Exhausting	0) _____	1) _____	2) _____	3) _____
Sickening	0) _____	1) _____	2) _____	3) _____
Fearful	0) _____	1) _____	2) _____	3) _____
Punishing-Cruel	0) _____	1) _____	2) _____	3) _____

APPENDIX 6: Numerical Rating Scale-101 Questionnaire

Patient's Name: _____

Date: _____

Please indicate on the line below, the number between 0 and 100 that best describes the pain that you experience when it is at it's worst. A zero (0) would mean "no pain at all", and 100 would mean "pain as bad as it could be". Please only write a number.

Please indicate on the line below, the number between 0 and 100 that best describes the pain that you experience when it is at it's least. A zero (0) would mean "no pain at all", and 100 would mean "pain as bad as it could be". Please only write a number.

APPENDIX 7: Foot Function Index Pain Subscale

The line next to each question represents the amount of pain you typically had in each situation. On the far left is "No pain" and on the far right is "The worst pain imaginable". Place a mark on the line to indicate how bad your foot pain was in each of the following situations. If you were not involved in one or more of these situations, mark that item NA.

How severe was your foot pain:

No Pain

Worst Pain

1. At it's worst?

2. Before you get up in the morning?

3. When you walked barefoot?

4. When you stood barefoot?

5. When you walked wearing shoes?

6. When you stood wearing shoes?

7. When you walked wearing orthotics?

8. When you stood wearing orthotics?

9. At the end of the day?

Saag, K.G., Saltzman, C.L., Brown, C.K. and Budiman-Mak, E. 1996. The Foot Function Index for Measuring Rheumatoid Arthritis Pain: Evaluating Side-to-Side Reliability. Foot and Ankle International, 17 (8): 506-510.

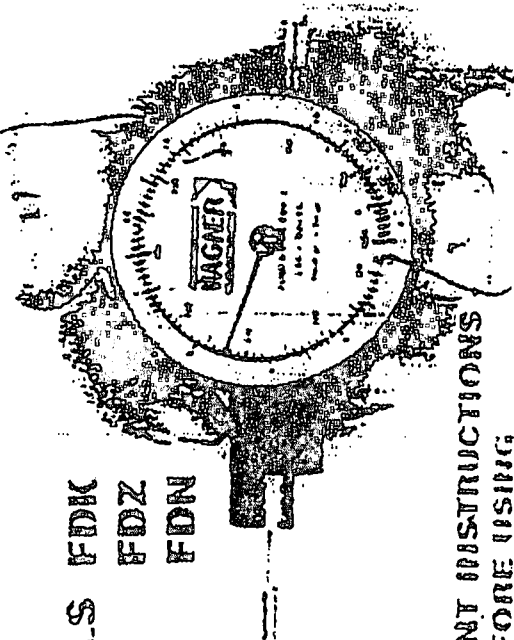
FORCE DIAL CERTIFICATE OF CALIBRATION

WAGNER INSTRUMENTS certifies that all
FORCEDIALS are calibrated at the factory to meet the
specified accuracy of $\pm 1\%$ of full scale, advertised in our
current catalog.

QUALITY CONTROL DIRECTOR

FORCE DIALTM
PUSH - PULL FORCE GAGE

MODELS FDK
FDZ
FDN



IMPORTANT INSTRUCTIONS
READ BEFORE USING

WAGNER INSTRUMENTS
P.O. BOX 1217
GREENWICH, CT 06836 U.S.A.
TEL : 203-069-9681
FAX : 203-069-9871

GENERAL

Your FORCE DIAL should not be used to measure forces below 25% of full scale since true accuracy is degraded as readings decrease from full scale. Before placing the FORCE DIAL into service it is also recommended to test for accuracy according to procedures found in the CALIBRATION section of this manual.

Model FDK FORCE DIALS have no zero on the dial, since setting the pointer at zero has no significance in calibration or accuracy: see CALIBRATION for details.

Lubrication of the FORCE DIAL is not recommended.

IMPORTANT

To prevent damage, keep an implement accessory on the plunger even when the gage is not in use and when using the pull hook. This provides a positive stop and prevents the plunger from being pushed too far.

CALIBRATION

The calibration of the FORCE DIAL may be checked by attaching the pull hook and suspending test weights at 1/4, 1/2, 3/4, and full capacity in the vertical position. The weight of the plunger, flat tip and pull hook (.03 LB, 17/32 OZ, 15 G) should be subtracted from test results. If it is determined that recalibration is required the instrument should be returned to the factory.

IMPLEMENT WEIGHT ADJUSTMENT

The FORCE DIAL is calibrated for use in the horizontal position. When using low capacity models - thru 2 LB/1000 G/40 N - in the vertical position, add or deduct the weight of the implements used from your readings, as follows:

WEIGHT OF IMPLEMENTS

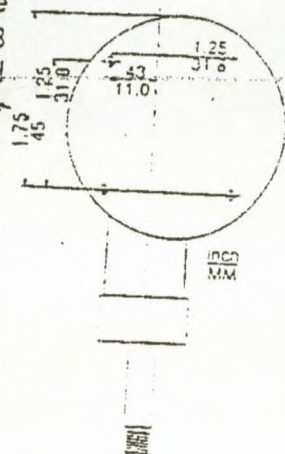
- Plunger: .015 LB/1/4 OZ/7 G
- Flat Tip: .004 LB/1/16 OZ/2 G
- Long Rod: .009 LB/5/32 OZ/4 G
- Pull Hook: .013 LB/7/32 OZ/6 G

ADJUSTMENT:

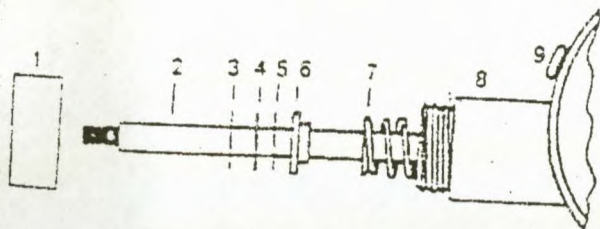
USE	WITH	
Pushing Down	Plunger/Flat Tip	-9 G
Pushing Down	Plunger/Long Rod	-11 G
Pulling Down	Plunger/Flat Tip/Hook	-15 G
Pushing Up	Plunger/Flat Tip	-9 G
Pushing Up	Plunger/Long Rod	-11 G
Pulling Up	Plunger/Flat Tip/Hook	-15 G

MOUNTING

Your FORCE DIAL may be mounted with three #6 (.138 in/3.5 mm O.D.) sheet metal screws using the hole pattern shown below. The three dimples on the rear housing will assist in starting the screws. Sturdy posts are located internally behind the dimples to accept the screws. The screws should penetrate no more than 3/8 inches or 10 mm.



PARTS



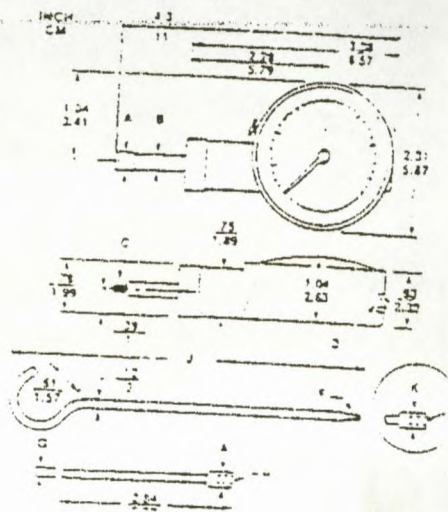
- | | | |
|--------------|-------------------------|-----------------|
| (1) Retainer | (5) Calibration Washers | (6) Case |
| (2) Plunger | (6) Plate | (9) Push Button |
| (3) Disc | (7) Spring | (10) Crystal |
| (4) Clip | | (11) Pointer |

ACCESSORIES: *

- (12) Flat Tip (thru 2 LB / 1000 G / 10 N)
(13) Flat Tip (5 LB / 2500 G / 20 N & up)
(14) Long Rod (thru 2 LB / 1000 G / 10 N)
(15) Long Rod (5 LB / 2500 G / 20 N & up)
(16) Pull Hook (thru 2 LB / 1000 G / 10 N)
(17) Pull Hook (5 LB / 2500 G / 20 N & up)

Not shown in diagram.

DIMENSIONS



High and low capacity models differ slightly in design. The lettered dimensions above, along with the corresponding measurements and comments shown below identify these small variations.

All dimensions are approximate.

Low Capacity (thru 2 LB/1000 G) High Capacity (5 LB/2500 G & up)

A	19	45 cm	A	26	65 cm
B	12	3 cm	B	24	6 cm
C	M3	male	C	M4	male
D	M3	male	D	M3	female
E	M3	female	E	M3	male
G	12	3 cm	G	14	35 cm
H	M3	female	H	M4	female
J	2.8	7-1 cm	J	3.2	8-6 cm
K	19	45 cm			