THE EFFICACY OF MANIPULATION AND MOBILIZATION IN THE TREATMENT OF MORTON'S NEUROMA

BY

NEETU GOVENDER

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Final submission of a dissertation to the Faculty of Health in partial compliance with the requirements for a Master's Degree in Technology: Chiropractic at the Technikon Natal.

I, Neetu Govender, do hereby declare that this dissertation represents my own work both in conception and execution.

18-01-02

Neetu Govender Date

Approved for final submission

18-01-02

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DEDICATION

To my dearest husband Megan, thank you for all the love, guidance, encouragement, and constant support.

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ABSTRACT

The purpose of this randomised, placebo-controlled clinical trial was to investigate the efficacy of foot and ankle manipulation and mobilization as opposed to a placebo treatment (de-tuned ultrasound), in terms of objective and subjective findings in the treatment of Morton's neuroma.

This clinical trial consisted of two groups, each with twenty patients. Patients who were diagnosed by the researcher as suffering from Morton's neuroma were included in the study. The patients were randomly allocated into the respective groups. The ages of the patients ranged from 23 to 79 years old. Group A received the de-tuned ultrasound as the placebo treatment and Group B received foot and ankle manipulation and mobilization as well as the de-tuned ultrasound to eliminate any massage effect that may have been incurred. It was hypothesised that foot and ankle manipulation and mobilization would be effective in the treatment of Morton's neuroma.

The treatment protocol consisted of a course of six treatments over a treatment period of three weeks. Subjective and objective measurements were taken at the initial, third and final consultations. Subjective data was obtained via the use of the Numerical Rating Scale 101, the Short-form McGill Pain Questionnaire and the Foot Function Index. Objective data was obtained by means of digital algometer measurements.

Upon collection of the data, the statistical package SPSS© was used to record and analyse the data. Due to the sample size being below sixty, non-parametric tests were used. Inter-group comparisons that were made using the Mann-Whitney U-test showed that both groups started off similarly in terms of the patients' perception of pain and disability. According to the data obtained from the Numerical Rating Scale 10 (NRS 101), there was a statistically significant difference in the patients' level of pain perception at the final consultation in favour of Group B. Inter-group comparison of algometer readings showed a statistically significant difference in terms of pain pressure threshold and pain pressure tolerance at the final consultation in favour of Group B. The above results indicated that manipulation and mobilization was more effective in the treatment of Morton's neuroma.

Intra-group comparisons were made using the Friedman's Test for K-related samples. A Dunn's procedure (a multiple comparison test) was then performed for significant findings to determine at which stage the treatment made a significant difference. Analysis of the subjective data showed statistically significant differences for both groups indicating that there was a decrease in the levels of pain perception and disability in both groups. However for the Short-form McGill Pain Questionnaire statistically significant differences were seen within Group B only. The subjective improvement reflected from the NRS 101 and the Foot Function Index within Group A may have been attributed to the placebo effect.

Analysis of the objective data obtained from the algometer readings for pain pressure threshold and pain pressure tolerance showed that statistically significant differences were found only within Group B.

It can be noted that both subjectively and objectively, foot and ankle manipulation and mobilization appears to be a reliable treatment for Morton's neuroma, and that foot and ankle manipulation and mobilization appears to be more effective than de-tuned ultrasound in the treatment of Morton's neuroma.

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DEFINITION OF TERMS

Fixation

The state whereby an articulation has become temporarily immobilised in a position which it may normally occupy during any phase of physiologic movement. The immobilisation of an articulation in a position of rest when the joint is in movement (Bergman, 1993)

Manipulation

A manual procedure that involves a directed thrust to move a joint past the physiological range of motion, without exceeding the anatomic limit (Gatterman, 1995).

Mobilization

Movement applied singularly or repetitively within or at the physiologic range of joint motion, without imparting a thrust or impulse, with the goal of restoring joint mobility (Gatterman, 1995).

Motion Palpation

A palpatory diagnostic procedure utilised to assess the character of the motion of a motion unit, to determine if a motion dysfunction exists (Nook, 1998).

Morton's neuroma

Morton's neuroma is a commonly occurring disorder associated with symptoms of forefoot pain and parasthesias caused by perineural fibrosis (Rasmussen et al. 1996).

Placebo

An intervention designed to simulate medical therapy, but not believed (by the investigator or clinician) to be a specific therapy for the target condition. It is used either for its psychological effect or to eliminate observer bias in an experimental setting (Turner et al. 1994)

CHAPTER ONE

THE PROBLEM AND ITS SETTING

1.1 PROBLEM STATEMENT

The purpose of this randomised, placebo-controlled study was to determine the efficacy of manipulation and mobilization of the foot and ankle joints in terms of objective and subjective measurements in order to demonstrate the contribution of such an intervention in the treatment of Morton's neuroma.

1.2 SUB-PROBLEMS

1.2.1 SUB-PROBLEM 1

The first sub-problem was to investigate the effectiveness of foot and ankle joint manipulation and mobilization used to treat the experimental group, in terms of objective and subjective measurements in order to establish the value of foot and ankle manipulation and mobilization in the treatment of Morton's neuroma.

1.2.2 SUB-PROBLEM 2

The second sub-problem was to investigate the effectiveness of de-tuned ultrasound used to treat the control group, in terms of objective and subjective measurements in order to establish the value of de-tuned ultrasound in the treatment of Morton's neuroma.

1.2.3 SUB-PROBLEM 3

The third sub-problem was to integrate the results obtained from the experimental group and control group in order to determine the contribution of manipulation and mobilization of the foot and ankle joints, as opposed to de-tuned ultrasound, in the treatment of Morton's neuroma.

1.3 HYPOTHESES

1.3.1 THE ALTERNATIVE HYPOTHESIS

It was hypothesised that manipulation and mobilization of the foot and ankle joints for the treatment of Morton's neuroma, will in terms of objective and subjective measurements provide pain relief.

1.3.2 THE NULL HYPOTHESIS

It was hypothesised that manipulation and mobilization of the foot and ankle joints for the treatment of Morton's neuroma, will have no effect on pain in terms of objective and subjective findings.

1.4 THE IMPORTANCE OF THE STUDY

Morton's neuroma is likely to be the most common intrinsic nerve disorder of the foot (Levy and Hetherington, 1990). It is associated with symptoms of forefoot pain and parasthesias (Rasmussen et al. 1996). The orthodox treatment for Morton's neuroma includes metatarsal padding, arch supports, steroid injections and surgery (Basadonna et al. 1999).

According to a single case study conducted by Basadonna et al. (1999), frequent complications of steroid injections are the development of subcutaneous fat pad atrophy, altered cutaneous pigmentation, and telangiectasia.

Surgery is an invasive technique and should always be considered as a last resort (Johnson et al. 1988). Due to the controversy of the invasive therapies used for treating Morton's neuroma there is a need to establish the efficacy of more conservative forms of therapy.

Brantingham et al. (1994), conducted a retrospective analysis of case records of 29 patients diagnosed with Morton's neuroma, who received chiropractic treatment which included, manipulation, mobilization, ultrasound, whirlpool, ice and diathermy. On a follow-up examination, only 5 patients had less than 50% pain relief. Most patients reached their level of improvement after 6 to 9 treatments. This review suggests that manipulation and mobilization may have value in the treatment of Morton's neuroma,

however it was not a controlled study and it did not compare manipulation and mobilization to placebo. Physiotherapeutic modalities were also used to treat the patients. Manipulation and mobilization seems to be a reasonable alternative used in the treatment of Morton's neuroma as it is non-invasive and has minimal side-effects (Brantingham et al. 1994). Therefore in order to determine the efficacy of manipulation and mobilization excluding the use of physiotherapeutic modalities in the treatment of Morton's neuroma, it is necessary to do a placebo-controlled study. This study endeavoured to investigate the role that manipulation and mobilization would play in the treatment of Morton's neuroma.

MEMORANDUM

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CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

Morton's neuroma is a commonly occurring disorder associated with symptoms of forefoot pain and parasthesias caused by perineural fibrosis (Rasmussen et al. 1996). The condition is also known as Morton's metatarsalgia, metatarsalgia with interdigital neuritis, plantar digital neuritis, and interdigital neuroma (Brantingham et al. 1994). Although the term neuroma is used throughout the literature, it may be misleading, as Morton's neuroma is not a nerve cell tumour.

2.2 PREVALENCE / INCIDENCE OF MORTON'S NEUROMA

Youngswick (1994) has shown that out of 4000 patients presenting to their podiatric practice, 372 were diagnosed with a neuroma (ie. 9.3%). Of the 372 patients diagnosed with an intermetatarsal neuroma, 318 were females and 54 were males. The condition may occur bilaterally and it is possible for multiple neuromas to occur in the same foot (Mollica, 1997). The typical site of occurrence for a neuroma is either in the second or third intermetatarsal space and it may also occur in other intermetatarsal spaces (Mollica, 1997).

2.3 ANATOMY AND BIOMECHANICS OF THE FOOT

The foot's 26 bones include 14 phalanges, 5 metatarsals, and 7 tarsal bones. The foot can be divided into three functional segments. The posterior segment, comprising of the talus and the calcaneus, is at the apex of the foot and is part of the ankle joint. It basically supports the body by its articulation on the tibia within the ankle mortise. The calcaneus is the posterior portion of the foot that is in direct contact with the ground.
The middle segment of the foot consists of the 5 tarsal bones, that is, the navicular, the cuboid, and 3 cuneiforms. The anterior segment contains 5 metatarsal bones and 14 phalangeal bones forming the toes (Cailliet, 1997).

The concept of medial and lateral longitudinal arches is static and is based on the similarity between the arch shape of the foot. This concept cannot simply be transferred to the weight-bearing foot, which is moving and subject to changing forces. An arch is fixed at each end and bent upward to resist and to conduct into its support loads.
In terms of support, the intrinsic muscles, tibialis anterior and peroneus longus, have been shown to be inactive on static weight-bearing and this is strong evidence that the ligaments and plantar aponeurosis must play a predominant role in the support of the static foot skeleton. The ligaments of the foot are histologically identical to the plantar fascia (Klenerman, 1991).

The ankle joint has two axes of movement, when the joint is in flexion and extension. Thus the foot moves in the ankle like a poorly mounted wheel and swerves slightly from

side-to-side as dorsiflexion and plantarflexion occurs. Normally the swerve is compensated by the action of the subtalar and talonavicular joints (Klenerman, 1991).

Pronation of the subtalar joint occurs during the swing phase and heel contact. During pronation, the talus adducts, plantarflexes and is displaced anteriorly on the calcaneus thus causing the navicular and the first three rays to move forward and abduct in relation to the fourth and the fifth rays. The subtalar joint supinates during midstance and propulsion, this results in the talus abducting, dorsiflexing and becoming posteriorly displaced on the calcaneus (resulting in the windlass effect which passively advances the calcaneus). Hence, as the calcaneus moves forward, the fourth and fifth rays move forward (Carrier et al. 1975).

The intermetatarsophalangeal bursa lies superior to the transverse metatarsal ligament in the web spaces between the second and third, and the third and fourth digits of the foot. This bursa projects distal to the ligament, being closely applied to the neurovascular bundle. The internal and the external plantar nerves exit the sole of the foot on each side of the flexor digitorum brevis muscle. These divide into digital nerves that track distally between the plantar aponeurosis and the tendons. The internal plantar nerves divides into three digital nerves to enter the three medial web spaces. Each nerve further divides on the plantar aspect of the transverse metatarsal ligament and supplies a branch to the opposing sides of two toes. Innervation to the fourth cleft is supplied by the lateral plantar cutaneous nerve. The digital nerve to the third cleft is most often involved. Digital arteries accompany the digital nerves (Strong and Thomas, 1987).

At the level of the metatarsal heads, these nerves pass beneath the transverse intermetatarsal ligament. At this point, they are at risk of compression. The third interdigital nerve is most commonly involved, followed by the second interdigital nerve. The first and fourth interdigital nerves are rarely affected (Willick and Herring, 1998).

2.4 AETIOLOGY OF MORTON'S NEUROMA

Mulder (1951) surgically demonstrated that the neuroma was adherent to the intermetatarsal bursa and could only be removed by opening the bursa by performing gentle dissection. On inspection of the bursa he found that it appeared to be enlarged and bore the marks of frequent damage to its fibrous walls in the form of thickening and formation of irregular fibrous bands and layers. Mulder (1951) also suggested that the neuroma was caused mechanically by repeated pinching of the plantar nerve between the metatarsal heads during the abnormal movements associated with weak transverse arches.

There are many conditions implicated in the aetiology. In a study of the results of surgical treatment carried out by Ruuskanen et al. (1994) on 45 patients (52 feet), it was noted that a hallux valgus deformity was present in 13 feet. Hammer toes were present in 13 feet. Clinically evident flat foot was noted in 5 feet.

Viladot (1992) discovered that of the 66 patients treated surgically, insufficiency of the first ray, with or without hallux valgus, and overloading of the lateral metatarsal heads was present in 43. Fourteen patients had hammer toes and 5 had pes cavus. Other conditions present were flat foot, Freiburg's disease and a synovial cyst.

Bossley and Cairney (1980) showed by dissection the close proximity of the intermetatarsophalangeal bursae to the neurovascular bundles. It was therefore suggested that inflammation of these bursae could cause secondary fibrosis leading to the classical symptoms of Morton's neuroma.

Carrier et al. (1975) offers a biomechanical viewpoint on the aetiology of Morton's neuroma. When the talus and the calcaneus move forward during supination and pronation, the third interspace is subjected to a shearing force. During anterior displacement of the medial three segments of the forefoot, a strain is placed on the medial bifurcation of the third plantar common digital nerve. During anterior displacement of the lateral two segments, the tension is on the lateral bifurcation of the nerve. The recurring trauma to the nerve leads to an inflammatory process. Carrier et al. (1975) suggests that the nerve trauma is compounded by the fact that nerves don't contain elastin and are therefore incapable of stretching when subjected to tension. The other factor implicated by Carrier et al. (1975), is the double origin of the nerve of the third interspace as it is subjected to greater shearing forces because of its greater thickness and is thus more vulnerable to damage.

Biomechanical abnormalities such as foot hyperpronation, hypersupination, digital contractures and hammer toes have also been implicated in the aetiology of Morton's neuroma (Brantingham et al. 1994).

Aggravating factors are all situations that determine chronic compression between two metatarsal heads, these include, walking on hard surfaces, wearing tight or high-heeled shoes, and excessive mobility of the fourth metatarsal (Basadonna et al. 1999).

Viladot (1992) suggested that narrow shoes with high heels produce microtrauma to the metatarsal heads during walking.

Activities that increase risk of interdigital neuroma include running, ballet dancing, stair stepping, and other activities that include dorsiflexion of the toes. Inflexibility of the hip flexors, hamstrings, or plantar flexors may all lead to excessive compensatory extension of the metatarsophalangeal joint during push-off. Side-to-side compression of the forefoot, as occurs when athletic footwear is too narrow, can also compress the interdigital nerves (Willick and Herring, 1998).

2.5 CLINICAL PRESENTATION

The patient usually complains of a burning pain in the ball of the foot that is aggravated by activity and tight footwear and relieved by rest (Willick and Herring, 1998). It may also be described as a dull, cramping sensation associated with burning, tingling, and/or numbness which radiates into the toes, followed by intermittent bouts of sharp, shooting pains (Mollica, 1997). According to Brantingham et al. (1994), removing tight-fitting or high-heeled shoes and massaging the foot alleviates the symptoms.

The diagnosis of Morton's neuroma is usually based on subjective and clinical findings, and in those patients whose symptoms are accompanied by co-existing neurological conditions, ultrasonography and Magnetic Resonance Imaging (MRI) may be helpful in the diagnosis (Mendicino and Rockett, 1997). Diagnosis is sometimes confirmed by the reproduction of pain caused by squeezing the web space between the metatarsal heads and also by squeezing the metatarsal heads with pressure on the sides of the foot (Brantingham et al. 1994).

2.6 PATHOLOGY

According to Mann and Reynolds (1983), the most common pathological findings were of perineural fibrosis and degeneration of nerve tissue as well as thickening and hyalinisation of the walls of the endoneural vessels. Johnson et al. (1988), have also

found pathological findings of thickening and fibrosis of the epineurium and perineurium and degeneration of myelinated fibres.

The nerve shows evidence of trauma with demyelination occurring in the early stages with oedema (Levy and Hetherington, 1990).

Vilodot (1992), suggests that histological findings show that the cause of the neuroma is a reactive fibroblastic perineural and intraneural process, and are therefore characteristic of an irritative lesion.

2.7 DIFFERENTIAL DIAGNOSIS OF MORTON'S NEUROMA

- Metatarsalgia
- Metatarsophalangeal joint synovitis
- Metatarsal stress fracture
- Tarsal tunnel syndrome
- Intermetatarsal bursitis
- Extensor tendon tenosynovitis
- Sesamoiditis
- Freiberg's disease
- Systemic inflammatory conditions
- Joint dysfunction

The above list was adapted from: Rasmussen et al. (1996), Mollica (1997) and Hinwood (1990).

2.8 THE EFFECTIVENESS OF MANIPULATION AND MOBILIZATION OF THE FOOT

Brantingham et al. (1994) did a review of 29 patients, with the diagnosis of Morton's neuroma, who received chiropractic treatment.

The average age of the patients was 40 years. There were 20 females and nine males. The average duration of foot pain was 19 months. The average number of treatments was eight. On follow-up, three months after treatment was completed, 16 patients (55.2%) reported an excellent outcome (75-100% pain relief). Eight patients (27.6%) had a moderate outcome (50-75% pain relief), and five patients (17.2%) had a poor outcome (less than 50% pain relief). Most patients reached their level of improvement after 6 to 9 treatments.

A case report done by Brantingham et al. (1994) showed successful results. A 37-year-old male engineer described a burning pain in the proximal phalanx of the left fourth toe (started 17 years ago). On examination mild bilateral hypersupination and hammer toes were revealed. Squeezing the web space between the third and fourth metatarsal heads reproduced the burning pain. The treatment consisted of mobilization of the metatarsals and metatarsophalangeal joints, mobilization of the forefoot and rearfoot, manipulation of the cuboid intertarsal joint and cuneiform intertarsal joints and ankle mobilization. Ultrasound was applied before manipulation and a metatarsal felt-pad was placed beneath the metatarsal heads. Thirteen treatments were provided in a three month period. After

the first and second months of treatment the pain intensity was rated at 2 out of 10, and after the third month the pain intensity level was rated at 1 out 10.

Two case reports were presented by Brantingham et al. (1991). The first was a 54-year-old female whose pain, especially on the right foot, extended into the toes with burning numbness and tingling. Treatment consisted of bilateral mobilization of the second, third and fourth metatarsals to restore intermetatarsal glide. Manipulation was delivered to the intertarsal joints. Mobilization was also administered to the midtarsal joints. Hydrotherapy and ultrasound were also applied. Five treatments over a period of ten days resolved most of her pain. The patient reported 70% relief of symptoms.

The second case report concerned a 21-year-old woman who described a stabbing pain in the right ball of her foot. The pain was followed by a sense of cramping between the third and fourth toes. Treatment was initially one week of daily cold whirlpool and ultrasound (to decrease the inflammation). This was followed by mobilization of the right metatarsals and manipulation of the right intertarsal joints. She reported a 95% relief of her symptoms. She was seen again after three months and reported continued relief.

Another case report was presented by a practising chiropractor, Hinwood (1990), in which he himself was the patient. He reports to have experienced severe intermittent pain localised to the region of the fourth metatarsal head of the right foot. Adjustments were performed to the painful area. The adjustment was painful, but resulted in immediate dissipation of the acute pain. However if the foot was left untreated, the pain would

continue. Initially, the pain seemed to return less quickly following chiropractic adjustment. In the final stages the foot had to be adjusted three to four times a night in order to relieve the pain. Exploratory surgery was performed on the third interspace and a large neuroma was excised with relief of the symptoms.

The above case studies and the review of 29 patients supports the use of manipulation and mobilization in the treatment of Morton's neuroma. However, in the case described by Hinwood (1990) surgical intervention was imperative. The above treatments also combined manipulation and mobilization with physiotherapeutic modalities, hence the true effectiveness of manipulation and mobilization could not be established. There was also no placebo-controlled study performed, hence the efficacy of manipulation and mobilization could not be established. The present placebo-controlled study endeavoured to establish the efficacy of manipulation and mobilization in the treatment of Morton's neuroma.

2.9 MEDICAL MANAGEMEMT OF MORTON'S NEUROMA

Medically, the more common treatments used are invasive techniques.
Rasmussen et al. (1996) studied patients who received a single corticosteroid injection for treatment of third webspace plantar interdigital neuroma. Forty three patients (51 feet) were available for follow-up study. Initially, the pain was relieved in 36 patients. Twenty-four feet (47%) required surgical excision. Most of the remaining 27 feet (53%) which were not treated surgically experienced residual symptoms. It was suggested that a single

corticosteroid injection could not be recommended as a cure of the symptoms but as a temporary measure or as a non-operative treatment.

A case of bilateral interdigital Morton's neuroma treated with steroid injection therapy developed plantar fat pad atrophy, shown on magnetic resonance imaging. Pathological changes that occurred at the site of injection included subcutaneous fat atrophy, depigmentation of the skin, and telangiectasias. Steroid injection therapy has caused changes in the plantar aspect of the feet with serious functional problems (Basadonna et al. 1999). A patient diagnosed with interdigital neuroma was treated with a local corticosteroid injection later developed hyperpigmentation, thinning of the skin and subcutaneous fat atrophy at the site of the injection (Reddy et al. 1995).

Johnson et al. (1988) reported on persistent pain after excision of an interdigital neuroma. Thirty-four patients (37 feet) had a re-operation for pain that persisted after excision of a neuroma. Only 1 patient was not available for follow-up. Twenty-two patients had complete relief or marked improvement of the pain, 3 had improvement but had persistent pain and 8 had no improvement or worse pain.

Ruuskanen et al. (1994) reported on 45 patients who were operated on for Morton's neuroma. The outcome was good in 20, fair in 14, and poor in 11 in a 6 year follow-up period.

A metatarsal pad positioned proximal to the heads of the central three metatarsals may reduce symptoms. Nonsteroidal anti-inflammatory drugs (NSAIDs) may relieve acute pain and inflammation (Mollica, 1997).

According to the current literature on medical intervention the most common treatments used are surgery, corticosteroid injections, NSAIDs, and metatarsal padding. There is a need to establish a conservative treatment protocol that may be used initially, before a patient considers surgery. This study endeavored to ascertain whether manipulation and mobilization of the foot and ankle joints is a reasonable and effective conservative treatment protocol for the treatment of Morton's neuroma.

2.10 THE PLACEBO EFFECT

Turner et al. (1994) calculated that placebo responses ranged from 15% to 58% and on average symptoms were relieved by placebo in 35% of patients.
Psychoneuroendoimmunology provides a model in which placebo responses are seen to link psychological and physical processes through common anatomical pathways. The mind and body are linked by established neural and hormonal pathways (Jamison, 1996).

There are many misconceptions about placebos, including the following beliefs:

a) about one third of the patients will have a placebo response in any clinical trial;
b) placebo effects are brief;
c) certain personality types are more likely to be placebo-responders;

d) placebo responders have nothing wrong with them to begin with;

e) giving a placebo is the same as doing nothing.

Highly compliant patients may have better outcomes than non-compliant patients even when complying with a placebo. There is also some evidence that highly anxious patients show the greatest placebo responses (Turner et al. 1994).

Rates of good patient outcomes after placebo treatments varies with different studies, but are high on average. Randomised controlled trials can establish the effect of a treatment above and beyond non-specific (placebo) effects (Turner et al. 1994).

2.11 SUMMARY

In summary the literature indicated the need for a randomised controlled trial to show the efficacy of mobilization and manipulation in the management of Morton's neuroma. Surgery and corticosteroid therapy has disadvantages and side-effects (Johnson et al. 1988 and Basadonna et al. 1999). The efficacy of manipulative therapy has not been established in the treatment of Morton's Neuroma. This pilot study should add to the existing body of knowledge and open new areas of research in this field.

CHAPTER 3

MATERIALS AND METHODS

3.1 INTRODUCTION

This single-blinded, randomised, placebo-controlled study compared foot and ankle manipulation and mobilization to placebo (de-tuned ultrasound) in the management of Morton's neuroma, over a three-week period.

3.2 PATIENT SELECTION

A sample size of forty patients diagnosed with Morton's neuroma was used. The patients were recruited from the local Durban community by means of distribution of pamphlets, advertisements, posters and referrals. Patients who responded to advertisements were examined by the researcher to assess whether or not they fulfilled the inclusion criteria.

3.3 INCLUSION AND EXCLUSION CRITERIA

Patients who met the inclusion criteria were accepted into this study. This was determined at the initial consultation as follows,

- a detailed case history (Appendix 1) was taken, and a relevant part of a physical examination (Appendix 2) was performed on each patient by the researcher;
- a foot and ankle regional examination (Appendix 3) was performed on each patient;

- the researcher then explained the nature and importance of the study and each patient was given the Patient Information Letter (Appendix 4) to read. If the patient had any questions regarding the study and the condition, they were answered at this point;
- each patient then read and answered the Informed Consent Form (Appendix 5).

3.3.1 INCLUSION CRITERIA

- There was no restriction on age and sex of the patients.
- Only those patients diagnosed by the researcher as suffering from Morton's neuroma were included in this study. The diagnostic criteria were:

➢ patients who had a history of burning pain in the web space of the small toes, which was aggravated by wearing tight-fitting shoes or high-heeled shoes, and relieved by removing the shoe and massaging the foot, or,

➢ patients who suffered from pain that was reproduced by squeezing the web space between the metatarsal heads, or,

➢ patients who experienced pain that was reproduced on squeezing the metatarsal heads by applying pressure to the sides of the foot.

3.3.2 EXCLUSION CRITERIA

- Patients were asked to refrain from anti-inflammatories and any other form of therapy for foot pain.
- Patients who did not have restrictions of the foot and ankle joints, as manipulation and mobilization were only applied to areas of restriction.
- Patients were advised against wearing tight footwear during the course of the study.
- Patients with the following conditions were excluded:
  - primary metatarsalgia
  - tarsal tunnel syndrome
  - metatarsal stress fracture
  - Freiburg's disease
  - systemic inflammatory conditions
  - metatarsal joint synovitis
  - severe degenerative arthritis.

3.4 THE SAMPLE GROUP

Forty eligible patients were chosen to participate in the study. The patients were randomly allocated to a placebo group and a treatment group. There were twenty cards with "A" and twenty cards with "B" marked on them. Treatment A was the placebo group and treatment B was the treatment group. At the initial consultation the patients chose a card from a box and were placed in the chosen group.

De-tuned ultrasound was used as the placebo treatment. However, ultrasound therapy involves oscillatory type movements of the ultrasound head via a couplant over the area to be treated. Hence, controversy exists as to whether ultrasound can be used as a form of placebo. It has been argued that there is a massaging effect on the area that is treated. To eliminate any controversy, the de-tuned ultrasound was applied to both groups of patients.

Both groups were motion palpated to find restrictions in joint motion and tenderness as well as to locate an interdigital soft tissue mass (the neuroma). Group A received the application of de-tuned ultrasound over the areas of pain and restrictions. The areas of pain and restriction received the de-tuned ultrasound for a period of five minutes. Group B was mobilised to remove possible intermetatarsal and midtarsal restrictions. Manipulation was then delivered to any areas of restriction found within the ankle and foot joints (Brantingham et al. 1994). After the manipulation and mobilization, group B also received the de-tuned ultrasound for a period of five minutes.

Both groups of patients received a total of six treatments over a maximum period of three weeks. The number of treatments given and the frequency of treatment were based on a study done by Brantingham et al. (1994). All the patients were advised against wearing tight footwear during the course of the study.

3.5 MEASUREMENTS

Objective and subjective data were obtained before the first, third and final treatment sessions. At each of these visits patients were required to complete a Numerical Pain Rating Scale 101 (Jenson et al. 1996), a Short-form McGill Pain Questionnaire (Melzack 1987) and a Foot Function Index (Budiman-Mak et al. 1991). A digital algometer was used to obtain pain pressure threshold and pain pressure tolerance (Livingston et al. 1998).

3.5.1 SUBJECTIVE MEASUREMENTS

3.5.1.1 THE NUMERICAL PAIN RATING SCALE 101 (NRS 101)

The NRS 101 consists of asking the patient to rate the perceived level of pain on a numerical scale from 0 to 100. A rating of 0 represents no pain and a rating of 100 represents the worst possible pain experienced by the patient. The intensity of pain is indicated, both at its best and worst, by the patient.

In a study carried out by Jenson et al. (1986), 75 patients suffering from chronic pain rated their pain using 6 types of measuring tools. The NRS 101 was shown to be more advantageous than the other measures. Administration and scoring was found to be simpler. Administration could have either been in a written or verbal form. It also has 101

response categories which makes it better than other pain intensity measures which have limited response options. The NRS 101 was not associated with incorrect responses. According to Jenson et al. (1986) the NRS 101 seems to be a wise choice over other pain intensity measures.

3.5.1.2 THE SHORT-FORM McGILL PAIN QUESTIONNAIRE

The Short-form McGill Pain Questionnaire, which is used to obtain data on the sensory, affective and evaluative dimensions of pain has become one of the most widely used tests to measure pain (Melzack 1987). The form consists of 15 descriptors, with 1-11 representing the sensory dimensions of pain and 12-15 representing the affective dimensions of pain. Each pain descriptor is ranked by the patient on an intensity scale of 0 = none, 1 = mild, 2 = moderate, and 3 = severe pain.

This questionnaire was developed to be used where detailed information regarding pain is required quickly, as well as to reduce patient fatigue, and appears to be a useful tool (Melzack 1987).

3.5.1.3 THE FOOT FUNCTION INDEX

According to Budiman-Mak et al. (1991), the Foot Function Index (FFI) was developed to measure the impact of foot pathology on function in terms of pain, disability, and activity restriction. In 1986 a three year clinical trial was started at five hospitals in

Chicago to examine the efficacy of foot orthoses in the prevention of pain, deformity and disability (Budiman-Mak et al. 1991). Foot pain, disability and deformity were measured and the patients were randomised into treatment and control groups. Patients were examined every six months over three years. At each visit the patients were examined for various clinical findings and they were also required to complete the FFI at the consultation. An additional FFI was given to the patients to complete at home and post it to the researchers According to the above study, the FFI was considered to be an easily administered clinical index which provided a practical method of measuring pain. The conclusions made by Budiman-Mak et al. (1991) were as follows:

- the FFI has good test-retest properties which indicates that it produces consistent information,
- the FFI appears to be able to detect changes in clinical status occurring over short periods of time,
- and the FFI is proved to be a useful instrument in clinical practice and in clinical research.

The FFI consists of three sub-scales which provided data on foot pain, disability and activity limitation. According to Budiman-Mak et al. (1991), the activity limitation sub-scale was less consistent than the other two and hence the contribution of this sub-scale to the measurement of foot function was not clear. Therefore for the purpose of this study the sub-scales which provided data on foot pain (Section A) and disability (Section B) were utilised. The various descriptors were rated from 0 to 10, with 0 indicating no pain and 10 indicating the worst pain.

3.5.2 OBJECTIVE MEASUREMENTS

Pain pressure threshold and pain pressure tolerance were measured using the digital algometer (Algometer Commander^{TM}). Pressure threshold is defined as the minimum pressure that is required to cause pain (Livingston et al. 1998). Pressure tolerance is defined as the highest pressure that can be tolerated under clinical conditions (Livingston et al. 1998).

According to Livingston et al. (1998), pressure measurement is effective for evaluating the results of pain relieving modalities such as anesthetic blocks, heat, manipulation and anti-inflammatories. Due to its reliability and reproducibility, algometry can be used for objective medico-legal documentation of pain intensity (Fischer, 1986).

The following method was used in obtaining algometer measurements:

- the involved intermetatarsal space was exposed,
- before applying pressure to the area, the patient was requested to verbally indicate the onset of pain (in the case of pressure threshold) and in the case of measuring pressure tolerance the patient was requested to verbally indicate the amount of pressure that could be tolerated,
- the intermetatarsal area was palpated to find the exact spot of maximum pain intensity, which was then marked and documented for further testing,
- the applicator tip was then placed over the mark and a force was applied perpendicular to the skin's surface at a gradually increasing rate,

- as soon as the patient verbally indicated, the pressure was released and a result was recorded by the algometer automatically,
- three separate readings were taken to improve the reliability of the test.

3.6 INTERVENTIONS

Foot and ankle restrictions that were found in the patients within group B were mobilised and manipulated, while the patients in group A received de-tuned ultrasound. Patients were treated twice a week for a period of three weeks. The most common fixations found were: medial and lateral dorsal to plantar shear of the midtarsal joints, metatarsal shear, plantar to dorsal cuboid, subtalar eversion, and long axis distraction of the talocrural joint.

The following were the most common manipulative techniques used to treat the patients in group B.

- **Long Axis Distraction (talocrural)**

  This technique is usually used for loss of long axis distraction joint play movement. The patient is in the supine position while the doctor stands at the foot end of the table. Contact is made with the middle finger over the dome of the talus while the other hand re-inforces the contact. The ankle is held in dorsiflexion and a long axis distraction is applied with both hands (Bergman et al. 1993).

- **Mobilization for Intermetatarsal Glide or Shear**

  The shafts of the metatarsals are isolated. The doctor uses the thumbs to contact on the dorsal aspects of the metatarsal shafts while the fingers contact on the plantar aspect. One metatarsal is dorsiflexed while the other is plantarflexed. This movement is performed several times (Brantingham et al. 1991).

- **Plantar to Dorsal Cuboid**

  There is a double thumb contact on the plantar surface of the cuboid. A thrust is given in a plantar to dorsal manner while the forefoot is plantarflexed with the fingers (Brantingham et al. 1991).

- **Mobilization of the Midtarsal Joints on Forefoot**

  During treatment of the right foot, the calcaneus is fixed with the left hand while the right is fixed around the shafts of the metatarsals. A figure of eight movement is induced while the forefoot everts and inverts during motion (Brantingham et al. 1991).

3.7 STATISTICAL ANALYSIS

3.7.1 TREATMENT OF THE DATA

3.7.1.1 SUBJECTIVE DATA

- The scores from NRS 101 were represented as percentages and recorded separately for the initial, third and final consultations in both groups.
- The maximum pain intensity score in the Short-form McGill Pain Questionnaire is 45. The score for each form was added up and recorded for the initial, third and final consultations.
- There are 2 sections to the Foot Function Index (FFI). The first section gives the researcher an indication on the intensity of pain, therefore referred to as FFI-P. The second section gives the researcher an indication of the level of disability that is experienced by the patient, therefore referred to as FFI-D. The maximum score obtainable for FFI-P is 50, and the maximum score obtainable for FFI-D is 70. The scores for FFI-P and FFI-D were added up and recorded separately for the initial, third and final consultations.

Questionnaires completed by the patients were screened to ensure that they had been completed correctly. The data was statistically analysed with the level of significance (α) set at 5% or 0.05.

3.7.1.2 OBJECTIVE DATA

Pain pressure threshold and pain pressure tolerance were recorded in newtons at the initial, third and final consultations with the use of a digital algometer. The data was recorded separately for both groups and was statistically analysed with α set at 0.05.

The sample size was small ie. 20 patients per group, therefore non-parametric tests were used.

3.7.2 STATISTICAL PROCEDURES

The Technikon Natal research statistician, Mr. K. Thomas, was consulted with regards to the manner in which data from the research study was to be analysed. Due to the small sample size ie. 20 patients per group, non-parametric tests were used. Data was transferred into a spreadsheet in the SPSS© software package for statistical analysis (SPSS Inc., 1999).

The Mann-Whitney U-test was used for inter-group analysis of the subjective and objective data. The Friedman test was used for intra-group analysis of the subjective and objective data. These results were shown to be statistically significant, therefore further post-hoc testing was done. Reference will later on be made to the p value. The p value is a probability, with a value ranging from zero to one (Instat, 2001). If the p value is small,

it is highly unlikely that the difference between samples is caused by random sampling, it is therefore concluded that the samples have different means.

3.7.2.1 THE MANN-WHITNEY U-TEST

The Mann-Whitney U-test is a non-parametric test used to compare the data obtained from two independent groups. The purpose of this test was to determine whether there was any significant difference between the placebo and treatment groups with respect to the NRS 101, short-form McGill Pain Questionnaire, Foot Function Index, and the algometer readings (pain pressure threshold and tolerance) at the $\alpha = 0.05$ level of significance.

Hypothesis Testing:

The null hypothesis Ho stated that there was no difference in pain levels, with regards to the pain questionnaires and the algometer readings between the groups. The alternative hypothesis H_1 stated that there was a difference in pain levels, with regards to the pain questionnaires and the algometer readings between the groups.

- Ho: There was no difference between the groups.
- H_1: There was a difference between the groups.
- $\alpha = 0.05$ = level of significance of the test

The Decision Rule:

For a one-tailed test:

- p = reported p value/2 $< \alpha$ if H_1 is of form > and Z is positive

  if H_1 is of form < and Z is negative

- p = 1 – (reported p value)/2 $< \alpha$ if H_1 is of form > and Z is negative

  if H_1 is of form < and Z is positive

- $\alpha = 0.05$

p was the observed significance level of the test

(Thomas, 2001)

3.7.2.2 THE FRIEDMAN TEST FOR K-RELATED SAMPLES

The Friedman test is a non-parametric test that compares three or more paired groups (Instat, 2001). If the p value is small, one can conclude that at least one of the treatments differs from the rest, it is therefore necessary to look at post-hoc tests to determine which group differs from which other group (Instat, 2001). In this study the post-hoc test used was a multiple comparison procedure called the Dunn Procedure (Daniel, 1978). The Friedman test was used within the treatment group and the placebo group to determine if there was any significant difference according to the NRS 101, Short-form McGill Pain Questionnaire, Foot Function Index and the algometer readings between the first, third and the sixth consultations.

Hypothesis Testing:

The null hypothesis H_0 stated that there was no difference between consultations with regards to the variable of interest. The alternative hypothesis H_1 stated that there was a difference between consultations with regards to the variable of interest.

- $\alpha = 0.05$ = level of significance of the test.

The Decision Rule:

For a two-tailed test:

- Reject H_0 at α level of significance if $p < \alpha$
- Do not reject H_0 at α level of significance if $p \geq \alpha$

The Dunn Procedure

If the null hypothesis H_0 was rejected for the Friedman's Test, then this multiple comparison procedure had to be applied to determine which of the treatments were significantly different (Daniel, 1978).

3.8 THE TREATMENT OF THE SUB-PROBLEMS

SUB-PROBLEM ONE

The first sub-problem was to investigate the efficacy of foot and ankle joint manipulation and mobilization used to treat the experimental group, in terms of objective and subjective measurements in order to establish the value of foot and ankle manipulation and mobilization in the treatment of Morton's neuroma.

SUB-PROBLEM TWO

The second sub-problem was to investigate the efficacy of de-tuned ultrasound used to treat the control group, in terms of objective and subjective measurements in order to establish the value of de-tuned ultrasound in the treatment of Morton's neuroma.

SUB-PROBLEM THREE

The third sub-problem was to integrate the results obtained from the experimental group and control group in order to determine the contribution of manipulation and mobilization of the foot and ankle joints as opposed to de-tuned ultrasound in the treatment of Morton's neuroma.

3.8.1 THE DATA REQUIRED

- The data required for testing the hypothesis for the subjective findings in both groups were obtained from each patient's response to the NRS 101, Short-form McGill Pain Questionnaire, and the Foot Function Index.

- The data required for testing the objective findings in both groups were obtained from the readings recorded by the digital algometer.

3.8.2 MEANS OF COLLECTION OF THE DATA

All the data required was collected from the participating patients at the Technikon Natal Chiropractic Day Clinic. The data collection was carried out by the researcher. The patients in both groups were required to complete the pain questionnaires before the initial, third and final consultations. The digital algometer readings were obtained before the initial, third and final consultations. The information was stored in each patient's file after the consultations.

3.9 SUMMARY

Forty patients suffering from Morton's neuroma were selected to participate in this study. Twenty patients each were randomly allocated into the treatment group and the placebo group. Those in the treatment group received manipulation and mobilization of the foot and ankle joints and those in the placebo group received de-tuned ultrasound. Each patient was assessed in terms of objective and subjective clinical findings and all the necessary data was obtained for statistical analysis.

CHAPTER FOUR

THE RESULTS

4.1 INTRODUCTION

The first part of this chapter contains the demographic data of all the patients included in the study. A total of twenty patients were in group A and twenty patients were in group B. The second part of this chapter contains the statistical analysis of the subjective and objective data obtained from the patients over the treatment period.

The patients within group A received the placebo treatment (de-tuned ultrasound). The patients within group B received manipulation and mobilization of fixations in the foot and ankle joints.

4.2 CRITERIA GOVERNING THE ADMISSIBILITY OF THE DATA

Information obtained from the case history, foot and ankle regional examination, Numerical Rating Scale 101, Short-form McGill Pain Questionnaire, Foot Function Index and the digital algometer were used as data for the study. All the pain questionnaires were explained to the patient, who then completed the questionnaires. All the digital algometer readings were taken by the researcher.

The null hypothesis Ho stated that there was no difference between consultations with regards to the variable of interest. The alternative hypothesis H_1 stated that there was a difference between consultations with regards to the variable of interest. The level of significance (α) was set at 0.05.

4.3 DEMOGRAPHIC DATA

Table 1 Gender Distribution

GENDER	GROUP A	GROUP B	TOTAL
FEMALES	15	16	31 (77.5%)
MALES	5	4	9 (22.5%)

The male to female ratio is approximately 10:3

Table 2 Age Distribution

AGE INTERVALS	GROUP A	GROUP B	TOTAL
20 – 29	2	2	4 (10%)
30 – 39	1	4	5 (12.5%)
40 – 49	3	3	6 (15%)
50 – 59	7	5	12 (30%)
60 – 69	4	4	8 (20%)
70 – 79	3	2	5 (12.5%)

The mean age for group A is approximately 53 years.

The mean age for group B is approximately 50 years.

The mean age of the sample is 52 years.

The age range is 23 – 79 years.

Table 3 Occupation of the Patients

GROUP A	NUMBER	%	GROUP B	NUMBER	%
Self-employed	1	5	Caterer	2	10
Housewife	2	10	Housewife	2	10
Retired	5	25	Retired	5	25
Office Clerk	1	5	Businessman	1	5
Student	1	5	Interior Decorator	1	5
Secretary	1	5	Car Guard	1	5
Sales Representative	2	10	Librarian	1	5
Reflexologist	1	5	Engineer	1	5
Bookkeeper	2	10	Nurse	1	5
Graphic Designer	1	5	Sales Representative	1	5
PR Consultant	1	5	Artist	1	5
Production Co-ordinator	1	5	Administrative Officer	1	5
Teacher	1	5	Secretary	1	5
			Student	1	5

Table 4 Race Distribution

RACE	GROUP A	GROUP B
BLACK	0	0
MIXED RACE	1	2
INDIAN	6	0
WHITE	13	18

Table 5 The Site of the Neuroma

SITE*	GROUP A	GROUP B	TOTAL
SECOND	8	8	16 (40%)
THIRD	12	11	23 (57.5%)
FOURTH	0	1	1 (2.5%)

*refers to intermetatarsal space

Table 6 The Side of the Foot Affected

SIDE AFFECTED	GROUP A	GROUP B	TOTAL
RIGHT	8	7	15
LEFT	7	12	19
BOTH	5	1	6

In cases where the neuroma occurred bilaterally, the patient chose the foot that was to be treated.

4.4 THE ANALYSED DATA

4.4.1 THE INTER-GROUP ANALYSIS USING THE MANN-WHITNEY U-TEST

Table 7 Comparison of groups A and B using the Mann-Whitney U-test to analyse results obtained from the Numerical Rating Scale 101 (NRS 101) at treatment six

NUMERICAL RATING SCALE 101					
	GROUP A			GROUP B	
	MEAN	S.D.*	p-VALUE	MEAN	S.D.
NRS 1	51.5000	23.8333	0.3715	49.4250	13.4519
NRS 6	40.7000	25.6071	**0.030**	25.4000	18.7305

The values that are shown for the NRS 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly.

The null hypothesis is rejected for the Numerical Rating Scale 101, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between the groups.

*S.D. = Standard Deviation

❖ The p-value that is indicated above is the reported p-value/ 2

Table 8 Comparison of groups A and B using the Mann-Whitney U-test to analyse results obtained from the Short-form McGill Pain Questionnaire at treatment six

SHORT-FORM MCGILL PAIN QUESTIONNAIRE					
	GROUP A			GROUP B	
	MEAN	S.D.	p-VALUE	MEAN	S.D.
MCGILL 1	12.3000	9.5647	0.480	18.9500	11.4132
MCGILL 6	9.2500	6.5283	0.111	8.3500	8.4808

The values that are shown for the MCGILL 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly.

The null hypothesis is accepted for the Short-form McGill Pain Questionnaire, indicating that at the $\alpha = 0.05$ level of significance there was no statistically significant difference between the groups.

- The p-value that is indicated above is the reported p-value/ 2

Table 9 Comparison of groups A and B using the Mann-Whitney U-test to analyse results obtained from Foot Function Index – Pain (FFI – P) at treatment six

FOOT FUNCTION INDEX – PAIN					
	GROUP A			GROUP B	
	MEAN	S.D.	p-VALUE	MEAN	S.D.
FFI – P 1	25.6000	10.5750	0.112	29.1000	7.1148
FFI – P 6	18.5500	11.7763	0.1365	14.6000	10.9227

The values that are shown for the FFI - P 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly.

The null hypothesis is accepted for the Foot Function Index – Pain, indicating that at the $\alpha = 0.05$ level of significance there was no statistically significant difference between the groups.

- The p-value that is indicated above is the reported p-value/ 2

Table 10 Comparison of groups A and B using the Mann-Whitney U-test to analyse results obtained from Foot Function Index – Disability (FFI – D) at treatment six

FOOT FUNCTION INDEX – DISABILITY					
	GROUP A			GROUP B	
	MEAN	S.D.	p-VALUE	MEAN	S.D.
FFI – D 1	25.4500	21.4340	0.3295	24.8500	17.1104
FFI – D 6	21.2500	22.0188	0.096	11.8500	14.4086

The values that are shown for the FFI - D 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly.

The null hypothesis is accepted for the Foot Function Index – Disability, indicating that at the $\alpha = 0.05$ level of significance there was no statistically significant difference between the groups.

- The p-value that is indicated above is the reported p-value/ 2

Table 11 Comparison of groups A and B using the Mann-Whitney U-test to analyse results obtained from the algometer readings for pain pressure threshold at treatment six

ALGOMETER READINGS FOR PAIN PRESSURE THRESHOLD					
	GROUP A			GROUP B	
	MEAN	S.D.	p-VALUE	MEAN	S.D.
ALGO 1	19.5200	7.4216	0.245	20.6550	6.9250
ALGO 6	19.1050	7.2477	**0.018**	25.6300	10.4674

The values that are shown for the ALGO 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly.

The null hypothesis is rejected for the algometer readings for pain pressure threshold, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between the groups.

- The p-value that is indicated above is the reported p-value/ 2

Table 12 Comparison of groups A and B using the Mann-Whitney U-test to analyse results obtained from the algometer readings for pain pressure tolerance at treatment six

ALGOMETER READINGS FOR PAIN PRESSURE TOLERANCE					
	GROUP A			GROUP B	
	MEAN	S.D.	p-VALUE	MEAN	S.D.
ALGO 1	27.8900	9.3610	0.0615	32.1150	8.1041
ALGO 6	28.5150	10.9679	**0.0185**	35.9700	10.7951

The values that are shown for the ALGO 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly.

The null hypothesis is rejected for the algometer readings for pain pressure tolerance, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between the groups.

- The p-value that is indicated above is the reported p-value/ 2

4.4.2.1 THE INTRA – GROUP ANALYSIS USING THE FRIEDMAN TEST

Table 13 Comparison of groups A and B using the Friedman test to analyse results obtained within the groups from the Numerical Rating Scale 101 (NRS 101) at treatments one, three and six

NUMERICAL RATING SCALE 101						
	GROUP A			GROUP B		
	Tx 1*	Tx 3	Tx 6	Tx 1	Tx 3	Tx 6
MEAN	51.5000	40.1750	40.7000	49.4250	45.6250	25.4000
S.D.	23.8333	20.0613	25.6071	13.4519	24.3045	18.7305
p-VALUE	**0.022**			**0.000**		

For both groups A and B the null hypothesis is rejected for the Numerical Rating Scale 101, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between consultations.

* Tx = Treatment

Table 14 Comparison of groups A and B using the Friedman test to analyse results obtained within the groups from the Short-form McGill Pain Questionnaire at treatments one, three and six

SHORT-FORM MCGILL PAIN QUESTIONNAIRE						
	GROUP A			GROUP B		
	Tx 1	Tx 3	Tx 6	Tx 1	Tx 3	Tx 6
MEAN	12.3000	11.0500	9.2500	18.9500	13.9000	8.3500
S.D.	9.5647	8.4634	6.5283	11.4132	11.2713	8.4808
p-VALUE	0.537			**0.000**		

For group A, the null hypothesis is accepted for the Short-form McGill Pain Questionnaire, indicating that at the $\alpha = 0.05$ level of significance there was no statistically significant difference between consultations.

For group B, the null hypothesis is rejected for the Short-form McGill Pain Questionnaire, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between consultations.

Table 15 Comparison of groups A and B using the Friedman test to analyse results obtained within the groups from the Foot Function Index - Pain at treatments one, three and six

FOOT FUNCTION INDEX – PAIN						
	GROUP A			GROUP B		
	Tx 1	Tx 3	Tx 6	Tx 1	Tx 3	Tx 6
MEAN	25.6000	22.5500	18.5500	29.1000	22.8000	14.6000
S.D.	10.5750	10.8796	11.7763	7.1148	10.7488	10.9227
p-VALUE	**0.010**			**0.000**		

For both groups A and B the null hypothesis is rejected for the Foot Function Index - Pain, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between consultations.

Table 16 Comparison of groups A and B using the Friedman test to analyse results obtained within the groups from the Foot Function Index - Disability at treatments one, three and six

FOOT FUNCTION INDEX – DISABILITY						
	GROUP A			GROUP B		
	Tx 1	Tx 3	Tx 6	Tx 1	Tx 3	Tx 6
MEAN	25.4500	27.6500	21.2500	24.8500	18.0500	11.8500
S.D.	21.4340	21.4826	22.0188	17.1104	16.4812	14.4086
p-VALUE	**0.005**			**0.000**		

For both groups A and B the null hypothesis is rejected for the Foot Function Index - Disability, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between consultations.

Table 17 Comparison of groups A and B using the Friedman test to analyse results obtained within the groups from the algometer readings for pain pressure threshold at treatments one, three and six

ALGOMETER READINGS FOR PAIN PRESSURE THRESHOLD						
	GROUP A			GROUP B		
	Tx 1	Tx 3	Tx 6	Tx 1	Tx 3	Tx 6
MEAN	19.5200	21.2150	19.1050	20.6550	19.1500	25.6300
S.D.	7.4216	7.1613	7.2477	6.9250	7.4921	10.4674
p-VALUE	0.316			**0.002**		

For group A, the null hypothesis is accepted for the algometer readings for pain pressure threshold, indicating that at the $\alpha = 0.05$ level of significance there was no statistically significant difference between consultations.

For group B, the null hypothesis is rejected for the algometer readings for pain pressure threshold, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between consultations.

Table 18 Comparison of groups A and B using the Friedman test to analyse results obtained within the groups from the algometer readings for pain pressure tolerance at treatments one, three and six

ALGOMETER READINGS FOR PAIN PRESSURE TOLERANCE						
	GROUP A			GROUP B		
	Tx 1	Tx 3	Tx 6	Tx 1	Tx 3	Tx 6
MEAN	27.8900	27.9900	28.5150	32.1150	30.2050	35.9700
S.D.	9.3610	9.2825	10.9679	8.1041	11.4584	10.7951
p-VALUE	0.963			**0.011**		

For group A, the null hypothesis is accepted for the algometer readings for pain pressure tolerance, indicating that at the $\alpha = 0.05$ level of significance there was no statistically significant difference between consultations.

For group B, the null hypothesis is rejected for the algometer readings for pain pressure tolerance, indicating that at the $\alpha = 0.05$ level of significance there was a statistically significant difference between consultations.

4.4.2.2 THE DUNN'S PROCEDURE (MULTIPLE COMPARISON TEST)

If the null hypothesis Ho is rejected for the Friedman's Test, then this multiple comparison procedure will have to be applied to determine which of the treatments are significantly different (Daniel, 1978).

The null hypothesis was rejected for all the subjective and objective findings in group B. It was then necessary to apply the Dunn's procedure (described below) to the pain questionnaires and the algometer readings to determine which of the treatments were significantly different.

Let R_j and $R_{j'}$ be the j^{th} and the j'^{th} treatment rank totals.

Let α be the experiment-wise error rate. Usually $\alpha = 0.10$.

Decision Rule:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

In the above formula:

b = the number of blocks

k = the number of treatments

z = value in the inverse normal distribution corresponding to $\{1-[\alpha/k(k-1)]\}$

In order to compute the treatment rank totals, the values in each block were ranked (from lowest to highest) and then the sum of the ranks for each treatment was computed.

In this case $k = 3$, $\alpha = 0.10$, $z = 2.12$

4.4.2.2.1 Dunn's procedure for the Numerical Rating Scale 101 (below)

TREATMENTS (k)			
BLOCKS	ONE	THREE	SIX
1	55.0 (2)	65.0 (3)	35.0 (1)
2	50.0 (2)	50.0 (2)	50.0 (2)
3	50.0 (3)	45.0 (2)	35.0 (1)
4	50.0 (3)	25.0 (2)	15.0 (1)
5	51.0 (3)	30.0 (2)	10.0 (1)
6	50.0 (3)	10.0 (2)	0.0 (1)
7	90.0 (2.5)	90.0 (2.5)	60.0 (1)
8	50.0 (3)	40.0 (2)	25.0 (1)
9	60.0 (3)	57.5 (2)	45.0 (1)
10	42.5 (3)	10.0 (2)	5.0 (1)
11	50.0 (3)	42.5 (2)	22.5 (1)
12	42.5 (3)	30.0 (2)	20.0 (1)
13	42.5 (3)	23.5 (2)	7.5 (1)
14	52.5 (3)	50.0 (2)	37.5 (1)
15	22.5 (2.5)	22.5 (2.5)	0.5 (1)
16	65.0 (2.5)	65.0 (2.5)	60.0 (1)
17	30.0 (3)	25.0 (2)	15.0 (1)
18	52.5 (2)	55.0 (3)	5.0 (1)
19	42.5 (3)	37.5 (2)	30.0 (1)
20	40.0 (3)	30.0 (1.5)	30.0 (1.5)

The Rank totals are:

Rank 1 (R_1) = 55.5

Rank 2 (R_2) = 43

Rank 3 (R_3) = 21.5

Therefore, according to :

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_2\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|55.5 - 43\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$12.5 \text{ is not} \geq 13.4,$$

hence, between treatment 1 and 3 the result is declared statistically insignificant.

For between treatment 3 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_2 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|43 - 21.5\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$21.5 \geq 13.4$$

the result is declared statistically significant.

For between treatment 1 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|55.5 - 21.5\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$34 \geq 13.4$$

the result is declared statistically significant.

4.4.2.2.2 Dunn's procedure for the Short-form McGill Pain Questionnaire (below)

TREATMENTS (k)			
BLOCKS	ONE	THREE	SIX
1	22 (2.5)	22 (2.5)	13 (1)
2	28 (2)	28 (2)	28 (2)
3	15 (3)	5 (2)	4 (1)
4	13 (3)	8 (2)	3 (1)
5	10 (3)	8 (2)	4 (1)
6	39 (3)	11 (2)	1 (1)
7	22 (2)	22 (2)	22 (2)
8	5 (3)	3 (1.5)	3 (1.5)
9	37 (3)	33 (2)	23 (1)
10	13 (3)	3 (2)	2 (1)
11	32 (3)	18 (2)	7 (1)
12	18 (3)	7 (1.5)	7 (1.5)
13	14 (3)	2 (2)	1 (1)
14	29 (2.5)	29 (2.5)	20 (1)
15	4 (2.5)	4 (2.5)	0 (1)
16	14 (2)	15 (3)	13 (1)
17	5 (2)	7 (3)	2 (1)
18	38 (2)	39 (3)	4 (1)
19	15 (3)	10 (2)	6 (1)
20	6 (3)	4 (1.5)	4 (1.5)

The Rank totals are:

Rank 1 (R_1) = 53.5

Rank 2 (R_2) = 43

Rank 3 (R_3) = 23.5

Therefore, according to :

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_2\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|53.5 - 43\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$10.5 \text{ is not} \geq 13.4,$$

hence, between treatment 1 and 3 the result is declared statistically insignificant.

For between treatment 3 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_2 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|43 - 23.5\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$19.5 \geq 13.4$$

therefore the result is declared statistically significant.

For between treatment 1 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|53.5 - 23.5\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$30 \geq 13.4$$

therefore the result is declared statistically significant.

4.4.2.2.3 Dunn's procedure for the Foot Function Index – Pain (below)

TREATMENTS (k)			
BLOCKS	ONE	THREE	SIX
1	44 (2)	47 (3)	31 (1)
2	30 (3)	27 (1.5)	27 (1.5)
3	32 (3)	29 (2)	26 (1)
4	22 (3)	14 (2)	4 (1)
5	31 (3)	24 (2)	9 (1)
6	30 (3)	8 (2)	2 (1)
7	42 (2.5)	42 (2.5)	35 (1)
8	26 (3)	20 (2)	15 (1)
9	19 (3)	18 (2)	11 (1)
10	30 (3)	4 (2)	3 (1)
11	32 (3)	18 (2)	10 (1)
12	22 (3)	18 (2)	14 (1)
13	25 (3)	14 (2)	4 (1)
14	35 (2.5)	35 (2.5)	29 (1)
15	27 (2.5)	27 (2.5)	2 (1)
16	35 (3)	25 (1)	27 (2)
17	18 (2.5)	18 (2.5)	12 (1)
18	36 (3)	33 (2)	1 (1)
19	24 (3)	21 (2)	16 (1)
20	22 (3)	14 (1.5)	14 (1.5)

The Rank totals are:

Rank 1 (R_1) = 57

Rank 2 (R_2) = 41

Rank 3 (R_3) = 22

Therefore, according to :

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_2\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|57 - 41\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$16 \geq 13.4$$

hence, between treatment 1 and 3 the result is declared statistically significant.

For between treatment 3 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_2 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|41 - 22\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$19 \geq 13.4$$

therefore the result is declared statistically significant.

For between treatment 1 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|57 - 22\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$35 \geq 13.4$$

therefore the result is declared statistically significant.

4.4.2.2.4 Dunn's procedure for the Foot Function Index – Disability (below)

TREATMENTS (k)			
BLOCKS	ONE	THREE	SIX
1	58 (2)	60 (3)	33 (1)
2	42 (3)	30 (1.5)	30 (1.5)
3	25 (3)	21 (2)	15 (1)
4	31 (3)	17 (2)	7 (1)
5	2 (3)	0 (1)	1 (2)
6	34 (3)	8 (2)	2 (1)
7	21 (2.5)	21 (2.5)	19 (1)
8	3 (2.5)	3 (2.5)	0 (1)
9	37 (3)	28 (2)	17 (1)
10	4 (3)	2 (2)	0 (1)
11	33 (3)	2 (2)	1 (1)
12	19 (3)	16 (2)	11 (1)
13	26 (3)	13 (2)	2 (1)
14	48 (3)	43 (2)	35 (1)
15	0 (2)	0 (2)	0 (2)
16	46 (2)	42 (1)	49 (3)
17	22 (3)	18 (2)	7 (1)
18	33 (3)	27 (2)	0 (1)
19	7 (3)	5 (2)	3 (1)
20	6 (3)	5 (1.5)	5 (1.5)

The Rank totals are:

Rank 1 (R_1) = 56

Rank 2 (R_2) = 39

Rank 3 (R_3) = 25

Therefore, according to :

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_2\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|56 - 39\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$17 \geq 13.4$$

hence, between treatment 1 and 3 the result is declared statistically significant.

For between treatment 3 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_2 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|39 - 25\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$14 \geq 13.4$$

therefore the result is declared statistically significant.

For between treatment 1 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|56 - 25\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$31 \geq 13.4$$

therefore the result is declared statistically significant.

4.4.2.2.5 Dunn's Procedure for the Algometer Readings for Pain Pressure Threshold (below)

TREATMENTS (k)			
BLOCKS	ONE	THREE	SIX
1	21.5 (1)	30.2 (3)	28.6 (2)
2	23.7 (1)	33.0 (3)	29.0 (2)
3	16.2 (2)	15.8 (1)	17.6 (3)
4	25.9 (1)	36.0 (2)	40.9 (3)
5	7.40 (1)	11.4 (2.5)	11.4 (2.5)
6	23.7 (2)	14.5 (1)	41.8 (3)
7	23.3 (2)	12.7 (1)	31.6 (3)
8	18.9 (1)	20.2 (2)	18.4 (3)
9	23.7 (1)	25.9 (2)	49.7 (3)
10	31.2 (3)	9.60 (1)	11.4 (2)
11	33.0 (3)	18.4 (1)	21.1 (2)
12	11.8 (1)	14.0 (2)	16.7 (3)
13	11.4 (1)	17.6 (2)	21.5 (3)
14	24.8 (1)	25.0 (2)	36.0 (3)
15	28.1 (3)	18.4 (1)	22.8 (2)
16	16.7 (2)	9.60 (1)	17.0 (3)
17	10.5 (1)	14.9 (2)	15.8 (3)
18	22.0 (1.5)	22.0 (1.5)	27.7 (3)
19	16.0 (1)	18.4 (2)	23.7 (3)
20	23.3 (2)	15.4 (1)	29.9 (3)

The Rank totals are:

Rank 1 (R_1) = 31.5

Rank 2 (R_2) = 34

Rank 3 (R_3) = 54.5

Therefore, according to :

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_2\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|31.5 - 34\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

2.5 is not ≥ 13.4

hence, between treatment 1 and 3 the result is declared statistically insignificant.

For between treatment 3 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_2 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|34 - 54.5\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

20.5 ≥ 13.4

therefore the result is declared statistically significant.

For between treatment 1 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|31.5 - 54.5\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$23 \geq 13.4$$

therefore the result is declared statistically significant.

4.4.2.2.6 Dunn's Procedure for the Algometer Readings for Pain Pressure Tolerance (below)

TREATMENTS (k)			
BLOCKS	ONE	THREE	SIX
1	31.6 (1)	35.2 (2)	36.9 (3)
2	49.2 (3)	40.9 (1)	43.5 (2)
3	37.4 (1)	38.7 (2)	38.9 (3)
4	38.7 (2)	36.0 (1)	47.0 (3)
5	21.5 (1)	23.3 (2)	28.6 (3)
6	37.6 (1)	21.1 (2)	40.4 (3)
7	37.4 (2)	17.6 (1)	40.4 (3)
8	28.8 (2)	30.3 (3)	22.8 (1)
9	36.5 (1)	37.8 (2)	66.8 (3)
10	32.8 (3)	13.2 (1)	29.0 (2)
11	38.0 (2)	50.1 (3)	36.5 (1)
12	16.7 (1)	18.9 (2)	19.2 (3)
13	28.1 (1)	28.7 (2)	33.4 (3)
14	39.4 (1)	58.0 (3)	40.4 (2)
15	39.6 (2)	35.2 (1)	45.7 (3)
16	23.0 (3)	21.5 (1)	22.1 (2)
17	23.7 (3)	22.0 (1)	23.3 (2)
18	28.6 (1)	32.1 (2)	35.3 (3)
19	21.2 (1)	22.0 (2)	35.2 (3)
20	32.5 (2)	21.5 (1)	34.0 (3)

The Rank totals are:

Rank 1 (R_1) = 34

Rank 2 (R_2) = 35

Rank 3 (R_3) = 51

Therefore, according to :

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_2\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|34 - 35\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

1 is not ≥ 13.4

hence, between treatment 1 and 3 the result is declared statistically insignificant.

For between treatment 3 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_2 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|35 - 51\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

16 ≥ 13.4

therefore the result is declared statistically significant.

For between treatment 1 and 6:

$$\left|R_j - R_{j'}\right| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

$$\left|R_1 - R_3\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$\left|34 - 51\right| \geq 2.12\sqrt{\frac{20.3(3+1)}{6}}$$

$$17 \geq 13.4$$

therefore the result is declared statistically significant.

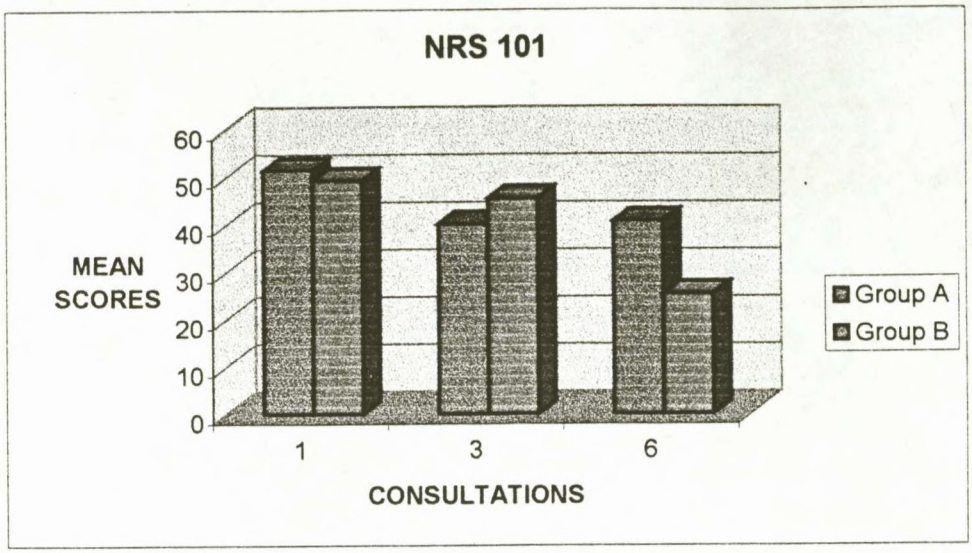

Figure 1

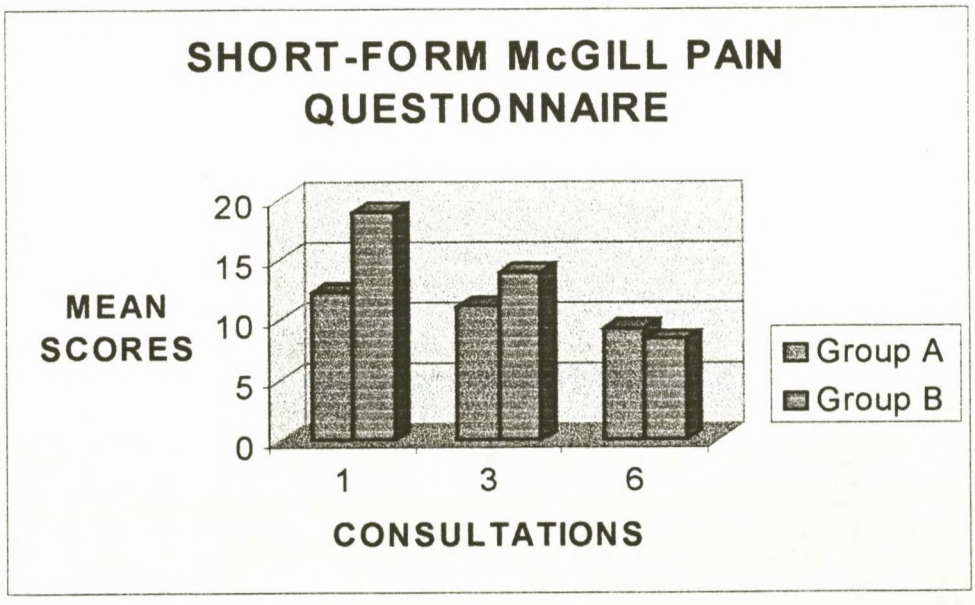

Figure 2

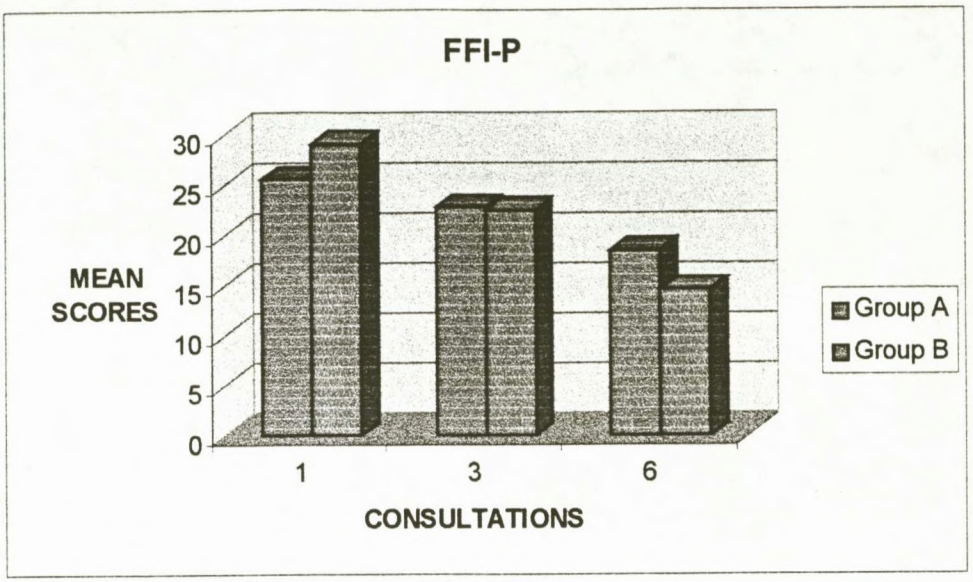

Figure 3

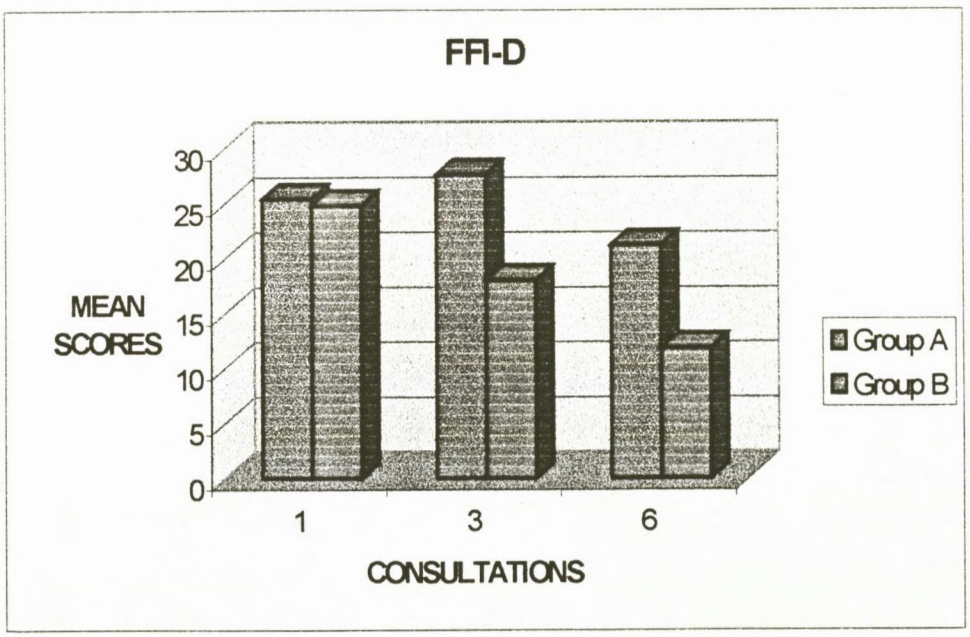

Figure 4

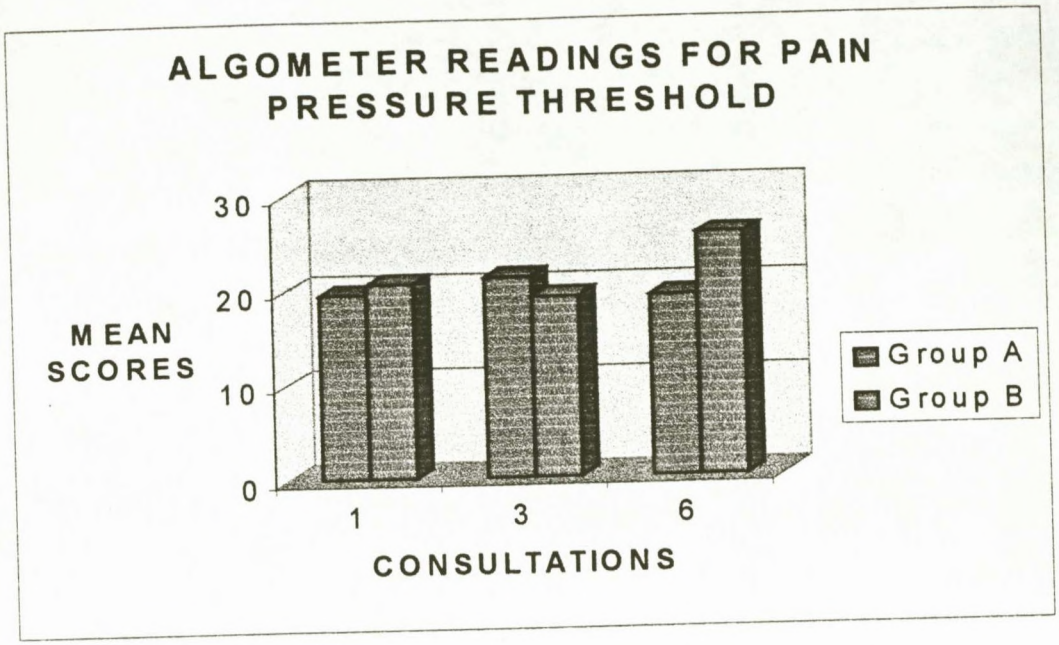

Figure 5

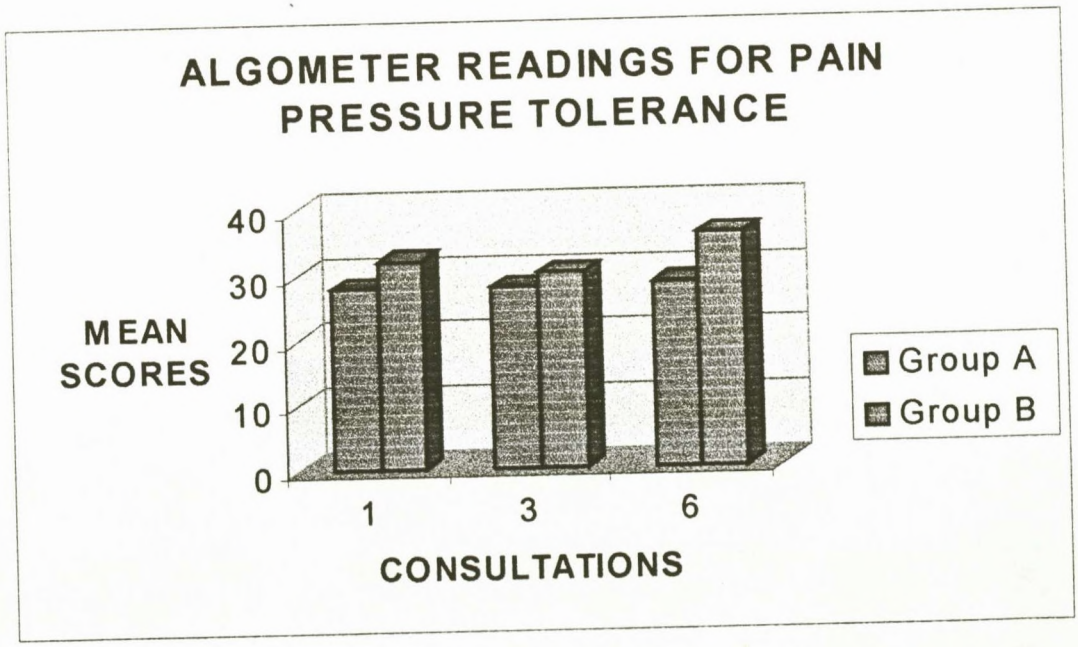

Figure 6

CHAPTER FIVE

DISCUSSION OF THE RESULTS

5.1 DISCUSSION OF THE RESULTS

This chapter is a discussion of the subjective and objective data presented in Chapter Four. The subjective data was obtained from the Numerical Rating Scale 101 (NRS 101), Short-form McGill Pain Questionnaire and the Foot Funtion Index. The objective data was obtained from readings taken by the digital algometer. Data was obtained at the beginning of the initial, third and final consultations.

The demographic data that is presented in Chapter Four is also discussed in this chapter. The demographic data was extracted from the Case History and the Foot and Ankle Regional Examination.

5.2 DICUSSION OF THE DEMOGRAPHIC DATA

Thirty-one (77.5%) of the patients in this study were female and nine (22.5%) were male (Table 4.1). According to Table 4.2 the highest percentage of patients were mainly distributed in the age category 40 – 69 years. With 15% of the total patients in this study being between 40 – 49 years old, 30% being 50 – 59 years old, and 20% being 60 – 69

years old. The mean age of the sample was 52 years with the age range being 23 – 79. The above gender and age distributions are in keeping with the studies mentioned below.

According to Viladot (1992), a total of 75 patients with Morton's neuroma were operated on. Of the 75 patients, 60 were female and 15 were male. The average age of the patients was 44 years with age range 13 – 69 years.

In a retrospective study by Mann and Reynolds (1983), 56 patients who had 76 interdigital neuromas excised were evaluated. There were 53 females and 3 males with an average age of 55 years in the study.

Johnson et al. (1988), re-operated 34 patients who suffered from persistent pain after surgery. Of the 34 patients, 30 were females and 4 were males. The average age of the patients was 47.9 years with the age range being 19 – 74 years.

Rasmussen et al. (1995) followed up on 43 patients who received a single corticosteroid injection for the treatment of interdigital neuromas in the third webspaces. Twenty-nine of the patients were female and 14 were male. The mean age of the patients was 53 years with the age range being 24 – 77 years.

Ruuskanen et al. (1994) performed follow up examinations on 45 patients who were previously operated on. Thirty-five of the patients were female and 10 were male. The mean age of the patients was 50 years with the age range being 21 – 79 years.

Upon review of the above studies a clear trend can be observed, the condition appears to be more prevalent in individuals who are middle-aged and it also is apparent that the

condition is more prevalent in females. Females usually wear tight, high-heeled shoes which is a possible aetiological factor discussed earlier.

The race distribution (Table 4.4) is not a true indication of which racial group the condition is more commonly found in, as, most of the advertising was done in the residential areas in close vicinity to Technikon Natal for easy access for follow-up treatments. The highest population of residents in these areas are caucasian, hence, the greatest response to adverts was amongst the white community.

Table 4.5 shows which intermetatarsal spaces the neuroma commonly occurred in. Twenty-three (57.5%) of the patients had neuromas occurring in the third intermetatarsal space, 40% (16) had neuromas occurring in the second intermetatarsal space and just 1 (2.5%) patient presented with a neuroma in the fourth intermetatarsal space.

According to Johnson et al. (1988), the distribution of the 39 intermetatarsal spaces (37 feet and 34 patients) were as follows: 23 % of the neuromas occurred in the second intermetatarsal space, 74.4% occurred in the third intermetatarsal space, and 2.6% occurred in the fourth intermetatarsal space.

The long-term results of neurectomy were evaluated in a follow-up study done by Keh et al. (1992), where 53 patients with 70 symptomatic Morton's neuromas were evaluated with the follow-up time varying from 11 to 130 months. Sixty-seven percent of the neuromas occurred in the second interspace, 24.3% of the neuromas occurred in the third interspace, 5.7% occurred in the first interspace, and 2.9% occurred in the fourth interspace.

The information from the above 2 studies and the present study suggest that neuromas are more commonly found in the second and third intermetarsal spaces. It is also evident that neuromas are much less frequently found at the first and fourth intermetarsal spaces.

5.3 DISCUSSION OF THE SUBJECTIVE AND OBJECTIVE DATA

5.3.1 Inter-group Analysis

The data from the first consultation from both groups was assessed to determine if there was any difference between the two groups in terms of signs and symptoms of the presenting condition. Information as to whether patients from both groups differed in terms of their initial pain intensity was also obtained. The comparison of the sixth consultation for both groups indicated which treatment protocol was more effective.

5.3.1.1 The Subjective Data

- **The Numerical Rating Scale 101**

  Comparison of the first consultation of both groups showed no statistically significant difference ($p = 0.3715$). This indicated that both groups started off similarly in terms of pain perception. Comparison of the final consultation of both groups showed a statistically significant difference ($p = 0.030$). Group B exhibited a much lower mean

score than Group A, indicating that the pain perception levels of Group B were lower at the final consultation.

Summary

At the initial consultation there was no significant statistical difference between the groups, indicating that both groups showed no differences between their original pain perception. However, at the final consultation there was a statistically significant difference between the groups. This result indicated that Group B had a lower level of pain perception at the final consultation. Therefore the null hypothesis which states that there was no difference between the groups was rejected. The alternative hypothesis, which states that there was a difference between the groups, was accepted. The treatment protocol for Group B was more effective in reducing the patient's perception of pain.

- **The Short-form McGill Pain Questionnaire**

  Comparison of the first consultation of both groups showed no statistically significant difference ($p = 0.480$). This indicated that both groups started off similarly in terms of pain perception. Comparison of the final consultation of both groups also showed no statistically significant difference ($p = 0.111$). Both groups exhibited lower mean scores at the final consultations.

Summary

It was evident that both treatment protocols were equally effective in reducing the patients' level of pain perception. Therefore the null hypothesis, which states that there was no difference between the groups was accepted and the alternative hypothesis which

states that there was a difference between the groups was rejected. However the patients within Group A received a placebo treatment which indicated that the placebo effect played a role in the level of pain perception in Group A.

- **The Foot Function Index – Pain**

  Comparison of the first consultation of both groups showed no statistically significant difference ($p = 0.112$). This indicated that both groups started off similarly in terms of pain perception. Comparison of the final consultation for both groups also showed no statistically significant difference ($p = 0.1365$). Both groups exhibited lower mean scores at the final consultations.

Summary

It was evident that both treatment protocols were effective in reducing the patients' level of pain perception. Therefore the null hypothesis, which states that there was no difference between the groups, was accepted and the alternative hypothesis, which states that there was a difference between the groups was rejected. However the patients within Group A received a placebo treatment which indicated that the placebo effect played a role in the level of pain perception in Group A.

- **The Foot Function Index – Disability**

  Comparison of the first consultation of both groups showed no statistically significant difference ($p = 0.3295$). This indicated that both groups started off similarly in terms

of their level of disability. Comparison of the final consultation of both groups also showed no statistically significant difference ($p = 0.096$).

Summary

It was evident that both treatment protocols were effective in reducing the patients' level of disability. Therefore the null hypothesis, which states that there was no difference between the groups, was accepted and the alternative hypothesis, which states that there was a difference between the groups was rejected. However, the patients in Group A received a placebo treatment which indicated that the placebo effect played a role in the level of disability experienced by the patients in Group A.

5.3.1.2 The Objective Data

- **The Algometer Readings**

  The comparison of the initial algometer readings showed no statistically significant difference ($p = 0.245$ and $p = 0.0615$ for pain pressure threshold and pain pressure tolerance respectively) between the two groups, indicating that pain sensitivity to pressure was similar at the beginning of the study.

  The comparison of the final algometer readings showed statistically significant differences ($p = 0.018$ and $p = 0.0185$ for pain pressure threshold and pain pressure tolerance respectively) between the two groups. The mean scores for both pain pressure threshold and pain pressure tolerance were significantly different at the final

consultations indicating that Group B responded better in terms of pain sensitivity to pressure.

Summary

There was a statistically significant difference between the two groups in terms of pain pressure threshold and pain pressure tolerance. Therefore the null hypothesis, which states that there was no difference between the groups, was rejected and the alternative hypothesis, which states that there was a difference between the groups, was accepted. The above evidence suggests that Group B' s treatment protocol was more effective in the treatment of Morton's neuroma.

5.3.2 The Intra-group Analysis

The evaluation of the subjective and objective data obtained from the initial, third and final consultations represent the time response of the treatment protocol. The analysis of the subjective and objective intra-group data between the initial and the third consultation represents the initial relative effectiveness of the treatment protocol. The comparison of the data between the third and final consultations and the first and final consultations represents the relative effectiveness of the treatment protocol as a whole.

5.3.2.1 The Subjective Data

- **The Numerical Rating Scale 101**

  An analysis of the results at treatments one, three and six revealed a statistically significant difference in both groups ($p = 0.022$ and $p = 0.000$ for groups A and B respectively), indicating that there was a decrease in the levels of pain perception by the patients in both groups. The results for Group B were highly significant ($p = 0.000$), hence a multiple comparison procedure (the Dunn's procedure) was carried out to determine at which stage the treatment made significant difference. The results from this procedure showed that between the initial and the third treatment there was no statistically significant improvement and between the third and the final treatment there was a statistically significant improvement. An analysis of the data from the first and the final treatment showed an overall improvement in the patients' pain perception, which was statistically significant.

Summary

The NRS 101 pain questionnaire monitors the levels of pain perception experienced by the patients. The comparison of the data showed a statistically significant improvement in both groups, indicating a decrease in pain perception. The improvement in Group A (the placebo group) can be attributed to the placebo effect discussed in chapter two. The Dunn's procedure showed that according to the NRS 101, the initial relative effectiveness of the treatment protocol in Group B was not statistically significant but the relative effectiveness of the treatment protocol as a whole was statistically significant. The above evidence suggested that the treatment protocol administered to the patients in Group B (mobilization and manipulation) was effective in the treatment of Morton's neuroma.

- **The Short-form McGill Pain Questionnaire**

  An analysis of the results at treatments one, three and six revealed a statistically significant difference only in Group B ($p = 0.000$), indicating that there was a decrease in the levels of pain perception by the patients in Group B. Analysis of the results from Group A showed no statistical significance ($p = 0.537$). Due to the results for Group B being statistically significant, the multiple comparison procedure (the Dunn's procedure) was carried out to determine which treatment interval made a significant difference. The results from this procedure showed that between the initial and the third treatment there was no statistically significant improvement and between the third and the final treatment there was a statistically significant improvement. An analysis of the data from the first and the final treatment showed an

overall improvement in the patients' pain perception, which was statistically significant

Summary

The Short-form McGill Pain Questionnaire provides information regarding the sensory, affective and overall intensity of pain. The comparison of the data showed a statistically significant improvement within Group B, indicating a decrease in pain perception. The Dunn's procedure showed that according to the Short-form McGill pain questionnaire, the initial relative effectiveness of the treatment protocol within Group B was not statistically significant but the relative effectiveness of the treatment protocol as a whole was statistically significant. The above evidence suggested that the treatment protocol administered to the patients in Group B (mobilization and manipulation) was more effective than placebo in the treatment of Morton's neuroma.

- **The Foot Function Index – Pain**

  An analysis of the results at treatments one, three and six revealed a statistically significant difference in both groups ($p = 0.010$ and $p = 0.000$ for groups A and B respectively), indicating that there was a decrease in the levels of pain perception by the patients in both groups. The results for Group B were very highly significant ($p = 0.000$), hence a multiple comparison procedure (the Dunn's procedure) was carried out to determine which of the treatments were significantly different. The results from this procedure showed that between the initial and the third treatment there was a statistically significant improvement and between the third and the final treatment

there was also a statistically significant improvement. An analysis of the data from the first and the final treatment showed an overall improvement in the patients' pain perception, which was statistically significant.

Summary

The FFI - P provides information on the impact of the patient's pain on their normal daily activities. The comparison of the data showed a statistically significant improvement in both groups, indicating a decrease in pain perception. The improvement in Group A (the placebo group) can be attributed to the placebo effect discussed in chapter two. Highly significant results were obtained from Group B and this is evident by observing the mean scores over treatments one, three and six. The Dunn's procedure showed that according to the FFI - P, the initial relative effectiveness and relative effectiveness of the treatment protocol as a whole in Group B were both statistically significant. The above evidence suggested that the treatment protocol administered to the patients in Group B (mobilization and manipulation) was effective in the treatment of Morton's neuroma.

- **The Foot Function Index – Disability**

  An analysis of the results at treatments one, three and six revealed a statistically significant difference in both groups ($p = 0.005$ and $p = 0.000$ for groups A and B respectively), indicating that there was a decrease in the levels of disability by the patients in both groups. The results for Group B were highly statistically significant ($p = 0.000$), hence a multiple comparison procedure (the Dunn's procedure) was carried out to determine at which stage the treatments made a statistically significant

difference. The results from this procedure showed that between the initial and the third treatment there was a statistically significant improvement and between the third and the final treatment there was also a statistically significant improvement. An analysis of the data from the first and the final treatment showed an overall improvement in the patients' disability, which was statistically significant.

Summary

The FFI - D is a measure of the patients' perception of disability in terms of foot problems. The comparison of the data showed a statistically significant improvement in both groups, indicating a decrease in pain perception. The improvement in Group A (the placebo group) can be attributed to the placebo effect discussed in chapter two. Highly statistically significant results were obtained from Group B and this is evident by observing the mean scores over treatments one, three and six. The Dunn's procedure showed that according to the FFI - D, the initial relative effectiveness and relative effectiveness of the treatment protocol as a whole in Group B was statistically significant. The above evidence suggested that the treatment protocol administered to the patients in Group B (mobilization and manipulation) was effective in the treatment of Morton's neuroma.

5.3.2.2 The Objective Data

- **The Algometer Readings**

  An analysis of the results at treatments one, three and six revealed a statistically significant difference only in Group B ($p = 0.002$ and $p = 0.011$ for pain pressure threshold and pain pressure tolerance respectively), indicating that there was a decrease in the levels of pain sensitivity to pressure by the patients in Group B. An analysis of the results obtained from Group A showed no statistical significance. Due to the results for Group B being statistically significant, the multiple comparison procedure (the Dunn's procedure) was carried out to determine at which stage the treatments made a statistically significant difference. The results from this procedure showed that between the initial and the third treatment there was no statistically significant improvement and between the third and the final treatment there was a statistically significant improvement. An analysis of the data from the first and the final treatment showed an overall improvement in the patients' pain sensitivity to pressure, which was statistically significant.

Summary

The algometer measures the patients' pain pressure threshold and pain pressure tolerance objectively. The comparison of the data showed a statistically significant improvement only within Group B, indicating a decrease in pain sensitivity to pressure. The Dunn's procedure showed that according to the algometer readings for pain pressure threshold and pain pressure tolerance, the initial relative effectiveness of the treatment protocol in

Group B was not statistically significant but the relative effectiveness of the treatment protocol as a whole was definitely statistically significant. The above evidence suggested that the treatment protocol administered to the patients in Group B (mobilization and manipulation) was more effective than placebo in the treatment of Morton's neuroma.

5.4 INTER-GROUP HYPOTHESIS

It was hypothesised that there would be a statistically significant difference between the two groups with respect to the objective and subjective clinical findings, showing that foot and ankle manipulation and mobilization would be more effective than placebo in the treatment of Morton's neuroma.

A comparison of Group A – placebo, with Group B – manipulation and mobilization, showed a statistically significant difference with respect to pain perception in the final consultation in favour of Group B. Comparison of the first consultation of both groups showed no statistically significant difference, indicating that both groups started off similarly in terms of pain perception (Figures 1 and 2).

According to the Foot Function Index, the two groups started off similarly at the first consultation in terms of their pain (FFI – P) and disability (FFI – D). According to the results obtained it was shown that both treatment protocols were effective in reducing the

patients' level of pain and disability. However, there were no statistically significant differences between the groups (Figures 3 and 4).

According to the analysis of the results obtained from the algometer readings for pain pressure threshold and pain pressure tolerance, both groups started off similarly in terms of their pain sensitivity to pressure. Comparison of the final algometer readings for pain pressure threshold and pain pressure tolerance, revealed statistically significant differences between the groups (Figures 5 and 6).

5.5 INTRA-GROUP HYPOTHESIS

It was hypothesised that there would be a difference between consultations with regards to the variable of interest in Group B, showing that manipulation and mobilization is more effective than placebo in the treatment of Morton's neuroma.

According to the patients' perception of pain, upon comparison of the data obtained at treatments one, three, and six, statistically significant differences were obtained in both groups, revealing that there was a decrease in the levels of pain perception in both groups, however the results were very highly statistically significant for Group B for the NRS 101. Analysis of the results obtained from the Short-form McGill pain questionnaire revealed a statistically significant difference only in Group B. According to the Dunn's procedure, it was shown that between the first and the third consultations there was no significant improvement in the level of pain perception. However, between the third and

the final consultations there was a significant improvement in the level of pain perception, and an overall analysis of the data from the first and the final consultations showed an overall improvement in the patients' level of pain perception within Group B.

According to the Foot Function Index, a statistically significant difference was apparent in both groups for perception of pain and disability. However the results for Group B were highly statistically significant, hence the Dunn's procedure was carried out. When comparing the initial and third consultations in Group B, a significant improvement was noted. A significant improvement was also noted between the third and the final consultations. An analysis of the data from the first and the final consultations showed an overall improvement in the patients' perception of pain and disability in Group B.

When comparing the data obtained from the algometer readings for pain pressure threshold and pain pressure tolerance, statistically significant differences were found only within Group B. Upon analysis of the results from the Dunn's procedure, between the first and the third consultations there was no statistically significant improvement. Between the third and the final consultations there was a statistically significant improvement. The analysis of the data from the first and the final consultations showed an overall improvement in the patients' pain sensitivity to pressure, which was statistically significant. Upon observation of the objective data it was evident that manipulation and mobilization was more effective than placebo in the treatment of Morton's neuroma.

5.6 CONCLUSIONS

From the above data it can be concluded that according to subjective measures, Morton's neuroma responded better to manipulation and mobilization than placebo. According to objective measures, statistically significant differences only occurred within Group B, it can therefore be concluded that manipulation and mobilization was superior to placebo in the treatment of Morton's neuroma.

5.7 LIMITATIONS OF THE STUDY

The first limitation of the study was the sample size. A larger sample size would have strengthened the conclusions made in the study.

The subjective questionnaires used in this study were not especially designed for patients with Morton's neuroma. It would be better if a specific questionnaire was designed for the condition in a study of this nature.

The fact that the digital algometer readings were taken by the researcher introduces a bias in the study. It is also possible that a human error may have occurred when taking the readings. A possible solution to the above problem is that an independent examiner be available to take the readings by the digital algometer.

5.8 COMPARISON OF THE RESULTS WITH OTHER STUDIES

This is the first randomised placebo-controlled study that investigates the efficacy of manipulation and mobilization to placebo (a pilot study). The only other study that can be compared is a review that was carried out by Brantingham et al. (1994). This retrospective analysis included the case records of 29 patients diagnosed with Morton's neuroma. The patients received a combination of treatment that included: manipulation, mobilization, ultrasound, whirlpool, ice and diathermy. The average age of the patients was 40 years. There were 20 females and 9 males. The average number of treatments given was eight. On a follow-up examination, three months after the treatment was completed 55.2% of the patients reported an excellent outcome. It was also reported that 27.6% of the patients had a moderate outcome and 17.2% of the patients had a poor outcome. Most patients reached their level of improvement after 6 to 9 treatments.

The above review suggests that chiropractic intervention may have a value in the treatment of Morton's neuroma, however it was not a controlled study and it did not compare manipulation and mobilization to placebo. Physiotherapeutic modalities were also used to treat the patients. Orthotics and low-dye taping was also used on a number of the patients. Hence the true efficacy manipulation and mobilization could not be determined based on the above review.

The current study on Morton's neuroma has shown that manipulation and mobilization is effective in the treatment of Morton's neuroma in the short term, thus supporting the research carried out by Brantingham et al. (1994).

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

- It is recommended that a long-term follow-up (eg. 1 month after the sixth consultation) be included in future studies to assess the long term effects of manipulation and mobilization.
- A larger sample size would strengthen the conclusions made in the study.
- For future studies into this condition, a specific pain questionnaire that accurately describes the symptoms of Morton's neuroma should be researched and utilised.
- In order to exclude bias from the study, an independent examiner should be available to record the readings obtained from the digital algometer.
- To improve the statistical significance of the study in terms of sample selection, the patients should be limited to the most common age and gender population group.

6.2 CONCLUSIONS

It was evident that Group B – manipulation and mobilization showed a better subjective response throughout the study in terms of the sensory, affective and overall intensity of pain perception. The data obtained from the inter-group comparison for the NRS 101 revealed that statistically significant differences were found only within group B – manipulation and mobilization.

Due to the placebo effect playing a role in subjective questionnaires, it is sensible to base one's conclusions on the outcomes of the objective measurements.
The data obtained from the intra-group comparison for the algometer readings revealed that statistically significant differences were found only within Group B – manipulation and mobilization. According to the inter-group analysis of the data obtained from the algometer readings, it was shown that there were statistically significant differences between the groups in favour of Group B. Observation of the mean scores for the algometer readings (Figures 5 and 6) revealed that Group B – manipulation and mobilization responded better than Group A – placebo in terms of pain sensitivity to pressure.

This study indicates that chiropractic manipulation and mobilization may be a useful short-term treatment for Morton's neuroma and strongly supports further research. It can therefore be concluded that both objectively and subjectively, chiropractic manipulation

and mobilization of the foot and ankle joints may be a reliable intervention in the treatment of Morton's neuroma in the short term.

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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

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:
  = Consensual:
- Fundoscopy findings:

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:
Otoscope examination:

IX & X Gag reflex:
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:

Foot and ankle regional examination

Patient:_____ File no:_____ Date:_____
Intern / Resident_____ Signature:_____
Clinician:_____ Signature:_____

Observation

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

_____
_____
Swelling_____
Heloma dura / molle_____
Skin_____
Nails_____
Shoes_____
Contours (achilles tendon, bony prominences)_____

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*_____

Neurological: Dermatomes_____

Reflexes_____

Special tests

Anterior drawer test_____
Talar tilt_____
Thompson test_____
Homan sign_____
Tinel's sign_____
Subtalar neutral position_____
Balance/proprioception_____
Test for rigid/flexible flatfoot_____
Kleiger test (med. deltoid)_____

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 maleoli_____
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

PATIENT INFORMATION LETTER

Study Title: The Efficacy of Manipulation and Mobilisation in the Treatment of Morton's Neuroma

Dear patient,

Welcome to this research study. You have been selected to participate in this clinical trial which compares two forms of therapy. You have a common foot condition which is known as Morton's neuroma. Restrictions of the foot play a significant role in this condition. Chiropractic treatment has been shown to be beneficial in the treatment of this condition, hence there is a need to determine the effectiveness of chiropractic treatment.

In order to determine the effectiveness of the treatment, this needs to be a placebo-controlled trial. There will be 2 treatment groups containing 30 patients each. One group will receive an actual treatment and the other will receive a placebo treatment. You will be assigned to a group, but you will not know which treatment you will be receiving. However, after participation in the study is complete, the patients in the placebo group will be given four free treatments at the Chiropractic Day Clinic.

During the study, you will be required to come in for a minimum of six treatments over a maximum period of three weeks. On the initial, third and final consultations, you will be given pain perception questionnaires to complete. Your pain will also be measured during those consultations.

While you are participating in this study, you will not be able to receive any other form of treatment for your condition. You are also advised to refrain from wearing tight shoes. There are no side-effects to the treatment.

Please be aware that you are free to leave the study at any time. Your full co-operation in this study will assist the chiropractic profession in increasing its knowledge, and improving its treatment of Morton's neuroma.

Treatment is free of charge and will be under the supervision of a qualified chiropractor. You are free to withdraw from the study at any time and if you have any questions, please do not hesitate to ask me.

Thank you.

Yours sincerely,

Neetu Govender
(Chiropractic Intern.)

APPENDIX 5

INFORMED CONSENT FORM

(To be completed by patient / subject)

Date :

Title of research project : **The Efficacy of Manipulation and Mobilisation in the Treatment of Morton's Neuroma**

Name of supervisor : Dr. H. Kretzmann

Name of research student : Neetu Govender

Please circle the appropriate answer	YES	NO
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?	Yes	No
a) at any time		
b) without having to give any a reason for withdrawing, and		
c) without affecting your future health care.		
9. Do you agree to voluntarily participate in this study	Yes	No

If you have answered no to any of the above, please obtain the necessary information before signing

Please Print in block letters:

Patient /Subject Name:_____ Signature:_____

Parent/ Guardian:_____ Signature:_____

Witness Name:_____ Signature:_____

Research Student Name:_____ Signature:_____

APPENDIX 6

Numerical Rating Scale - 101 Questionnaire

Date:_____ File no:_____ Visit no:_____

Patient name:_____

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

Please write only **one** number.

_____

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

Please write only **one** number.

_____

APPENDIX 7

Short-form McGill Pain Questionnaire (SF-MPQ)

Ronald Melzack (1984)

Date:_____ File no.:_____ Visit no:____

Patient name:_____

	NONE 0	MILD 1	MODERATE 2	SEVERE 3
THROBBING				
SHOOTING				
STABBING				
SHARP				
CRAMPING				
GNAWING				
HOT-BURNING				
ACHING				
HEAVY				
TENDER				
SPLITTING				
TIRING-EXHAUSTING				
SICKENING				
FEARFUL				
PUNISHING-CRUEL				

APPENDIX 8

FOOT FUNCTION INDEX

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

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

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

Section C: Do you have to?	**Yes**	**No**
Stay inside all day		
Stay in bed all day		

APPENDIX 9

Algometer Readings

Name: _____

File no.: _____

	Treatment 1	Treatment 3	Treatment 6
Pain Pressure Threshold			
Pain Pressure Tolerance			