A COMPARITIVE INVESTIGATION INTO THE EFFECTIVENESS OF TWO MOBILIZATIONS IN THE TREATMENT OF SYMPTOMATIC HALLUX ABDUCTOVALGUS (BUNIONS).

By

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I, C.T. Herholdt, do declare that this dissertation is representative of my own work in both conception and execution

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DEDICATION

This work is dedicated to my parents, Callie and Marika Herholdt for your unconditional love, provision and dedication to the family. Your love and support has allowed and motivated me to pursue a career in Chiropractic.

To my Lord Jesus, for many prayers answered.

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ABSTRACT

The purpose of this study was to compare two forms of mobilization in the treatment of symptomatic Hallux abductovalgus (bunions).

The study was a prospective, randomized clinical trial involving sixty subjects, thirty in each group, which were selected by means of convenience sampling from the general population within the greater Durban area. Group A received a Strain counter-strain mobilization (SCSM) of the first metatarso- phalangeal joint, used in conjunction with cryotherapy. Group B received Brantingham's mobilization (BM) of the first metatarso-phalangeal joint, used in conjunction with cryotherapy. Each group received five treatments over a two-week period and were required to attend a one-week follow up consultation for data collection.

Subjective assessment was carried out by means of the Numerical Rating Scale-101 (NRS-101) and the Foot Function Index (FFI). Objective assessment included measuring the pain pressure threshold using a digital algometer, the hallux valgus angle and passive dorsiflexion and plantarflexion of the first metatasal phalangeal joint were also measured using a goniometer. The Hallux-metatarsophalangeal-interphalangeal Scale (HAL) included assessment of both subjective and objective measurements. Subjective and objective assessments were performed and data collected on the first, third, fifth and one week follow up consultations.

Statistical analysis was completed at a 95% confidence interval. Inter-group analysis was done, using the Mann-Whitney U-test for subjective data and the unpaired t-test for objective data. Intra-group analysis was carried out using Friedman's test and Dunn's procedure.

In terms of subjective findings, both groups revealed a statistically significant improvement in terms of pain perception (NRS-101) over the treatment period. Both groups experienced a significant improvement in the Foot Function Index (FFI) in terms of pain and disability. Despite both groups improving, it seemed that Group B (Brantingham's Mobilization) improved considerably more that Group A (Strain counter-

strain mobilization) when comparing the percentage improvement over the treatment period.

In terms of objective findings, both groups revealed a significant improvement in the Hallux valgus angle, pressure pain threshold (Algometer readings), plantarflexion dorsiflexion and Hallux metatarsophalangeal-interphalangeal (HAL) scores. A statistically significant difference existed between groups with regards to the dorsiflexion and algometer scores at the sixth consultation, indicating that (Group B) Brantingham's mobilization improved significantly more than Group A (Strain counter-strain mobilization).

After analysis of the statistical data it is evident that a trend developed in which the improvement in Group B (BM) was accelerated and more comprehensive than Group A (SCSM), for all the measurements. It is the researchers opinion that both mobilizations are effective in the treatment of HAVB, but by employing Brantingham’s mobilization the therapeutic effect may be enhanced in terms of pressure pain tolerance and range of motion in the first MPJ.

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CHAPTER ONE

INTRODUCTION

1.1 THE PROBLEM AND ITS SETTING

Levy and Hetherington (1990: 828) define hallux abductovalgus as a "common deformity that involves a prominence of the medial aspect of the first metatarsal head and a lateral deviation of the greater toe." The term hallux abductovalgus and bunions are often used synonymously in current literature by Brantingham et.al. (1994) and Cimons (1999). Broodryk (2000) coined the abbreviation HAVB (hallux abductovalgus bunions) that will be used for the purposes of the study.

There is very little evidence in current literature to accurately determine the incidence and prevalence of HAVB. Many authors (Brantingham et.al.,1994; Cimons, 1999 and Levy and Hetherington, 1990: 827) refer to HAVB as being a "common deformity". Their references are however based on the authors vast clinical experience and not on categorical evidence.

According to Klenerman (1991: 57) there is little doubt that multiple causative factors exist as opposed to a single entity in the development of HAVB. Brantingham et.al. (1994) discusses a variety of structural and functional causes; for example a rounded first metatarsal head and low medial longitudinal arch. Other aetiological considerations such as familial tendencies (Klenerman, 1991:57) and mechanical aspects such as the use of pointed, high heeled shoes (Calliet 1997:167) should not however be excluded.

HAVB surgery is a well-documented, conventional form of treatment for HAVB (Khan, 1996). Meyer (1996) suggests that there are in excess of 150 surgical procedures performed on HAVB, most of which are "biomechanically unsound" (Jahss, 1991:943) and have been discarded (Yale, 1987:397). Surgery has limitations as many patients suffer with postoperative complications (Khan, 1996). Postoperative complications include reoccurrence of the deformity, scarring, avascular necrosis, infection and joint hypomobility (Jahss 1991: 943). According to Sammarco and Indusuyi (2001) the potential for complications exist even when the surgery is done meticulously, under correct conditions and by experienced surgeons. These facts support the need for a relatively painless, non-invasive treatment for HAVB (Khan, 1996).

Coughlin (1997) maintains that conservative care is always the first option for a patient with HAVB. According to Yale (1987), conservative therapy can be moderately effective in the early stages of the HAVB deformity. Conservative therapy includes active and passive exercises, stretching, shields, foot orthoses and advice on appropriate foot wear.

In this respect, two recent studies (Broodryk, 2000 and Guiry, 2001) have been performed to assess the benefit of mobilizations in the treatment of HAVB.

Broodryk (2000) performed a prospective, randomized, placebo controlled clinical trial to evaluate the efficacy of strain counter-strain mobilization (SCSM) in the treatment of HAVB. The SCSM proved to be more effective than placebo in the initial stages of treatment with a P value of 0.05 being obtained. In the other trial; a prospective, randomized placebo controlled clinical trial conducted by Guiry (2001), the Brantingham protocol for HAVB was found to be effective in the alleviation of symptoms with a P value of 0.05 being obtained. The results for each of the above research studies, although positive, were based on a limited sample size of 30 patients. Along with this, these studies had different subjective and objective measures, which makes it difficult to established which manual approach is clinically more effective in the treatment of HAVB.

Both these studies (Broodryk, 2000 and Guiry, 2001) employ a different manual therapy approach in the treatment of the functional HAVB:

The SCSM as defined by Jones (1992:1) is “relieving spinal or other joint pain by passively putting the joint into its position of greatest comfort.” This technique forms part of positional release therapy (PRT), which is described by D’Ambrogio and Roth (1997:1) and is accomplished by placing the involved tissues in an ideal position of comfort to reduce irritability of the tender point and to normalize the tissues associated with the dysfunction. The ideal position of comfort for HAVB according to Jones (1992:25) is when the hallux is placed into abduction (away from the midline of the body), eversion (valgus) and plantarflexion of the first metatarso-phalangeal joint (MPJ).

According to D’Ambrogio and Roth (1997:20) joints become hypomobile when the muscles across the joint become hypertonic and therefore the effects of PRT include:

- Reducing joint hypomobility
- Reduction of pain.
- Normalization of muscle hypertonicity.

On the other hand Brantingham’s protocol for HAVB (Brantingham et.al, 1994) involves progressive mobilization of the HAVB. Joint manipulative therapy[1] is used to induce motion within a hypomobile joint. The manipulation is delivered in the direction of established joint restriction.

[1]Bergman et.al, (1993) refers to joint manipulative procedures as being physical maneuvers designed to induce joint motion through either non-thrust techniques (mobilizations) or thrust techniques (manipulations) in the treatment of neuromusculoskeletal disorders. Joint mobilization is a form of manipulation applied within the physiological range of joint motion and is characterized by non-thrust passive movement induced into the joint. SCS is a mobilization and Brantingham’s technique is described as a “progressive mobilization” (Brantingham et.al., 1994). Progressive mobilization implies that at the initial consultation the patient will receive a grade 2 mobilization and with subsequent consultations mobilizations of this joint will progress from grade 2 mobilization to a grade 5 high velocity, low amplitude thrust (adjustment) as delineated by Maitland (1986). The adjustment according to Bergman et.al (1993) is a specific type of articular manipulation using either long or short leverage techniques with specific contacts. It is characterized by a dynamic thrust of controlled direction, amplitude and velocity.

The benefits of joint manipulative therapy (Edmond, 1993:2-7; Maitland, 1986:10-13 and Bergman et.al., 1993:137-157) include:

- Restoring normal joint range of motion.
- Reducing pain.
- Alleviating associated muscle spasm.
- Improving joint circulation and nutrition.

To summarize, the SCS technique aims to place the joint in the position of comfort in order to reduce joint hypermobility, reduce muscular hypertonicity and decrease pain. Brantingham's protocol aims to establish the direction of joint hypomobility and to restore normal movement in that direction, alleviate muscle spasm and decrease pain.

Thus one can see that joint manipulative therapy has been shown to be a helpful intervention in the treatment of HAVB. There however, remains uncertainty as to which mobilization approach is more effective in HAVB.

Therefore this study aims to investigate two treatment options with different mobilization approaches for HAVB.

1.2 AIM

The aim of this study is to compare, the effectiveness of SCSM versus BM in the treatment of symptomatic Hallux Abductovalgus (Bunions) in terms of subjective and objective clinical findings.

1.3 OBJECTIVES OF THE STUDY

1.3.1 OBJECTIVE ONE

The first objective is to determine the relative effectiveness of the SCSM versus BM in the treatment of symptomatic HAVB in terms of subjective findings.

1.3.2 OBJECTIVE TWO

The second objective is to determine the relative effectiveness of SCSM versus BM in the treatment of symptomatic HAVB in terms of objective clinical findings.

1.3.3 OBJECTIVE THREE

The third objective is to integrate and compare the data to determine whether one mobilization approach is more effective than the other.

1.4 DATA COLLECTION

Subjective data was obtained using the:

- Numerical Pain Rating Scale-101 (NRS-101),
- Foot Function Index Pain Subscale and
- Hallux-metatarsophalangeal-interphalangeal Scale (HAL).

Objective data was obtained by using:

- An algometer to measure pain pressure threshold and
- A goniometer to measure the HAV deformity and passive dorsiflexion and plantarflexion of the metatarso-phalangeal joint

1.5 THE HYPOTHESES

1.5.1 THE FIRST HYPOTHESIS

It was hypothesized that there would be no difference between SCSM and BM in the treatment of symptomatic HAVB in terms of subjective findings.

1.5.2 THE SECOND HYPOTHESIS

It was hypothesized that there would be no difference between SCSM and BM in the treatment of symptomatic HAVB in terms of objective findings.

CHAPTER TWO

A REVIEW OF THE RELATED LITERATURE

2.0 INTRODUCTION

In this chapter, a detailed discussion of the available literature on HAVB is presented. This includes:

2.1 Definitions of HAVB.
2.2 Incidence and prevalence of HAVB
2.3 Related structural and functional anatomy
2.4 Biomechanics of the first MPJ
2.5 Aetiological concepts of HAVB
2.6 Patho-anatomy of HAVB
2.7 Patient presentation and clinical evaluation.
2.8 Treatment

2.1 DEFINITIONS OF HAVB

Coughlin (1997) defines HAV as a progressive subluxation of the first metatarso-phalangeal joint, with lateral deviation[1] of the big toe and medial deviation[1] of the first metatarsal. Variable severity of the deviation causes a prominence of the medial eminence of the first MPJ, giving rise to the bunion deformity (Skinner, 1995: 389). Khan (1996) refers to bunion as an "associated condition" of HAV.

HAV and bunion are often used in current literature to describe the same condition. (Brantingham et.al., 1994)

[1] Lateral and medial deviation with reference to the midline of the body

Strictly HAV refers to:

> “a common deformity that involves a prominence of the medial aspect of the first metatarsal head and a lateral deviation of the greater toe”
> (Levy and Hetherington, 1990: 828).

Whereas a bunion describes:

> the combination of a callus, inflamed and thickened bursa and bony exostosis which overlies the HAV deformity.
> (Magee, 1997: 618)

Broodryk (2000) made use of the term Hallux abducto-valgus bunions (HAVB) to indicate the combination of these to closely integrated conditions. According to Klenerman (1991:57) the following conditions may co-exist in the HAVB complex:

- rotation of the hallux
- metatarsus primus varus
- overriding of the hallux and second toe
- overriding of the lateral toes
- metatarsalgia
- hammer and claw deformities of the lateral toes, and
- bunionette of the fifth metatarsal (Tailor’s bunion).

2.2 INCIDENCE AND PREVALENCE

Various authours (Brantingham et.al., 1994; Cimons, 1999; Kahn, 1996 and Levy and Hetherington, 1990:828) refer to HAVB as being a common deformity. There is little categorical evidence available to accurately determine the incidence and prevalence of HAVB.

In a review on HAVB, Hattrup and Johnson (1985) estimate the condition to be present between three and seventeen percent of the population depending on the age of the participants. Some studies estimate that up to 25 percent of the population have HAVB to some degree (Ombregt et.al.,1999: 925)

According to Coughlin (1997) HAVB occurs almost exclusively in shoe wearing societies. In a review of studies by Resch (1996) the incidence of HAVB in unshod populations is similar, two percent, in both males and females. In shod populations, women suffer two to three times more than men with HAVB.

The high frequency of HAVB amongst females is well documented in literature (Coughlin, 1997; Levy and Hetherington, 1990: 829 and Jahss, 1991: 945). In most studies of patients undergoing surgery for HAVB, ninety percent are woman. The over- representation is partly due to the demands made by woman on shoewear (Resch, 1996). This is supported by Jahss (1991;945) who is of the opinion that the use of high-heeled shoes with pointed toe boxes contributes to the 9 : 1 greater incidence of HAVB in woman. HAVB is relatively uncommon amongst males with an incidence of 6 percent (Coughlin and Shurnas, 2003). In Coughlin's (1997) experience, men undergoing surgery for HAVB, is infrequent compared to woman with a ratio of 1: 20.

2.3 RELATED STRUCTURAL AND FUNCTIONAL ANATOMY

Anatomy is the science concerned with the structure and function of the body (Moore and Dalley, 1999: 1)

The human foot is a highly specialized structure (Jahss, 1991: 31), uniquely suited to carry out its three main functions: support, propulsion and shock absorption (Klenerman, 1991: 1). The foot and ankle are made up of 28 bones and 55 articulations (Michaud, 1993: 1), which allows it to combine flexibility with stability (Klenerman, 1991:1)

The foot can be divided into three functional segments:

- forefoot,
    - The tarsometatarsal, intermetatarsal, metatasophalangeal and interphalangeal joints make up the forefoot (Magee, 1997: 603)
- midfoot
    - containing the midtarsal joints (Magee, 1997 : 602)
- and hindfoot.
    - Consisting of the tibiofibular,talocrural and subtalar joints (Magee, 1997 : 602)

Each with particular functions and specific disorders (Ombregt et.al., 1999:449).

The structural and functional anatomy of the MPJ will be discussed in relative detail as it has bearing on the aetiology of HAVB and on the outcome measures of this study.

2.3.1 STRUCTURAL ANATOMY OF THE FIRST MPJ

Metatarsophalangeal joints are typically condylar, hinged joints (Weinfeld and Schon, 1998) between the rounded metatarsal heads and shallow cavities on proximal phalangeal bases (Moore and Dalley, 1999: 638). The MPJ of the great toe differs from the lesser toes, due to the increased size of the metatarsal head (Moore, 1992:493) and the presence of a sesamoid mechanism that stabilizes the joint (Coughlin, 1997).

The articular surfaces of the first MPJ are large and pass well onto the plantar and dorsal surfaces, allowing for dorsiflexion during walking (Moore, 1992: 493). Articular cartilage covers the articular surface and is thickest in the sesamoid grooves. These two grooves are separated by a longitudinal ridge, crista, that is situated on the plantar aspect of the first metatarsal head (Dykyj, 1989).

2.3.1.1 ANATOMY OF THE SESAMOID COMPLEX

The sesamoid bones that are contained within the flexor hallucis brevis (FHB) tendons are convex and “ride” within the sesamoid grooves (Calliet, 1997:166). As they lie within the grooves on the plantar aspect of the first metatarsal, they attach distally to the proximal phalanx via the plantar plate (Coughlin, 1997). The sesamoids have no attachment to the metatarsal head and are free to follow the proximal phalanx in whatever direction it moves (Calliet, 1997: 166), which is laterally (with reference to the midline of the body) in HAVB.

2.3.1.2 JOINT CAPSULE

The capsule of the first MPJ attaches to the articular margins of the metatarsal head and phalangeal base (Moore, 1992: 493). The fibrous capsule is strengthened medially and laterally by the thick collateral ligaments (Calliet, 1997: 164) and the plantar plate, within which the sesamoids are contained, thickens the plantar aspect. The dorsal aspect of the capsule is formed by the aponeurosis of the extensor hallucis longus tendons, whose fibers descend medially and laterally. The capsule is weakest dorsomedialy where it is re-inforced by only the medial fibers of the extensor tendon. This is also the site of greatest pressure from the medially deviated metatarsal in the development of HAVB (Dykyj, 1989).

The stability of the first MPJ is anatomically maintained by the joint architecture and by a balanced arrangement of ligaments and tendons surrounding the joint (Dykyj, 1989).

2.3.1.3 LIGAMENTS

The first MPJ has nine associated ligaments, including the capsule (Dykyj, 1989)

- 2 collateral ligaments (medial and lateral) are strong cords flanking the joint (Moore and Dalley, 1999: 638)
- intracapsular medial and lateral sesamoid ligaments
- medial and lateral plantar ligaments.

The above three pairs are arranged in a ligamentous triangle on each side of the joint and is the primary mechanism keeping the metatarsal, the involved sesamoid and phalanx in proper arrangement for normal joint function.

- The capsular interosseous ligament transversely attaches the two sesamoid bones so that they don't move independently of each other.
- The deep transverse metatarsal ligament transversely unites adjacent MPJ and resists separation of the joints (Dykyj, 1989)

2.3.1.4 MUSCLE AND TENDON ATTACHMENTS ABOUT THE MPJ

The joint capsule of the first MPJ incorporates tendons of five muscles en route to their osseous insertion, namely:

- flexor hallucis brevis (FHB),
- abductor hallucis,
- adductor hallucis,
- extensor hallucis longus (EHL) and
- extensor hallucis brevis (EHB)

The FHB is a single bellied muscle, which divides to form medial and lateral tendons of insertion, each containing a sesamoid bone. The tendons emerge with the adjacent adductor and abductor hallucis tendons respectively and their combined tendons attach to the capsule. Fibers of the abductor hallucis insert on to the medial sesamoid bone and join the medial tendon of the FHB. The combined tendon attaches to the medial aspect of the base of the first phalanx.

The adductor hallucis muscle forms two tendons from the oblique and transverse heads. Fibers from both heads attach to the lateral sesamoid bone. Once the merger has taken place with the lateral tendon of the FHB, the lateral conjoined tendon forms and inserts into the lateral side of the base of the proximal phalanx Dykyj, 1989).

The EHL runs along the dorsal surface of the MPJ, where it extends to form the hood ligaments, (Calliet, 1997: 167) which form the roof of the dorsal wall of the joint capsule. The EHL sends out medial and lateral transverse fibers, which wrap around the sides of the joint, whist the remaining part of the tendon continues distally to insert the base of the distal phalanx (Dykyj, 1989).

The flexor hallucis longus (FHL) runs between the tendons of the FHB and passes in a groove between the two sesamoid bones. It is the only muscle tendon of the hallux that has no attachment to the first MPJ capsule (Dykyj, 1989).

2.3.2 FUNCTIONAL ANATOMY OF THE FIRST MPJ

The range of motion in this joint is greater than any other joint in the foot (Dykyj, 1989). The MPJ are condyloid, synovial, biaxial joints (Wadsworth, 1988: 203) allowing for motion in multiple planes (Reid, 1992:138). The MPJ permits dorsiflexion, plantarflexion (Michaud, 1993: 13) and some adduction, abduction and circumduction (Moore, 1992: 493). The MPJ has two distinct and separate axes that allow for pure sagital (plantarflexion / dorsiflexion) and transverse (adduction / abduction) plane motion. Sagital motion is very important for normal locomotion, whereas motion in the transverse plane is small and of little functional significance during the gait cycle (Michaud, 1993: 13).

The normal range of motion (ROM) of the big toe at the first metatarso-phalangeal joint is 70 º extension (dorsiflexion) and 45 ° flexion (plantarflexion).

The joint is also capable of slight abduction and adduction, but this is not measured. The closed pack position is full extension (Magee, 1997: 603). The capsular pattern of the first MPJ is a slight limit of plantarflexion together with a marked limitation of dorsiflexion (Ombregt et.al., 1999: 922).

2.4 BIOMECHANICS OF THE MPJ

The study of the normal mechanics of the musculo-skeletal system is the analysis of forces and their effects on anatomic structures such as bone, muscles, tendons and ligaments (Smidt, 1984).

Normal biomechanics of the foot and ankle are divided into static and dynamic components (Donatelli, 1990: 29):

- Static components include:
  - The bones,
  - Joint surface congruity,
  - Ligaments and
  - Fascia.
- Dynamic components include kinetics of the multiple bones and muscle function.

According to Skinner (1995: 390) the main functions of the first MPJ are as a weight bearing structure and stabilizer of the medial longitudinal arch. Therefore the MPJ’s static stability is provided by collateral ligaments and strong plantar plate (plantar aponeurosis and joint capsule). The dynamic stability is provided by the adductor hallucis and abductor hallucis.

One of the important dynamic components of the forefoot is the windlass mechanism. Dorsiflexion of the first MPJ is important in the windlass mechanism (Donatelli, 1990: 24). The action of the plantar aponeurosis is to force the metatarsal into plantarflexion, elevating the longitudinal arch during the third stance phase (Skinner, 1995: 390) and increase tension in the tissues to establish a rigid lever for push off. At least 60 ° –70 ° are needed in the first MPJ to develop enough tension in the plantar aponeurosis (Donatelli, 1990: 24).

The windlass mechanism allows for pressure to be transferred from the metatarsal heads to the toes, especially the hallux, during the terminal stance phase. If the stabilizing mechanism of the hallux is lost, as in HAVB, pressure is not transferred to the toes and remains beneath the metatarsal heads and metatarsalgia results (Skinner, 1995: 390)

2.5 AETIOLOGICAL CONCEPTS OF HAVB

According to Owens and Thordarson (2001) the HAVB deformity is complex and variable, resulting in controversy concerning it’s aetiology. Many authours suggest that a multi-factorial aetiology exists (Brantingham et.al., 1994; Magee, 1992: 456; Klaue et.al., 1994 and Klenerman,1991: 57).

To simplify matters aetiology will be discussed under the following categories:

- Genetic and hereditary factors
- Structural factors
- Functional factors
- Shoes and
- Other

2.5.1 GENETIC AND HEREDITORY

According to Coughlin (1997) hereditary factors are influential in the development of HAVB, and reports on a study (31 cases) on juvenile HAVB in which 94 percent of the children who were diagnosed with HAVB, had mothers who also presented with HAVB.

Yale (1987: 346) is a little more conservative, estimates that 30 percent HAVB are due to hereditary factors and / or of congenital origin. According to Calliet (1997: 167) congenital factors predispose HAVB later in life. Magee (1992: 456) suggests hereditary factors exist as HAVB is often familial and Klenerman (1991: 65) is of the opinion that a strong family history exists in 60 percent of cases and in his clinical experience has seen several cases of HAVB in three generations of the same family.

There is little categorical evidence to ascertain the extent to which genetic and hereditary factors are responsible for the HAVB deformity. The above authors (Coughlin,1997; Magee,1992: 456 and Klenerman,1991: 65) are in little doubt that a strong tie exists between hereditary factors and HAVB formation, making it an important aetiological differential.

2.5.2 STRUCTURAL FACTORS

Metatarsus primus varus (MPV) is a structural abduction deformity of the first metatarsal in relation to the other metatarsal bones. There is an increase angle between the first and second metatarsal (Coughlin, 1997). If the first metatarsal angle exceeds nine degrees it is considered abnormal (Jahss, 1991: 944), and is associated with HAVB deformity (Coughlin, 1997).

The relationship between HAVB deformity and MPV remains controversial (Prieskorn et.al., 1996). There is a considerable difference in opinion as to which is the primary deformity (Klenerman, 1991: 58). Tanaka et.al. (2000) feel that MPV is a major factor in the development of HAVB and Glascoe et.al (2001) found a positive correlation between HAVB and an increased first inter-metatarsal angle, whereas Klenerman (1991: 63) reports on MPV being secondary to HAVB.

HAVB may be brought about by other structural causes including:

- increased obliquity of the first tarso –metatarsal joint (Calliet, 1997: 167)
- short first metatarsal (Klenerman,1991: 58)
- weakening of ligamentous structures (especially the deep transverse planter ligament) responsible for preventing metatarsal head separation (Klenerman, 1991: 63)

The above three may also cause MPV, however the following are more closely associated with the development of HAVB:

- A rounded metatarsal head, is common and is related to the development of a progressive HAVB deformity (Coughlin, 1997). A rounded metatarsal head allows for a lateral shift of the proximal phalanx (Calliet, 1997; 167). Ferrari and Malone-Lee (2002) show that a rounded metatarsal is associated with an increased HAVB deformity.
- a valgus deformity of the ankle and posterior facet of the subtalar joint, causes a hindfoot pronation tendency (Tanaka et.al., 1999).
- and an elongated great toe “Egyptian type foot” (Brantingham et.al., 1994).

2.5.3 FUNCTIONAL FACTORS

The structural malformations discussed are more likely to cause HAVB when combined with functional abnormalities (Brantingham et.al., 1994)

A flat foot deformity also referred to as pes planus is a causative factor in the development of HAVB (Coughlin, 1997) as can be seen in Klenerman’s (1991: 59) report on the a high proportion of patients (83 percent) with HAVB having flat feet. Tanaka et.al. (1999) goes further to describe how depression of the medial longitudinal arch causes pronation of the foot, which in turn produces longitudinal rotation of the first ray, leading to valgus deformity of the big toe. Tanaka et.al.

(1999) also showed that the ankle joint and posterior facet of the subtalar joint in HAVB have a slight valgus deviation, causing the hindfoot in HAVB to have a tendency towards pronation. Yale (1987: 346) is of the opinion that HAVB is most often caused by any condition leading to exaggerated subtalar pronation.

Hypermobility of the first metatarso-cuneiform joint (MCJ) is suggested to play an important role in the development and progression of HAVB (Faber et.al., 1999). Lee and Young (2001) suggest that the importance of the first MCJ is as a communication point between the longitudinal and transverse arches. Excessive motion in the MCJ effects the structural biomechanics of the foot, causing HAVB.

Similarly hypermobility of the first ray is a causative factor in the development of HAVB (Lee and Young, 2001). Glascoe et.al (2001) describe how an unstable first ray elevates, diverges medially and rotates during gait. HAVB is thought to be a compensatory to malaligned first ray position. Ito et.al. (1999) report on a significant correlation to generalized joint laxity in females with symptomatic HAVB.

Muscle imbalance is also considered to be an important aetiological factor in the development of HAVB (Klenerman, 1991: 59). Adductor hallucis provides a significant deforming force in HAVB (Schonhaus and Cohen, 1992), due to it's considerable mechanical advantage over the antagonist muscle, the abductor hallucis. The imbalance causes the big toe to be pulled into valgus (Klenerman, 1991: 59), because of the adductor hallicus attachment to the proximal phalanx (Dykyj, 1989)

Coughlin (1997) and Klenerman (1991: 60) include contracture of achilles tendon as an intrinsic cause of HAVB. Achilles tendon tightness prevents normal dorsiflexion of the foot, causing the formation of a pronated foot.

2.5.4 SHOES

The wearing of shoes is not only a physical necessity, protecting our feet from cold and injury, but also a cultural necessity in most civilized societies (Resch, 1996). “HAVB is a problem of foot in the shoe” (Resch, 1996), as constrictive shoes appear to be the major extrinsic cause of HAVB (Coughlin, 1997). The mistake between shoe and foot size is easy to appreciate, as fashion conscious woman favour small, tight shoes (Meyer, 1996).

Shoes have a negative impact on our feet in two ways:

- by creating abnormal stress on feet (Yale, 1987:346)
- and by limiting active use of toes for more demanding tasks leading to muscle atrophy and imbalance (Resch,1996)

Wearing of incorrect shoes which primarily causes patients discomfort, is highlighted by a:

- drastically lower incidence of HAVB amongst unshod population (2 %) and
- a over-representation of woman suffering with HAVB due in part due to the demands made by woman on foot wear. (Resch, 1996)

Reid (1992: 148) suggests that high heeled shoes with pointed toe boxes are the main culprits in causing HAVB.

2.5.5 OTHER CONSIDERATIONS

Here follows a list of other considerations in the development of HAVB:

- Rheumatoid arthritis is commonly associated with HAVB as joint erosion and wear of capsular structures, especially on the medial side lead to HAVB (Klenerman, 1991:60).
- Infective arthritis

- Traumatic arthritis (Yale, 1987: 346)
- Neuromuscular disorders, cerebral palsy and stroke (Coughlin, 1997)
- Hyper ligamentous laxity disorders, for example Down's and Ehlers- Danlos syndrome (Jahss, 1991: 945)
- Obesity and
- Iatrogenic HAVB following amputation of the second toe (Klenerman, 1991: 61)

Although there is little consensus with regards to the aetiology of HAVB, altered structural and functional characteristics, as discussed above may result in pathological changes occurring in and around the first MPJ (Guiry, 2001).

2.6 PATHO-ANATOMY OF HAVB

The following patho-anatomical changes take place in the development of HAVB:

ALIGNMENT

In HAVB there is a medial deviation of the first metatarsal and lateral deviation of the great toe. There is also external rotation of the great toe due to the attachment of the adductor hallucis, causing it to pronate. As the HAVB deformity increases in magnitude, so does the pronation relative to the big toe (Coughlin, 1997).

ARTICULAR SURFACES

Yale (1987; 46) suggests that the first metatarsal bone and proximal phalanx articulate on their lateral joint surfaces, and that cartilage on the exposed condyles become atrophied. According to Jahss (1991; 947) as HAVB progresses osteoarthritis sets in due to:

- Uncovering of the joint medially and
- Incongruency of the remaining opposing articular surfaces

Thinning and erosion of articular cartilage, a decrease in joint space and marginal proliferation of bone occurs with progressive painful stiffening of the joint (Jahss, 1991: 947).

THE SESAMOID COMPLEX

The inter-sesamoid ridge, crista, on the plantar aspect of the first metatarsal gradually smoothes and offers little resistance to sesamoid displacement (Coughlin, 1997)

Many authors (Yale, 1987: 346; Klenerman, 1991: 63 and Calliet, 1997: 166) suggest the sesamoids displace laterally and this has been termed “subluxation of the sesamoids”. However, it is technically more accurate to describe the first metatarsal as deviating medially away from the sesamoid complex (Coughlin, 1997).

JOINT CAPSULE AND LIGAMENTS

The fibrous capsule is weakest dorso-medially. As the phalanx drifts laterally there is increased tension on the medial side, causing tearing and weakening of the medial capsular fibres (Dykyj, 1989) and medial collateral ligament (Hattrup and Johnson, 1985).

As HAVB increases the lateral capsule and lateral collateral ligament shorten. Initially these lateral structures are flexible and easily correctable, but with time they become contracted (Jahss, 1991: 948) and no longer allow for passive correction (Hattrup and Johnson, 1985).

General ligament laxity and more specifically increased laxity in the deep transverse metatarsal arch is noted in HAVB. This causes metatarsal separation (Dykyj, 1989) and advances HAVB deformity.

MUSCLE AND TENDON ATTACHMENTS

Hallux deviation redistributes tendon attachments in relation to joint axes of motion, serving to aggravate the deviation (Dykyj, 1989).

The abductor tendon is displaced plantarward (Coughlin, 1997) and now acts as a flexor (Jahss, 1991: 957), losing the ability to resist a valgus force (Hattrup and Johnson,1985).

The adductor hallucis muscle becomes a major deforming force in the development of HAVB due to:

- It’s attachment at the lateral aspect of the base of the proximal phalanx and lateral sesamoid (Coughlin,1997) and
- The considerable mechanical advantage it has over it’s antagonist, the abductor hallucis (Klenerman, 1991: 85).

With progression of HAVB deformity, the long tendon of the flexor and extensor muscles displace laterally into the first inter-metatarsal space. Instead of providing a stabilizing force, this contributes to the HAVB deformity (Hattrup and Johnson,1985), via a “bowstring” effect (Magee, 1997:618).

The literature (Yale, 1987: 346) shows that muscle maintains and increases the HAVB deformity.

BUNION FORMATION

As the first metatarsal moves medially, a callous develops on the medial aspect of the metatarsal bone. The overlying bursa thickens and may become inflamed. With time excessive bone may be laid down, forming a bony exostosis. The above changes: callous formation, thickened bursa and exostosis constitute a bunion. It is important to differentiate between HAVB and bunions. HAVB and bunions are separate entities, but HAVB may result in the formation of bunions (Magee,1997: 618).

2.7 THE CLINICAL PRESENTATION OF HAVB

2.7.1 SYMPTOMOLOGY

The primary symptom of HAVB is pain (Coughlin, 1997). This pain may be felt in different aspects of the first MPJ (Klenerman, 1991:65):

- Typical bunion pain is felt medially (on the medial aspect of the foot at the first metatarso-phalangeal joint) and is related to an inflamed bursa or pain from overlying callouses.
- Pain on the plantar aspect is related to metatarsalgia of the first metatarsal or osteoarthritis within the sesamoid complex.
- Pain on the dorsal aspect is less common and associated with hallux rigidus and dorsal osteophytic spurring.
- Poorly defined pain within first MPJ is usually caused by degenerative changes within the MPJ.

Symptoms arising from the lateral toes may be the main complaint and these include:

- Claw toes
- Dorsal callosities (Klenerman,1991: 65)
- Metatarsalgia under the second and third metatarsal heads
- Hammering of the second toe (Levy and Hetherington, 1990:828)
- Overlapping toes (Jahss, 1991:947)

There is an occasional complaint of joint stiffness especially if degenerative changes are present (Klenerman,1991: 65).

A problem facing patients is that of obvious cosmetic deformity. The bunion is the most visible component of HAVB (Coughlin, 1997). Patients fear their feet may deteriorate (Klenerman, 1991:66), desiring cosmetic improvement they resort to surgery (Hattrup and Johnson,1985). Cosmetic complaints are closely linked to shoe problems. One of the most common complaints is buying shoes wide enough to fit the feet comfortably (Klenerman,1991:66),as broad feet makes wearing normal shoes difficult (Calliet, 1997:170).

2.7.2 PHYSICAL SIGNS

The foot is a very complex structure, as a result foot pathology may have a very varied presentation. HAVB initially effects the first MPJ, but progresses to involve the whole forefoot (Kilmartin, 1994). Physical signs may differ from one patient to another, so a whole range of physical findings that may have a bearing on HAVB will be mentioned.

<u>SIGNS:</u>

- A lateral deviation of the great toe, which is the most obvious feature (Kahn, 1996).
- A hallux underlapping the second toe (Jahss, 1991: 947).

- An enlargement of the medial eminence of the first MPJ (Levy and Hetherington, 1990: 829).
- A separation of the first intermetatarsal space (MPV), which can be gauged from the width of the forefoot (Klenerman, 1991: 66).
- An increased pronation of the big toe, which denotes the magnitude of the HAVB deformity.
- A pes planus that may be identified (Coughlin, 1997).
- The plantar surface of the foot, may have plantar callosities, which is often associated with an underlying metatarsalgia (Klenerman, 1991: 66).

Palpation may reveal:

- Tenderness around the first MPJ.
- Tenderness under the metatarsal heads, associated with metatarsalgia.
- Subluxation or dislocation of the MPJ (Klenerman, 1991: 66).
- A tight achilles tendon (Coughlin, 1997).
- A tender bursa overlying the medial bony eminence of the first MPJ (Levy and Hetherington, 1990: 829).
- Crepitus with MPJ motion (Coughlin, 1997).

Range of motion of the first MPJ may be painful and limited (Levy and Hetherington, 1990: 829).

2.7.3 X-RAY FINDINGS

Coughlin et.al. (2002) suggest that the hallux valgus (HV) angle and the first-second intermetatarsal (IM) angle are the most commonly used angular measurements in the assessment of HAVB severity.

The HV angle is formed by the intersection of the longitudinal axes of the first metatarsal and proximal phalanx. A HV angle of less than 15 ° is accepted normal (Coughlin, 1997), whilst angulation of more than 20 ° is considered pathological and likely to cause symptoms (Klenerman, 1991:67)

The IM angle is created by an intersection of the longitudinal axes of the first and second metatarsals (Coughlin, 1997), with a resultant angle of less than 10 ° being considered normal (Condon et.al., 2002).

In a study by Coughlin and Freund (2001), they show a high reliability in the measurements of IM and HV angles, in respect of HAVB patients.

Radiological evaluation and angular measurements of HAVB is extensive (Kristen et.al., 2002; Thordarson and Krewer, 2002; Kuwano et.al., 2002). For the purposes of this study other radiological criteria that can be assessed will only briefly be mentioned, they include :

- Distal metatarsal articulation angle (DMAA).
- Lateral displacement of sesamoids (sesamoid luxation).
- Joint congruency.
- Metatarsal index (metatarsal lengths between the first and second Metatarsals).
- Hallux valgus inter-phalangeus angle.
- Size of the medial eminence.
- Sesamoid rotation angle.

With the use of the HV, IM angles and sesamoid luxation; a general classification system for HAVB was developed (Coughlin, 1997). It defines mild , moderate and severe deformities, which in turn helps to standardize the HAVB description and to assist surgical planning.

Table 2.1 X-ray classification of HAVB

The deformities are described as follows:

	Severity of the HAVB
1	Mild ♦ HV angle $<$ 20° ♦ IM angle of 11° ♦ Subluxation of the lateral sesamoid less than 50%
2	Moderate ♦ HV angle between 20° and 40° ♦ IM angle $<$ 16° ♦ 50-70% subluxation of the lateral sesamoid
3	Severe deformity ♦ HV angle $>$ 40° ♦ IM angle $\geq$ 16° ♦ More than 75% subluxation of the lateral sesamoid

Radiological evaluation should not only be quantitative (angular measurements), but qualitative too. Appreciation of bone appearance and joint spaces are qualitative components of radiological evaluation (Levy and Hetherington, 1990: 829)

Radiological features seen in HAVB include:

1) Bone changes

- A decrease in the quality of bone, osteoporosis (Levy and Heatherington, 1990:829)
- Subchondral cysts (Weinfeld and Schon, 1998)
- Sub articular sclerosis distal to the base of the proximal phalanx

- Altered shape of metatarsal head (Yale, 1987: 347). A rounded head is common and leads to the development of progressive HAVB deformity (Coughlin, 1997)
- Hypertrophy at sites of increased stress (Yale, 1987: 347). Hypertrophy of the medial cortex of the second metatarsal is a sign of second ray overload in HAVB (Lee and Young, 2001)
- Sesamoids undergo degenerative changes such as degenerative periositis, spurs, osteophytes (Yale, 1987: 347) and may elongate (Weinfeld and Schon, 1998)
- Medial eminence hypertrophy (Thordarsen and Krewer, 2002)

2) Joint changes

- Asymmetric joint space narrowing (Weinfeld and Schon, 1998)
- Osteophytic lipping and spurring at joint margins (Yale, 1987: 347).

3) Soft tissue changes

- Effusion within the articular capsule
- A bursa may be visualized overlying the deformed joint (Yale, 1987: 347).

The accurate quantitative and qualitative interpretation of radiographs are important, as radiological evaluation plays an essential role in the form of treatment the patient may receive.

2.8 TREATMENT

Due to the complex nature (Owens and Thordarson, 2001) and multi-factorial aetiology of HAVB (Brantingham et.al., 1994 and Klaue et.al.,1994) a broad spectrum of treatment approaches have been developed. Calliet (1997: 173) is of the opinion that treatment for HAVB must be individualized and based on the patients age, degree of deformity, severity and duration of symptoms. The primary question is always whether treatment should be conservative or surgical (Meyer, 1996).

2.8.1 SURGERY

HAVB surgery is a well-documented, conventional form of treatment for HAVB (Khan, 1996). Many surgical procedures have been described (Hattrup and Johnson, 1985), but for the purposes of this study only the general principles and complications of well accepted procedures will be described.

These can be divided into:

- Soft tissue procedures
- Osteotomies
- Combined procedures and
- Athroplasty.

2.8.1.1 SOFT TISSUE PROCEDURES

A classic “soft tissue” technique was described by in 1928 by McBride (Hattrup and Johnson, 1985). It was designed to remove the deforming force in HAVB by releasing the conjoint tendon from the base of the proximal phalanx and transplanting it together with the lateral head of the FHB to the metatarsal head. The lateral sesamoid is removed during the tendon transplant and the medial eminence is excised during the same incision.

Coughlin (1996) reports that hallux varus is a serious complication of the McBride procedure and that limitations of isolated distal soft tissue surgery are substantial.

2.8.1.2 OSTEOTOMY

Osteotomy is the commonest procedure used in HAVB surgery. Osteotomies may be performed on the proximal phalanx or first metatarsal, and therefore may be placed either distally or proximally (Resch,1996).

There is more risk of transfer metatarsalgia post-operatively in proximal osteotomies. This is because osteotomies result in shortening of the first metatarsal and leads to dorsal displacement thereof (Resch,1996). Hattrup and Johnson (1985) mention other complications as a result of osteotomy including: instability, non union, avascular necrosis of the metatarsal head, reoccurrence, under correction and over correction with hallux varus development.

2.8.1.3 ATHROPLASTY

Two techniques described in literature include:

- In 1912 Keller described a procedure which removes part of the proximal phalanx of the great toe (Resch,1996).
- Mayo procedure which removes the first metatarsal head (Jahss,1991: 1091)

The principle behind athroplasty is that it shortens the first ray, which allows repositioning of the toe and better aligned with the first metatarsal. It does not solve the problem of forefoot widening and leads to weakening during push off (Resch,1996). Coughlin (1997) reports on other complications following athroplastic type surgery including: post- operative metatarsalgia, cock-up deformity of the big toe, inter-phalangeal joint stiffness, marked shortening and impaired control and function.

Forefoot surgery is becoming increasingly more popular. With this comes the potential for complications even when surgery is performed meticulously, by an experienced surgeon and under controlled conditions. When complications arise they can present difficult and challenging problems (Sammarco and Indusuyi, 2001).

It is for this reason that conservative avenues for HAVB care should be sought first. Coughlin (1997) states that non-operative care is always the first option for a patient suffering from HAVB.

2.8.2 CONSERVATIVE CARE

There is a wide range of conservative treatment for HAVB of which few have been well researched. For the purposes of this study conservative care will be discussed under the following:

- 2.8.2.1 Footwear and orthotics
- 2.8.2.2 Splinting
- 2.8.2.3 Homeopathic intervention
- 2.8.2.4 Manipulation

2.8.2.1 FOOTWEAR AND ORTHOTICS

Since HAVB is a problem of the foot in the shoe, wearing correct shoes should solve the problem (Resch, 1996). According to Hattrup and Johnson (1985) the most useful non-surgical approach is to advise on appropriate shoe wear and the use of orthotics.

Various authors (Brantingham, et.al.,1994; Coughlin,1997; and Yale, 1987: 347) advocate the use of accommodative orthoses in addition to good fitting footwear as part of a comprehensive, conservative treatment approach to HAVB. Orthoses will help in the management of pes planus, wider toe boxes will eliminate friction over the medial eminence and together they may reduce symptoms substantially (Coughlin, 1997).

Jahss (1991: 967) advises on the following when buying shoes :

- Acceptance of less than stylish shoes.
- Shoe shape must accommodate a wide forefoot.
- Toe box must be high enough to clear hammer or clawing toes.

Kilmartin et.al. (1994) performed a prospective, randomised, placebo controlled clinical trial on 122 children between the ages of nine and ten years of age, to determine the effect of orthoses in the treatment of juvenile HAVB. The orthoses were designed to prevent excessive pronation of the subtalar joint.

The children were reviewed every 6 months over a three year trial period to check compliance. The results indicated an increase in the HV angle in both treatment and non treatment groups, with more deterioration in the treatment group. The authors concluded that their orthoses should not be used in juvenile HAVB, as it increased the rate of HAVB progression.

Although a randomised selection procedure was used, the treatment group had a significantly higher HV angle than the control group. Despite this affecting the outcome of the study, the authors maintain that juvenile HAVB deteriorates between the ages of 11 and 14 years regardless of whether they wear biomechanical orthoses or well fitting shoes. This can be related to the fact that the juveniles are yet to reach skeletal maturity.

2.8.2.2 SPLINTING

Various authors (Calliet, 1997: 174; Jahss,1991: 970; Klenerman, 1991:67 and Yale,1987:347) suggest a stabilising splint should be worn at night to treat HAVB. According to Calliet (1997: 174) night splints should be used on a flexible forefoot that can be manually corrected. In order to be effective it adducts the first metatarsal and abducts the 2 phalanges of the great toe.

Grosio (1992) performed a clinical trial to assess the effectiveness of thermoplastic splints combined with active and passive exercises in a group of 56 children with juvenile HAVB. The patients ages ranged from one month to 16 years. Grosio (1992) made use of an office made, low temperature thermoplastic splints, which made it easier to accommodate the individuals anatomical and pathological characteristics. The splint could also be reset periodically to accommodate growing feet.

The study showed a satisfactory improvement in the HV and IM angles in 50 percent of feet. The validity of these results are questionable for a number of reasons:

- Inclusion criteria for the research was not standardized.
- It was not a randomised clinical trial.
- No statistical analysis was performed on the data collected.
- No mention is made of the effectiveness of the treatment with respect to relieving pain.
- The study also had a number of treatment variables including splinting, active exercises and passive exercises making it difficult to assess the effectiveness of any single treatment entity.

2.8.2.3 HOMEOPATHIC INTERVENTION

Kahn (1996) performed a double blinded, comparative, placebo controlled clinical trial to determine the effectiveness of *Tagetes patula* in the treatment of HAVB, in terms of pain, swelling and deformity of the first MPJ.

Group A consisted of 20 patients with bilateral HAVB, who had one foot treated with active tincture and the other with placebo paste. Group B consisted of 40 patients with unilateral deformities and were divided into two groups of 20 each. One group (Group Ba) received active treatment and the other (Group Bb) placebo paste.

Both groups A and B had a protective pad, which held the tincture in place and simultaneously decreased pressure and friction on the joint.

The results showed that both groups experienced a significant decrease in HV angle and width of the lesion on post treatment radiographic evaluation. There was also a significant decrease in pain. The placebo groups experienced no reduction in the HV angle and little reduction in pain. The slight benefit the placebo group obtained, was considered a result of the protective pad reducing pressure on the joint, because the condition worsened following pad removal. The author (Kahn,1996) recommends *T. patula* as an alternative treatment for patients not responding to other treatments and contra-indicated to surgery.

The study design, a comparative study using both objective (x-rays) and subjective data analysis, appears to be strong. Patient allocation into their respective groups, however does not appear to be randomised.

2.8.2.4 JOINT MANIPULATIVE PROCEDURES

Bergman et.al. (1993) refers to joint manipulative procedures as being physical maneuvers designed to induce joint motion through either non-thrust techniques (mobilizations) or thrust techniques (manipulations) in the treatment of neuromusculoskeletal disorders. Joint mobilization is a form of manipulation applied within the physiological range of joint motion and is characterized by non-thrust passive movement induced into the joint. The adjustment according to Bergman et.al. (1993) is a specific type of articular manipulation using either long or short leverage techniques with specific contacts. It is characterized by a dynamic thrust of controlled direction, amplitude and velocity.

According to the above definition SCS is a mobilization. The SCSM as defined by Jones (1992) is "relieving spinal or other joint pain by passively putting the joint into its position of greatest comfort." This technique forms part of positional release therapy (PRT), which is described by D'Ambrogio and Roth (1997) and is accomplished by placing the involved tissues in an ideal position of comfort to reduce irritability of the tender point and to normalize the tissues associated with the dysfunction. The ideal position of comfort for HAVB according to Jones (1992) is when the hallux is into abduction (away from the midline of the body), eversion (valgus) and plantarflexion of the first metatarso-phalangeal joint.

According to D'Ambrogio and Roth (1997) joints become hypomobile when the muscles across the joint become hypertonic and therefore the effects of PRT include:

- Reducing joint hypomobility.
- Reduction of pain.
- Normalization of muscle hypertonicity.

Jones (1992) claims that this technique is an effective, passive non-thrust mobilization for the relief of HAVB. Broodryk (2000) performed a prospective, randomized, placebo controlled clinical trial to evaluate the efficacy of strain counter-strain mobilization (SCSM) in the treatment of HAVB. The SCSM proved to be more effective than placebo in the initial stages of treatment with a P value of 0.05 being obtained.

This study did not require a radiological evaluation to include patients in the study and inclusion was based on clinical observation only, questioning the validity of participants entering the study. The study outcomes were based on subjective and objective measures of pain relief and no account was taken for changes in MPJ range of motion and the HAVB deformity.

Brantingham et.al. (1994) reported on a case study in which a 39 year old male presented with foot pain, six months after undergoing an unsuccessful bunionectomy. On examining the foot bilateral HAVB were observed, the tests for metatarsalgia were positive and motion palpation revealed several restrictions in the foot. The patient underwent a course of 5 treatments involving a progressive mobilization, adjustments and ice. The patient reported nearly a 100 percent improvement in symptoms and a year later was still experiencing 90 percent or more pain relief. The research outcomes seem purely subjective, and no objective measurements were discussed in follow up consultations. The positive outcome in this study may have been influenced by the multi-treatment protocol.

For the purposes of this study the above treatment plan of a progressive mobilization, adjustments of restricted joints and ice will be called Brantingham's Protocol for HAVB and the mobilization, Brantingham's Mobilization (BM). BM is a progressive mobilization (Brantingham et.al., 1994). Guiry (2001) explains progressive mobilization the following way:

At the initial consultation the patient received a Grade 2 [1] mobilization of the first MPJ. With subsequent follow-up consultations, and depending on patient improvement the mobilizations of the first MPJ increased from grade 2 to grade 5 mobilizations. In 2001, Guiry performed a prospective, randomised placebo controlled clinical trial and found the Brantingham protocol for HAVB to be effective in the alleviation of symptoms associated with HAVB with a P value of 0.05 was obtained. As with Broodryk (2000), Guiry's study also focussed on pain related objective outcomes and did not measure first MPJ range of motion, or changes in the HAVB deformity. Brantingham's protocol is a multi-treatment protocol, which may have affected the positive outcome of the study.

The results of Guiry's (2001) study on Brantingham's Protocol and Broodryk (2000) study on SCSM received positive results. These studies had varied and limited subjective and objective measures, resulting in the outcome measures being incomparable and therefore it is difficult to establish which manual procedure is more effective in the treatment of HAVB.

This study aims to investigate the SCSM and BM in the treatment of HAVB. The results of this study may shed light on which mobilization technique is better in the treatment of HAVB.

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[1] The grades of mobilization will be implemented according to the guidelines given by Maitland (1986:96).

Grade 1: Is a small amplitude movement near the starting position of the range (Michaud, 1993:134).

Grade 2: Is a large amplitude movement, which carries well into the range. It can occupy any part of the range that is free of any stiffness and muscle spasm (Michaud, 1993:134).

Grade 3: Is also large amplitude movement, but one that does move into stiffness and muscle spasm (Michaud, 1993:134).

Grade 4: Is a small amplitude movement stretching into stiffness and muscle spasm (Michaud, 1993:134).

Grade 5: Manipulation :" High velocity, low amplitude thrust accessing the Paraphysiological space but not exceeding the anatomical limit of Movement" (Michaud, 1993:134).

CHAPTER THREE

MATERIALS AND METHODS

3.0 INTRODUCTION

This chapter describes the general procedures and methods of performing the research, collecting the data and statistical analysis thereof.

In this chapter

3.1 Study Design

3.2 Patient Selection

3.3 Allocation of the subjects

3.4 Treatment Interventions

3.5 Methods of Measurement

3.6 Location of Data

3.7 Statistical Analysis

3.8 The Statistical Package

will be discussed.

3.1. STUDY DESIGN

The design was that of a prospective, randomized, comparative, clinical investigation to assess the effectiveness of SCSM versus BM in the treatment of symptomatic Hallux Abductovalgus (Bunions).

3.2. PATIENT SELECTION

A non-probability purposive sampling technique was used to attract participants. The study was limited to symptomatic patients with regard to HAVB residing in

KwaZulu-Natal province. Advertisements were placed at the Durban Institute of Technology Campus, ballet studios, yoga class venues and shoe shops.

Interested participants who responded to the adverts, underwent a telephonic interview to ensure their suitability for the research. Questions asked at the interview included:

- Have you been diagnosed or treated for bunions before?
- Do you experience any pain around the big toe?
- Do you have a tender and swollen big toe?
- Do you have any difficulty in wearing shoes comfortably?
- Have you noticed any deviation of the big toe?

Their age was also asked to ensure they fitted the age parameters (18-65 years). They were also asked if they had undergone any surgical correction for their HAVB, as this was also an exclusion criteria.

3.2.1 INCLUSION AND EXCLUSION CRITERIA

Following the telephonic interview patients attended an initial consultation during which the diagnosis of HAVB was made based on the findings of a case history (Appendix 1), physical examination (Appendix 2), foot an ankle regional examination (Appendix 3) and a radiographical evaluation. They were also be screened for suitability as research participants based on the following inclusion and exclusion criteria:

3.2.1.1 INCLUSION CRITERIA

The inclusion criteria were based on a combination of diagnostic criteria as used by Calliet (1997), Levy and Hetherington (1990) and Klenerman (1991).

Subjects had to display the following:

1) Pain around the first MPJ.
2) Enlarged portion of the first metatarsal head.
3) Inability to wear shoes comfortably.
4) Mild, moderate or severe lateral deviation of the hallux from the mid-sagital plane.
5) On Radiological examination an HV angle had to be greater than 15 ° and an intermetatarsal angle greater than 9 ° degrees.

3.2.1.2 EXCLUSION CRITERIA

1) Participants suffering from systemic or local pathology for example gout or osteoathritis were excluded from the study.
2) Participants who are contraindicated to joint manipulative therapy (Bergman et.al., 1993:133) were excluded from the study. The following factors were considered:

- Anticoagulant therapy
- Inflammatory arthritis
- Joint instability
- Fracture or dislocation
- Bone tumors or infection
- Musculo-skeletal injury
- Advanced / Severe degenerative joint disease

3) Participants using tight, narrow pointed high-heeled shoes (Reid, 1992:149), which nullify any therapeutic benefit derived from conservative care, were excluded from the study.
4) Any participant who is on any oral non-steroidal anti-inflammatory drug were required to participate in a wash out period prior to entering the study (Poul et.al, 1993)

5) Pregnant woman were excluded from the study as per standard X- ray protocol, as employed by radiography departments.
6) Participants younger than 18 years and older than 65 years will also be excluded from the study in keeping with Guiry's (2001) age parameters.

Patients who had undergone surgery were excluded from this study , so as not to skew the results.

3.3 ALLOCATION OF THE SUBJECTS

The study was limited to 60 patients. Participants were randomly allocated into 2 groups by drawing papers from a box. Thirty of the pieces of paper had the words "Group A" printed on them, and thirty had the words "Group B". Participants who draw Group A received SCSM. Participants in Group B received BM. Before treatment commenced patients had to read a letter of information (Appendix 5) and sign a consent form (Appendix 4).

3.4 TREATMENT INTERVENTIONS

3.4.1 STRAIN COUNTER-STRAIN MOBILISATION

Participants in Group A had the treatment protocol explained to them. Group A participants received SCSM as described by Jones (1992) and researched by Broodryk (2000). The SCSM involved:

- The patient lying in the prone position with the ipsilateral knee flexed to ninety degrees.
- The bunion tender point, under the lateral sesamoid bone, was contacted and pressure applied in a plantar to dorsal direction using a thumb contact.
- With the indifferent hand, the examiner contacts the hallux and induces abduction, eversion and flexion (plantar) of the first metatarso-phalangeal joint till the position of greatest comfort is achieved.

- The position is maintained for ninety seconds and then the hallux is slowly returned to it's neutral position over a thirty second period (Broodryk, 2000).
- At the end of each consultation participants had ice, indirectly applied to the HAVB joint , for 3-5 minutes.

3.4.2 BRANTINGHAM'S MOBILISATION

Participants in Group B had the treatment protocol explained to them. Group B participants received BM as described by Brantingham et.al (1994) and researched by Guiry (2001).

At the first consultation, the examiner applied a light axial traction to the first metatarsophalangeal joint by grasping the great toe between thumb, index and middle finger. Using the opposite hand, the examiner grasps the first ray just proximal to the metatarsal head. A light lateral glide and adduction (toward the midline of the sagital plane) mobilization was initiated at the first metatarsophalangeal joint (grade 2). At subsequent consultations the mobilization of the joint progressed from grade 2 to a grade 5 mobilization. The grades of mobilization were implemented according to the guidelines given by Maitland (1986:96).

The speed of progression from a grade 2 to a grade 5 mobilization was dependent on the pain / tenderness experienced by the patient. The aim was to deliver a high velocity, low amplitude thrust / manipulation (grade 5) to this joint by the fifth treatment (Guiry, 2001). The application of the mobilization was guided by the pain free range of motion of the patient, so as to avoid excessive pain, as recommended by Brantingham et.al., (1994). At the end of each consultation participants had ice, indirectly applied to the HAVB joint, for 3-5 minutes.

3.5 METHODS OF MEASUREMENTS:

3.5.1 THE SUBJECTIVE MEASUREMENTS

3.5.1.1 THE NUMERICAL PAIN RATING SCALE (NRS-101)

The NRS – 101 (Appendix 6) was chosen as it is easy to use, and it has been found to be a reliable and valid method to record subjective information relating to the patients' level of pain (Jensen, et al. 1986:125). The patients were asked to rate their pain as a percentage on two separate lines drawn from 0 (equivalent to no pain at all) to 100 (equivalent to pain as bad as it could be). The first number had to be their pain when it was at its worst, and the second number had to be their pain when it was at its least. Two scores were obtained, which was then divided by two, forming an average pain intensity score which was used for statistical analysis. An improvement in pain experienced by the patient was denoted by decreasing scores.

3.5.1.2 THE FOOT FUNCTION INDEX PAIN SCALE (FFI)

This index (Appendix 7) was developed to assess the impact of foot pathology on function in terms of pain, daily activities and disability. The FFI consists of 23 items divided into 3 sub-scales:

- Sub-scale 1 – foot pain
- Sub-scale 2 – disability
- Sub-scale 3 – activity limitation

as they relate to foot pathology.

The items in subscales 1 and 2 were scored from 0 –10. Zero meaning "no pain" and 10 meaning "pain as bad as could be". Patient s circled a number between 0 and 10, that they thought reflected their level of pain. The numbers were added up giving a total that was divided by the maximum number making up the subscale. A score was thus obtained for sub-scale 1 and sub-scale 2. The total FFI score was obtained by taking the average score for subscales 1 and 2 together. The total FFI scores were used to perform statistical analysis.

Budiman-Mak et.al. (1991) examined the FFI for test-retest reliability, internal consistency and construct and criterion validity. The study was carried out on 87 patients suffering with rheumatoid athritis. The authors found a strong correlation between the FFI total, sub-scale scores and clinical measures of foot pathology, supporting the criterion validity of the FFI. The authors suggest that the FFI should proof useful for both clinical and research purposes.

3.5.2. THE OBJECTIVE MEASUREMENTS

Both treatment approaches essentially attempted to restore the normal range of motion within the joint and to reduce the pain experienced by the patient. To measure these outcomes the following were used:

3.5.2.1 THE ALGOMETER

The algometer was used to determine any change in the pressure pain tolerance levels in hypersensitive spots, thus reflecting a quantitative response to the treatments (Fischer, 1986). The origin of pain in these tender areas may arise from ligaments, joint capsules, tendons and periosteum (Fischer, 1987).

The measurements were taken as described by Guiry (2001):

- The area of maximal tenderness on the planter medial aspect of the first MTJ line was located. The area was marked using a henna dye and a small cross made for identification in the following treatments.
- The foot plate of the algometer was placed over the area of maximal tenderness with the shaft exerting pressure in the direction that produced pain on palpation.

- The gauge was turned away from the patient and pressure was increased at a rate of approximately 10 Newton/second (1kg/sec).
- Patients were informed to indicate when they first sensed the pain produced by the pressure by saying “now”.
- Three consecutive readings were taken and their scores averaged to obtain the mean.
- The mean algometer readings were recorded in Newton’s.
- An increased level of pressure tolerated by the patient denotes an improvement in pressure–pain tolerance.

3.5.2.2 GONIOMETER

A goniometer was used to measure changes in ROM of the first MTPJ as recommended by Guiry (2001). In a study done by Rothstein et.al. (1983), the goniometer (regardless of the type) was found to have a high degree of intra-tester reliability for both elbow and knee measurements. It is a primary tool of measurement both for initial assessment and for charting patient progress (Rothstein et.al., 1983).

Goniometer readings were taken according to the procedure described by Donatelli (1990, 142).

- The patient lay prone and the foot was stabilized with one hand.
- The arms of the goniometer were placed on the long axis of the first ray and the first proximal phalanx.
- The hallux was passively dorsiflexed and the measurement recorded.
- The procedure was repeated for plantarflexion of the first MTP joint.

The goniometer was also be used to evaluate the HAVB deformity.
The MPJ angle (Magee, 1992:454), more commonly known as the hallux valgus (HV) angle is measured as the angle of intersection between the long axis of the

first metatarsal and the proximal phalanx (Calliet, 1997:173). The HV angle was measured by marking three dots using henna dye at three locations:

- In the midline of the distal first metatarsal shaft,
- The midline of the first MPJ and
- The midline of the proximal phalanx. The arms of the goniometer were aligned with the dots and the HV angle measured.

3.5.2.3 THE HALLUX METATARSOPHALANGEAL-INTERPHALANGEAL SCALE (HAL SCALE)

This scale (Appendix 8) aims to provide a standard method of reporting on the clinical status of the foot and was developed by the Orthopaedic Foot and Ankle Society. The scale involves assessment of both objective and subjective data to a maximum score of 100 points (Kitaoka et.al., 1994) The points allocation were as follows:

- 40 points allocated to pain
- 45 to function (including activity capabilities, shoe wear comfort and range of motion) and
- 15 points to alignment

An increase in the score denoted improvement.

This scale has been used in studies pertaining to the first metatarsophalangeal joint (Guiry, 2001 and Selner et.al., 1999).

All subjective and objective data (Appendix 9) was recorded prior to treatment on the initial, 3rd, 5th and 6th (one week follow up) consultations as recommended by Guiry (2001).

3.6 LOCATION OF DATA

The primary data was obtained from NRS-101, FFI, AOFAS Hallux Metatarsophalangeal-interphalangeal scale, algometer and goniometer readings.

The secondary data was collected from current journals, textbooks and Internet at the D.I.T. Berea Campus Library and Medical School Library (University of KwaZulu-Natal).

3.7 STATISTICAL ANALYSIS

3.7.1 PROCRDURE ONE: COMPARISON BETWEEN TWO UNPAIRED (INDEPENDENT) SAMPLES

3.7.1.1 THE MANN-WHITNEY U-TEST

The Mann-Whitney U-test, a non-parametric test, was used to compare two independent samples with respect to subjective variables. The above test was used to determine whether any significant differences existed between Group A and Group B at the 1st, 3rd ,5th and 6th (one week follow up) consultations for each of the variables at the $\alpha = 0.05$ level of significance.

Hypothesis Testing:

The null hypothesis (H_o) stated that there was no difference with regards to the variable under consideration between the groups A and B. The alternative hypothesis (H_1) stated that there was a difference with regards to the variable under consideration between groups A and B.

- H_o : There was no difference between groups A and B.

- H_1 : There was a difference between groups A and B.
- $\alpha = 0.05$ = level of significance of the test.

The Decision Rule.

For a two-tailed test:

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

3.7.1.2 THE UNPAIRED T-TEST

The two-sampled unpaired t-test was used to compare two independent samples with respect to objective variables. The above test was used to determine whether any significant differences existed between Group A and Group B at the 1st, 3rd ,5th and 6th (one week follow up) consultations for each of the variables at the $\alpha = 0.05$ level of significance.

Hypothesis Testing:

The null hypothesis (H_o) stated that there was no difference with regards to the variable under consideration between the groups A and B. The alternative hypothesis (H_1) stated that there was a difference with regards to the variable under consideration between groups A and B.

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

The Decision Rule.

For a two-tailed test:

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

3.7.2 PROCEDURE TWO: COMPARISON BETWEEN RELATED SAMPLES WITHIN GROUP A AND GROUP B INDEPENDENTLY

3.7.2.1 FRIEDMAN'S TEST

Friedman's test is a non-parametric test that compares three or more matched groups. If the P-value was small, one could conclude that at least one treatment differed from the rest. The Dunn Procedure was then used in cases where the null hypothesis was rejected to determine at which consultation an improvement was observed.

Hypothesis Testing:

The null hypothesis (H_o) stated that there was no improvement between consultations with regards to the variable under consideration. The alternative hypothesis (H_1) stated that there was an improvement between consultations with regards to the variable under consideration.

- H_o : There was no improvement between consultations.
- H_1 : There was an improvement between consultations.
- α = 0.05 = level of significance of the test.

The Decision Rule.

For a one-tailed test:

- Reject H_o , if $p < \alpha$
- Do not reject H_o , if $p \geq \alpha$. Where p is the reported p-value/2.
- 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
- $\alpha = 0.05$

If the alternative hypothesis was accepted the Dunn's Procedure was performed.

3.7.3 PROCEDURE THREE: STATISTICS SUMMARY

Visual summaries of analytical findings were given by the use of bar charts to compare Groups One and Two. Average (mean) readings were used to construct the bar charts.

3.8 THE STATISTICAL PACKAGE

The statistical package used was the SPSS Inc. 1999 Version 9 for Windows®. All data was entered and analyzed via this package.

CHAPTER FOUR

RESULTS

4.0 INTRODUCTION

This chapter covers demographic data and the results obtained from the statistical analysis of the data collected using the following measurement criteria:

- Subjective measures
  - NRS-101
  - FFI
- Objective measures
  - HV goniometer readings
  - plantarflexion readings
  - dorsiflexion readings
  - algometer readings and
  - HAL scores

4.1 CRITERIA GOVERNING THE ADMISSIBILITY OF DATA

Data collected and used was only taken from those patients who participated for the full duration of the study and who complied with the inclusion and exclusion criteria. Only the objective measurements that were taken by the researcher were used. All responses to subjective measurement questionnaires were completed under the researcher's supervision.

Key for abbreviations used in the following tables

Group A : Strain counter-strain mobilization
Group B : Brantingham's mobilization
V : Visit

Me : Mean

Sd : Standard deviation

MR : Mean rank

4.2 DEMOGRAPHIC DATA

The demographical data was collected from the case history and regional examination at the initial visit.

Table 4.1. Age distribution of patients (n = 60)

AGE	GROUP A	GROUP B	TOTAL (A+B)	PERCENTAGE (%)
18 – 24	4	4	8	13.3%
25 – 34	3	4	7	11.6%
35 – 44	4	4	8	13.3%
45 – 54	7	9	16	26.6%
55 – 65	12	9	21	35.0%
TOTAL	**30**	**30**	**60**	**100%**

Table 4.2. Average age and age range of patients

AGE	GROUP A	GROUP B
AVERAGE AGE	47.40	46.03
YOUNGEST	22	20
OLDEST	65	63

Table 4.3. Gender distribution of patients

GENDER	GROUP A	GROUP B	TOTAL (A+B)	PERCENTAGE (%)
FEMALE	25	29	54	90
MALE	5	1	6	10
TOTAL	**30**	**30**	**60**	**100**

Table 4.4. Race distribution of patients

RACE	GROUP A	GROUP B	TOTAL (A+B)	PERCENTAGE (%)
WHITES	18	24	42	70
BLACKS	1	1	2	3.3
INDIANS	9	3	12	20
OTHER	2	2	4	6.6
TOTAL	**30**	**30**	**60**	**100**

Table 4.5. HAVB distribution

HAVB DISTRIBUTION	GROUP A	GROUP B	TOTAL (A+B)	PERCENTAG E (%)
UNILATERAL	3	2	5	8.3
BILATERAL	27	28	55	91.7
TOTAL	**30**	**30**	**60**	**100**

Table 4.6. Predisposing factors (familial history, shoes and dancing)

PREDISPOSING FACTORS		GROUP A	GROUP B	TOTAL (A+B)	PERCENTAGE (%)
FAMILIAL HISTORY	Yes	25	26	51	85
	No	5	4	9	15
SHOES	Yes	25	23	48	80
	No	5	7	12	20
DANCING	Yes	5	15	20	33.3
	No	25	15	40	66.6

Table 4.7. Patient Occupation

OCCUPATION	GROUP A	GROUP B	TOTAL	PERCENTAGE (%)
HOUSEWIFE	10	11	21	35
PYSICAL INSTRUCTOR	2	2	4	6.6
PRO	3	0	3	5
STUDENT	5	3	8	13.3
MANAGER	2	3	5	8.3
SELF EMPLOYED	2	2	4	6.6
ARCHITECT	0	1	1	1.6
BEAUTY THERAPIST	1	1	2	3.3
ADMINISTRATOR	1	4	5	8.3
TRAVEL CONSULTANT	0	1	1	1.6
TEACHER	2	0	2	3.3
PHARMACIST	1	0	1	1.6
SECRETARY	1	2	3	5
TOTAL	**30**	**30**	**60**	**100**

4.3 INTER-GROUP ANALYSIS

4.3.1 INTER-GROUP ANALYSIS OF SUBJECTIVE DATA USING THE MAN-WHITNEY U TEST

Table 4.8. Statistical analysis of NRS-101and FFI scores comparing Group A and Group B at the visit one

SCORES	GROUP A VISIT 1			P-value	GROUP B VISIT 1		
	Me	Sd	MR		Me	Sd	Mr.
NRS-101	37.37	10.36	26.43	.068	43.27	12.51	34.57
FF1	30.23	13.99	25.03	.015	39.08	14.29	35.97

The null hypothesis was accepted for the NRS-101 scores, indicating **no difference** between Group A and Group B at the initial consultation. However, the null hypothesis was rejected for FFI scores, indicating a statistically **significant difference** between Group A and Group B at the initial visit.

Table 4.9. Statistical analysis of NRS-101and FFI scores comparing Group A and Group B at the visit three

SCORES	GROUP A VISIT 3			P-value	GROUP B VISIT 3		
	Me	Sd	MR		Me	Sd	Mr.
NRS-101	31.87	9.82	29.18	.556	33.76	10.78	31.82
FFI	27.19	13.76	26.23	.058	33.97	13.48	34.77

The null hypothesis was accepted for all of the above scores, indicating **no difference** between Group A and Group B at the third visits.

Table 4.10. Statistical analysis of NRS-101and FFI scores comparing Group A and Group B at the visit five

SCORES	GROUP A VISIT 5			P-value	GROUP B VISIT 5		
	Me	Sd	MR		Me	Sd	Mr.
NRS-101	27.25	11.93	32.20	.444	25.08	7.89	28.80
FFI	22.37	13.42	28.08	.283	25.99	11.44	32.92

The null hypothesis was accepted for all of the above scores, indicating **no difference** between Group A and Group B at the fifth visits.

Table 4.11. Statistical analysis of NRS-101and FFI scores comparing Group A and Group B at the visit six

SCORES	GROUP A VISIT 6			P-value	GROUP B VISIT 6		
	Me	Sd	MR		Me	Sd	Mr.
NRS-101	24.35	11.39	32.60	.346	21.17	10.31	28.40
FFI	22.90	14.64	31.57	.636	21.62	12.44	29.43

The null hypothesis was accepted for all of the above scores, indicating **no difference** between Group A and Group B at the sixth visits.

4.3.2 INTER-GROUP ANALYSIS OF OBJECTIVE DATA USING UNPAIRED T-TEST

Table 4.12. Statistical analysis of the HV angle, plantarflexion, dorsiflexionand algometer readings and HAL scores, comparing Group A and Group B at visit one

SCORES	GROUP A VISIT 1			P-value	GROUP B VISIT 1		
	Me	**Sd**	**MR**		**Me**	**Sd**	**Mr.**
HV ANGLE	28.33	7.14	3.40	.764	28.93	8.25	3.78
PLANTAR FLEXION	15.90	8.43	2.03	.615	17.20	11.26	1.95
DORSI FLEXION	54.03	15.67	1.70	.320	50.23	13.59	1.17
ALGOMETER	5.49	1.27	1.72	.193	5.06	1.26	1.10
HAL	71.23	7.61	1.93	.027	64.73	13.66	1.47

The null hypothesis was rejected for HAL scores, indicating a statistically **significant difference** between Group A and Group B at the initial visit. The null hypothesis was accepted for HV, plantarflexion, dorsiflexion and algometer readings indicating **no difference** between Group A and Group B at the first visit.

Table 4.13. Statistical analysis of the HV angle, plantarflexion, dorsiflexion and algometer readings and HAL scores, comparing Group A and Group B at visit three

SCORES	GROUP A VISIT 3			P-value	GROUP B VISIT 3		
	Me	Sd	MR		Me	Sd	Mr.
HV ANGLE	26.60	6.91	2.60	.629	25.70	7.44	2.55
PLANTAR FLEXION	17.17	6.83	2.27	.328	19.17	8.76	2.20
DORSI FLEXION	58.07	12.80	2.40	.418	60.73	12.55	2.30
ALGOMETER	6.04	1.17	2.30	.809	5.98	0.96	1.98
HAL	72.93	8.78	2.32	.628	71.93	7.00	2.12

The null hypothesis accepted for the above readings and scores, indicating **no difference** between Group A and Group B at the third visit.

Table 4.14. Statistical analysis of the HV angle, plantarflexion, dorsiflexion and algometer readings and HAL scores, comparing Group A and Group B at visit five

SCORES	GROUP A VISIT 5			P-value	GROUP B VISIT 5		
	Me	Sd	MR.		Me	Sd	Mr.
HV ANGLE	25.73	6.36	2.12	.748	25.13	7.92	2.03
PLANTAR FLEXION	19.43	6.37	2.77	.627	20.40	8.77	2.73
DORSI FLEXION	60.90	11.87	2.87	.187	65.00	11.89	2.93
ALGOMETER	6.50	1.12	3.07	.662	6.61	0.83	2.97
HAL	75.53	8.36	2.78	.424	76.97	5.02	2.97

The null hypothesis was accepted for the above readings and scores, indicating **no difference** between Group A and Group B at the fifth visit.

Table 4.15. Statistical results of the HV angle, plantarflexion, dorsiflexion and algometer readings and HAL scores, comparing Group A and Group B at visit six

SCORES	GROUP A VISIT 6			P-value	GROUP B VISIT 6		
	Me	Sd	MR		Me	Sd	Mr.
HV ANGLE	25.53	5.78	1.88	.444	24.10	8.38	1.63
PLANTAR FLEXION	20.00	6.21	2.93	.274	22.17	8.78	3.12
DORSI FLEXION	61.43	10.58	3.03	.018	68.30	11.35	3.60
ALGOMETER	6.33	1.34	2.92	.001	7.37	0.86	3.95
HAL	76.00	8.26	2.97	.060	79.63	6.31	3.45

The null hypothesis was rejected for dorsiflexion and algometer readings indicating a statistically **significant difference** between Group A and Group B at the sixth visit. The null hypothesis was accepted for the HV angle, plantarflexion and HAL scores, indicating **no difference** between Group A and Group B at the sixth visit.

4.4 INTRA-GROUP ANALYSIS

4.4.1 INTRA-GROUP ANALYSIS OF SUBJECTIVE DATA USING FRIEDMAN'S T-TEST

Table 4.16. Intra-group comparisons of Group A and Group B using Friedman's T-test to analyze results obtained from within groups from NRS-101 at visits 1,3,5 and 6

NRS-101								
	GROUP A				**GROUP B**			
	V1	**V3**	**V5**	**V6**	**V1**	**V3**	**V5**	**V6**
Me	37.37	31.87	27.25	24.35	43.27	33.78	25.08	21.17
Sd	16.36	9.82	11.93	11.39	12.52	10.78	7.89	6.31
Mr.	3.67	2.82	2.03	1.48	3.82	2.90	1.90	1.38
P-value	$<$ .001				$<$ .001			

For both groups the null hypothesis was rejected for NRS-101, indicating that at the α = 0.05 level of significance there was a statistically **significant improvement** in pain between the four consultations in each group.

Table 4.17. Intra-group comparisons of Group A and Group B using Friedman's T-test to analyze results obtained from within groups from FFI at visits 1,3,5 and 6

FFI								
	GROUP A				**GROUP B**			
	Tx1	**Tx3**	**Tx5**	**Tx6**	**Tx1**	**Tx3**	**Tx5**	**Tx6**
Me	30.23	27.19	22.37	22.9	39.08	33.97	25.99	21.62
Sd	13.99	13.76	13.42	14.64	14.29	13.48	11.44	12.44
Mr.	3.22	2.88	2.03	1.87	3.50	3.07	2.12	1.32
P-value	$< .001$				$< .001$			

For both groups the null hypothesis was rejected for FFI, indicating that at the $\alpha = 0.05$ level of significance there was a statistically **significant improvement** in pain and disability between the four consultations in each group.

4.4.2 INTRA-GROUP ANALYSIS OF OBJECTIVE DATA USING FRIEDMAN'S T-TEST

Table 4.18. Intra-group comparisons of Group A and Group B using Friedman's T-test to analyze results obtained from within groups from HV angle readings at visits 1,3,5 and 6

HV ANGLE (GONIOMETER)								
	GROUP A				**GROUP B**			
	V1	**V3**	**V5**	**V6**	**V1**	**V3**	**V5**	**V6**
Me	28.33	26.60	25.73	25.53	28.93	25.70	25.13	24.10
Sd	7.14	6.91	6.36	5.78	8.25	7.44	7.92	8.38
Mr.	3.40	2.60	2.12	1.88	3.78	2.55	2.03	1.63
P-value	$< .001$				$< .001$			

For both groups the null hypothesis was rejected, indicating that at the $\alpha = 0.05$ level of significance there was a statistically **significant improvement** in HV angle between the four consultations in each group.

Table 4.19. Intra-group comparisons of Group A and Group B using Friedman's T-test to analyze results obtained from within groups from plantarflexion readings at visits 1,3,5 and 6

PLANTARFLEXION								
	GROUP A				**GROUP B**			
	V1	**V3**	**V5**	**V6**	**V1**	**V3**	**V5**	**V6**
Me	15.90	17.17	19.43	20.00	17.20	19.17	20.40	22.17
Sd	8.43	6.83	6.37	6.21	11.26	8.76	8.77	7.78
Mr.	2.03	2.27	2.77	2.93	1.95	2.20	2.73	3.12
P-value	.003				$<$ .001			

For both groups the null hypothesis was rejected, indicating that at the α = 0.05 level of significance there was a statistically **significant improvement** in plantarflexion between the four consultations in each group.

Table 4.20. Intra-group comparisons of Group A and Group B using Friedman's T-test to analyze results obtained from within groups from dorsiflexion readings at visits 1,3,5 and 6

DORSIFLEXION								
	GROUP A				GROUP B			
	V1	V3	V5	V6	V1	V3	V5	V6
Me	54.03	58.07	60.90	61.43	50.23	60.73	65.00	68.30
Sd	15.67	12.80	11.87	10.58	13.59	12.55	11.89	11.35
Mr.	1.70	2.40	2.87	3.03	1.17	2.30	2.93	3.60
P-value	< .001				< .001			

For both groups the null hypothesis was rejected, indicating that at the $\alpha = 0.05$ level of significance there was a statistically **significant improvement** in dorsiflexion between the four consultations in each group.

Table 4.21. Intra-group comparisons of Group A and Group B using Friedman's T-test to analyze results obtained from within groups from algometer readings at visits 1,3,5 and 6

ALGOMETER								
	GROUP A				GROUP B			
	V1	V3	V5	V6	V1	V3	V5	V6
Me	5.49	6.04	6.50	6.33	5.06	5.98	6.61	7.37
Sd	1.27	1.18	1.12	1.34	1.260	0.96	0.83	0.86
Mr.	1.72	2.30	3.07	2.92	1.10	1.78	2.97	3.95
P-value	< .001				< .001			

For both groups the null hypothesis was rejected, indicating that at the $\alpha = 0.05$ level of significance there was a statistically **significant improvement** in pain threshold levels between the four consultations in each group.

Table 4.22. Intra-group comparisons of Group A and Group B using Friedman's T-test to analyze results obtained from within groups from HAL scores at visits 1,3,5 and 6

HALLUX METATARSOPHALANGEAL-INTERPHALANGEAL SCALE								
	GROUP A				GROUP B			
	V1	V3	V5	V6	V1	V3	V5	V6
Me	71.23	72.93	75.53	76.00	64.76	71.73	76.77	79.63
Sd	13.66	7.00	5.02	6.31	7.61	8.78	8.36	8.26
Mr.	1.93	2.32	2.78	2.97	1.47	2.12	2.97	3.45
P-value	< .001				< .001			

For both groups the null hypothesis was rejected, indicating that at the $\alpha = 0.05$ level of significance there was a statistically **significant improvement** in pain, function and alignment between the four consultations in each group.

4.5 DUNN'S PROCEDURE (MULTIPLE COMPARISON TEST)

If the null hypothesis (Ho) was rejected for the Friedman's T-test, then this multiple comparison procedure was applied to determine between which treatments a significant improvement took place (Daniel, 1987: 1078).

The null hypothesis was rejected for objective and subjective findings of Group A and Group B. It was necessary to apply Dunn's procedure (as described below) to the subjective and objective data to determine which treatments were significantly different.

Let V_j and V_j^1 be the j th and the j 1 th treatment rank totals.

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

$$\text{If } \left| V_j - V_j^1 \right| \geq z\sqrt{\frac{b\,k\,(k+1)}{6}}$$

In the above formula:

b = the number of the blocks

k = the number of readings

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

in this case, b = 30, k = 4, $\alpha = 0.10$ and z = 2.409

i.e. If the difference of rank totals $\geq$ 24.09 then V_j and V_j^1 are declared significant

for the purposes of this study, V_1 is the first visit, V_3 is the third visit, V5 is the fifth visit and V_6 is the sixth visit.

4.5.1 DUNN'S PROCEDURE – SUBJECTIVE DATA

Table 4.23. Dunn's procedure for NRS-101 (Group A)

NRS 101-GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	110.1	25.5	84.6	**3**	**Improvement**
1	110.1	49.2	60.9	**5**	**Improvement**
1	110.1	65.7	44.4	**6**	**Improvement**
3	84.6	23.7	60.9	**5**	**No improvement**
3	84.6	40.2	44.4	**6**	**Improvement**
5	60.9	16.5	41.4	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6 and 3 and 6, but no improvement could be demonstrated between visits 3 and 5 and 5 and 6 with regard to subjective data on pain perception for Group A.

Table 4.24. Dunn's procedure for NRS-101 (Group B)

NRS 101-GROUP B					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	114.6	27.6	87	**3**	**Improvement**
1	114.6	57.6	57	**5**	**Improvement**
1	114.6	73.2	41.4	**6**	**Improvement**
3	87	30	57	**5**	**Improvement**
3	87	45.6	41.4	**6**	**Improvement**
5	57	15.6	41.4	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6, 3 and 5 and 3 and 6, but no improvement could be demonstrated between visits 5 and 6 with regard to subjective data on pain perception for Group B.

Table 4.25. Dunn's procedure for FFI (Group A)

FFI-GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	96.6	10.2	86.4	**3**	**No improvement**
1	96.6	35.7	60.9	**5**	**Improvement**
1	96.6	40.5	56.1	**6**	**Improvement**
3	86.4	25.7	60.9	**5**	**Improvement**
3	86.4	30.5	56.1	**6**	**Improvement**
5	60.9	4.8	56.1	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 5, 1 and 6, 3 and 5 and 3 and 6, but no improvement could be demonstrated between visits 1 and 3 and 5 and 6 with regard to subjective data on pain and disability for Group A.

<u>Table 4.26.</u> **<u>Dunn's procedure for FFI (Group B)</u>**

FFI-GROUP B					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	105	12.9	92.1	**3**	**No improvement**
1	105	41.4	63.6	**5**	**Improvement**
1	105	65.4	39.6	**6**	**Improvement**
3	92.1	28.5	63.6	**5**	**Improvement**
3	92.1	52.5	39.6	**6**	**Improvement**
5	63.6	24	39.6	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 5, 1 and 6, 3 and 5 and 3 and 6, but no improvement could be demonstrated between visits 1 and 3 and 5 and 6 with regard to subjective data on pain and disability for Group B.

4.5.2 DUNN'S PROCEDURE –OBJECTIVE DATA

<u>Table 4.27.</u> **<u>Dunn's procedure for HV angle (Group A)</u>**

HALLUX VALGUS ANGLE – GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	102	24	78	**3**	**No improvement**
1	102	38.4	63.6	**5**	**Improvement**
1	102	45.6	56.4	**6**	**Improvement**
3	78	14.4	63.6	**5**	**No improvement**
3	78	21.6	56.4	**6**	**No Improvement**
5	63.6	7.2	56.4	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 5 and 1 and 6, but no improvement could be demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6 with regard to HV angle for Group A.

Table 4.28. Dunn's procedure for HV angle (Group B)

HALLUX VALGUS ANGLE – GROUP B					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	113.4	36.9	76.5	**3**	**Improvement**
1	113.4	52.5	60.9	**5**	**Improvement**
1	113.4	64.5	48.9	**6**	**Improvement**
3	76.5	15.6	60.9	**5**	**No improvement**
3	76.5	28	48.9	**6**	**Improvement**
5	60.9	12	48.9	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6 and 3 and 6, but no improvement could be demonstrated between visits 3 and 5 and 5 and 6 with regard to HV angle for Group B.

Table 4.29. Dunn's procedure for plantarflexion (Group A)

PLANTARFLEXION –GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	60.9	7.2	68.1	**3**	**No improvement**
1	60.9	23	83.1	**5**	**No improvement**
1	60.9	27	87.9	**6**	**Improvement**
3	68.1	15	83.1	**5**	**No improvement**
3	68.1	19.8	87.9	**6**	**No improvement**
5	83.1	4.8	87.9	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 6, but no improvement could be demonstrated between visits 1 and 3, 1 and 5, 3 and 5, 3 and 6 and 5 and 6 with regard to plantarflexion for Group A.

Table 4.30. Dunn's procedure for plantarflexion (Group B)

PLANTARFLEXION-GROUP B					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	58.5	7.5	66	**3**	**No improvement**
1	58.5	23.4	81.9	**5**	**No improvement**
1	58.5	38.1	96.6	**6**	**Improvement**
3	66	15.9	81.9	**5**	**No improvement**
3	66	27.6	93.6	**6**	**Improvement**
5	81.9	11.7	93.6	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 6 and 3 and 6, but no improvement could be demonstrated between visits 1 and 3, 1 and 5, 3 and 5 and 5 and 6 with regard to plantarflexion for Group B.

Table 4.31. Dunn's procedure for dorsiflexion (Group A)

DORSIFLEXION-GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	51	21	72	**3**	**No improvement**
1	51	35.1	86.1	**5**	**Improvement**
1	51	39.9	90.9	**6**	**Improvement**
3	72	14.1	86.1	**5**	**No improvement**
3	72	18.9	90.9	**6**	**No improvement**
5	86.1	4.8	90.9	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 5 and 1 and 6, but no improvement could be demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6 with regard to dorsiflexion for Group A.

Table 4.32. Dunn's procedure for dorsiflexion (Group B)

DORSIFLEXION-GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	35.1	33.9	69	**3**	**Improvement**
1	35.1	52.8	87.9	**5**	**Improvement**
1	35.1	72.9	108	**6**	**Improvement**
3	69	18.9	87.9	**5**	**No improvement**
3	69	39	108	**6**	**Improvement**
5	87.9	20.1	108	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6 and 3 and 6, but no improvement could be demonstrated between visits 3 and 5 and 5 and 6 with regard to dorsiflexion for Group B.

Table 4.33. Dunn's procedure for algometer (Group A)

ALGOMETER-GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	51.6	17.4	69	**3**	**No improvement**
1	51.6	40.5	92.1	**5**	**Improvement**
1	51.6	36	87.6	**6**	**Improvement**
3	69	23.1	92.1	**5**	**No improvement**
3	69	18.6	87.6	**6**	**No improvement**
5	92.1	4.5	87.6	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 5 and 1 and 6, but no improvement could be demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6 with regard to algometer readings for Group A.

Table 4.34. Dunn's procedure for algometer (Group B)

ALGOMETER-GROUP B					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	33	26.4	59.4	**3**	**Improvement**
1	33	56.1	89.1	**5**	**Improvement**
1	33	85.5	118.5	**6**	**Improvement**
3	59.4	29.7	89.1	**5**	**Improvement**
3	59.4	59.1	118.5	**6**	**Improvement**
5	89.1	29.4	118.5	**6**	**Improvement**

This implies that a significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6, 3 and 5, 3 and 6 and 5 and 6, with regard to algometer readings for Group B.

Table 4.35. Dunn's procedure for HAL scale (Group A)

HAL SCALE-GROUP A					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	57.9	11.7	69.6	**3**	**No improvement**
1	57.9	25.5	83.4	**5**	**Improvement**
1	57.9	31.2	89.1	**6**	**Improvement**
3	69.6	13.8	83.4	**5**	**No improvement**
3	69.6	19.5	89.1	**6**	**No improvement**
5	83.4	5.7	89.1	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 5 and 1 and 6, but no improvement could be demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6 with regard to pain, function and alignment for Group A.

Table 4.36. Dunn's procedure for HAL scale (Group B)

HAL SCALE-GROUP B					
VISIT	**RANK TOTAL**	**DIFFERENCE**	**RANK TOTAL**	**VISIT**	**CONCLUSION**
1	44.1	19.5	63.6	**3**	**No improvement**
1	44.1	45	89.1	**5**	**Improvement**
1	44.1	59.4	103.5	**6**	**Improvement**
3	63.6	25.5	89.1	**5**	**Improvement**
3	63.6	39.9	103.5	**6**	**Improvement**
5	89.1	14.4	103.5	**6**	**No improvement**

This implies that a significant improvement occurred between visits 1 and 5, 1 and 6, 3 and 5 and 3 and 6, but no improvement could be demonstrated between visits 1 and 3 and 5 and 6 with regard to pain, function and alignment for Group B.

4.6 BAR GRAPH REPRESENTATION OF INTER-GROUP ANALYSIS

Figure 1. **Inter-group comparisons between Group A and Group B with regards to the NRS-101 scores at the first, third, fifth and one week follow up consultations**

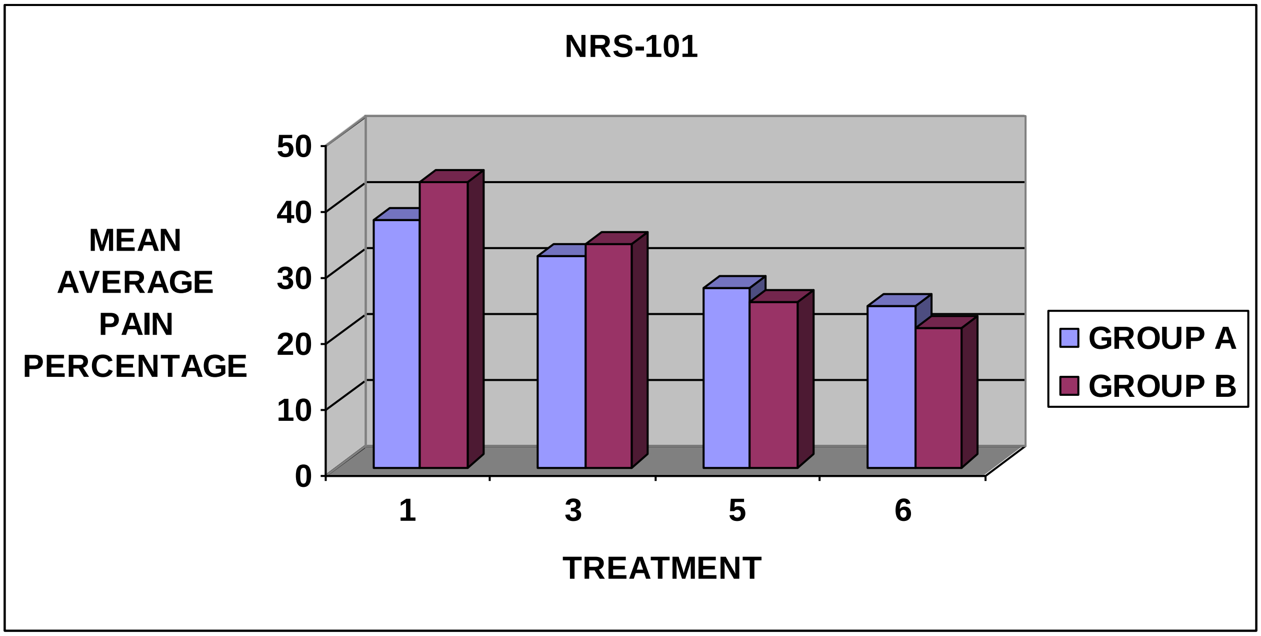


Figure 2. Inter-group comparisons between Group A and Group B with regards to the FFI scores at the first, third, fifth and one week follow up consultations

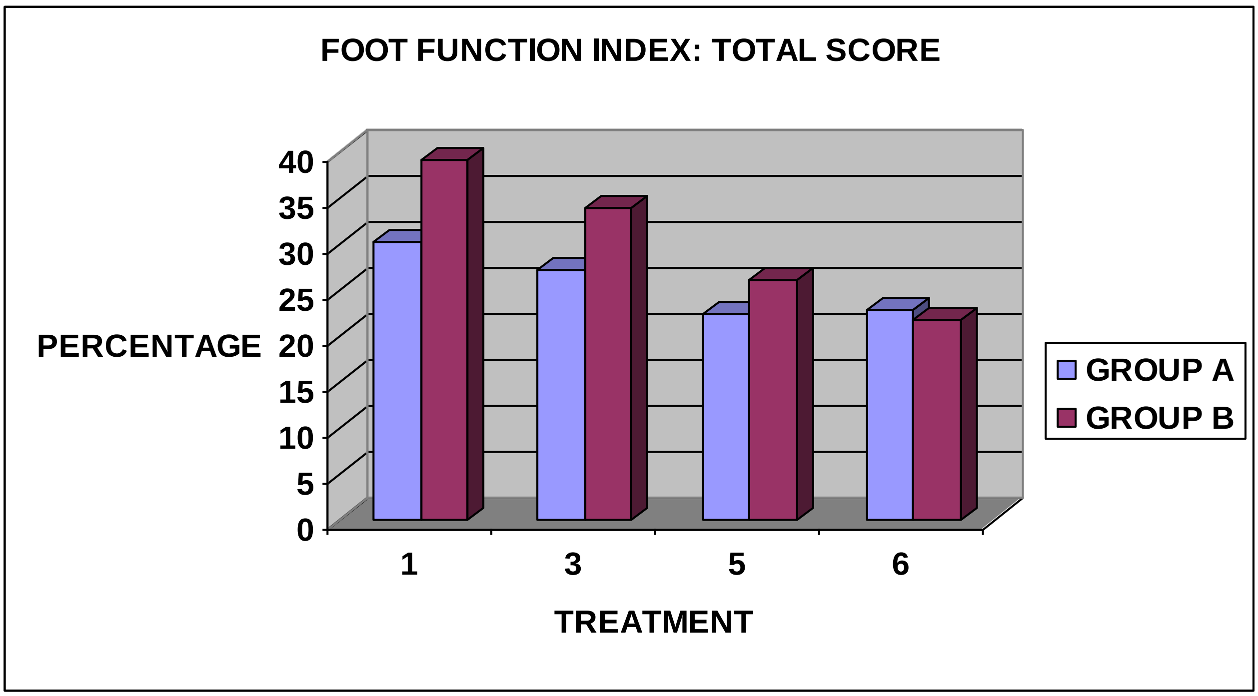


Figure 3 **Inter-group comparisons between Group A and Group B with regards to the HV angles (goniometer readings) at the first, third, fifth and one week follow up consultations**

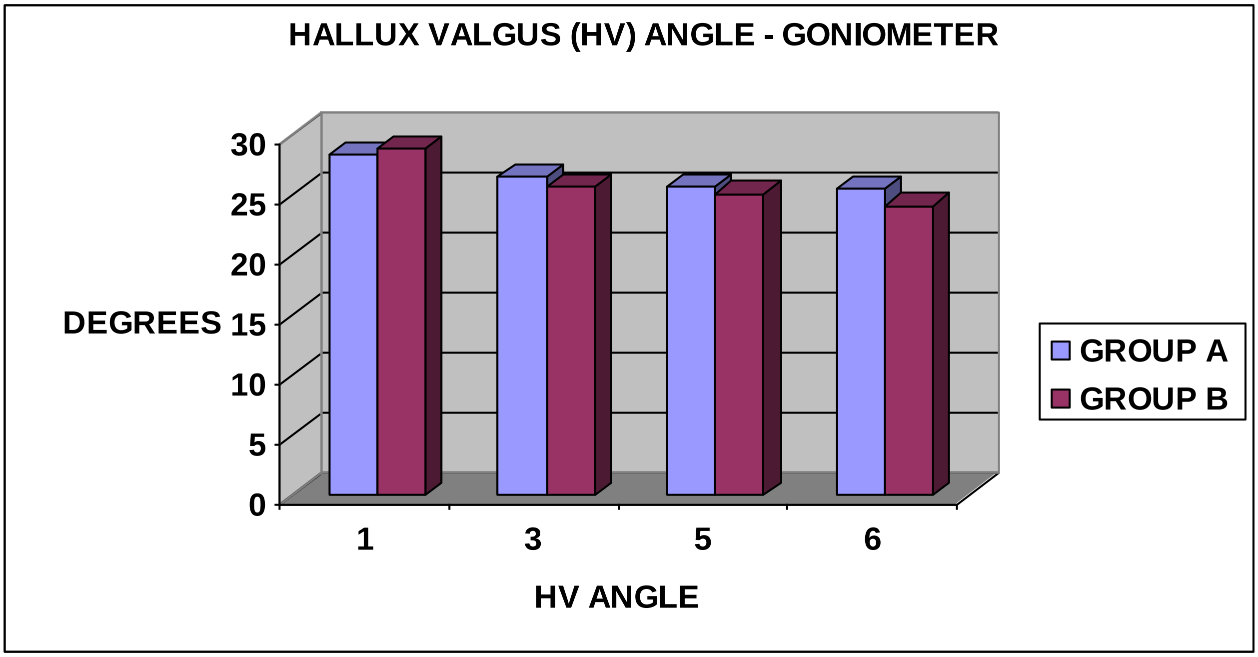


Figure 4 Inter-group comparisons between Group A and Group B with regards to plantarflexion of the first MPJ at the first, third, fifth and one week follow up consultations

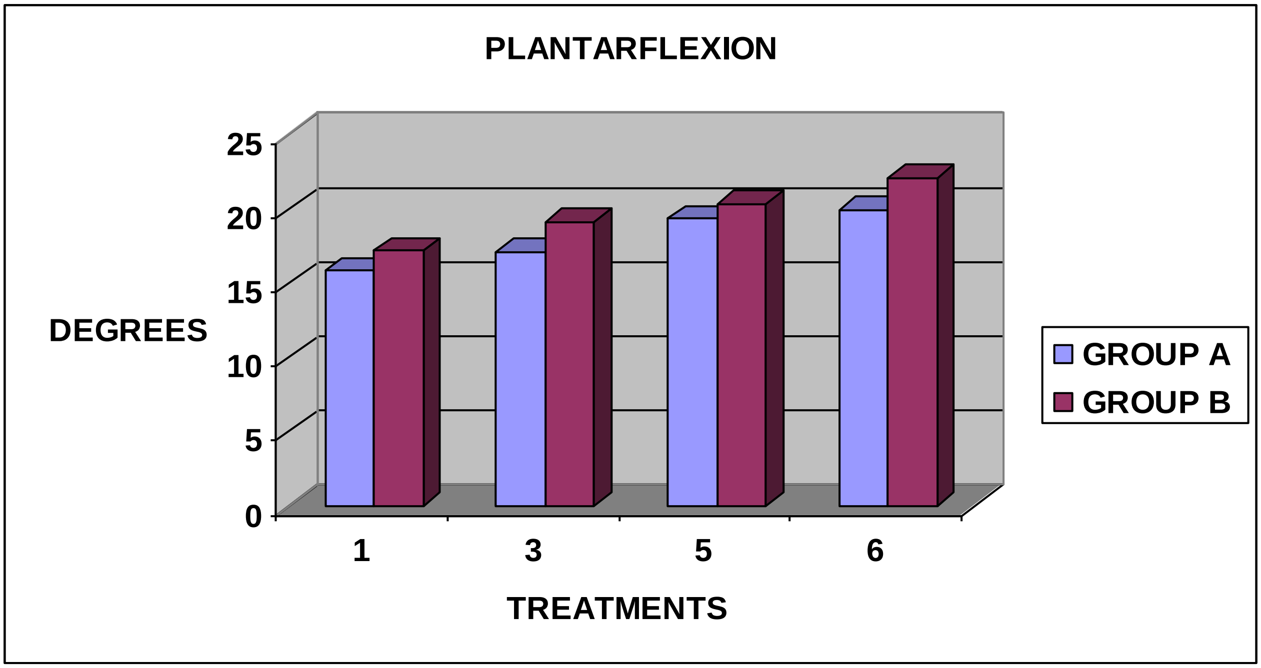


Figure 5 **Inter-group comparisons between Group A and Group B with regards to dorsiflexion of the first MPJ at the first, third, fifth and one week follow up consultations**

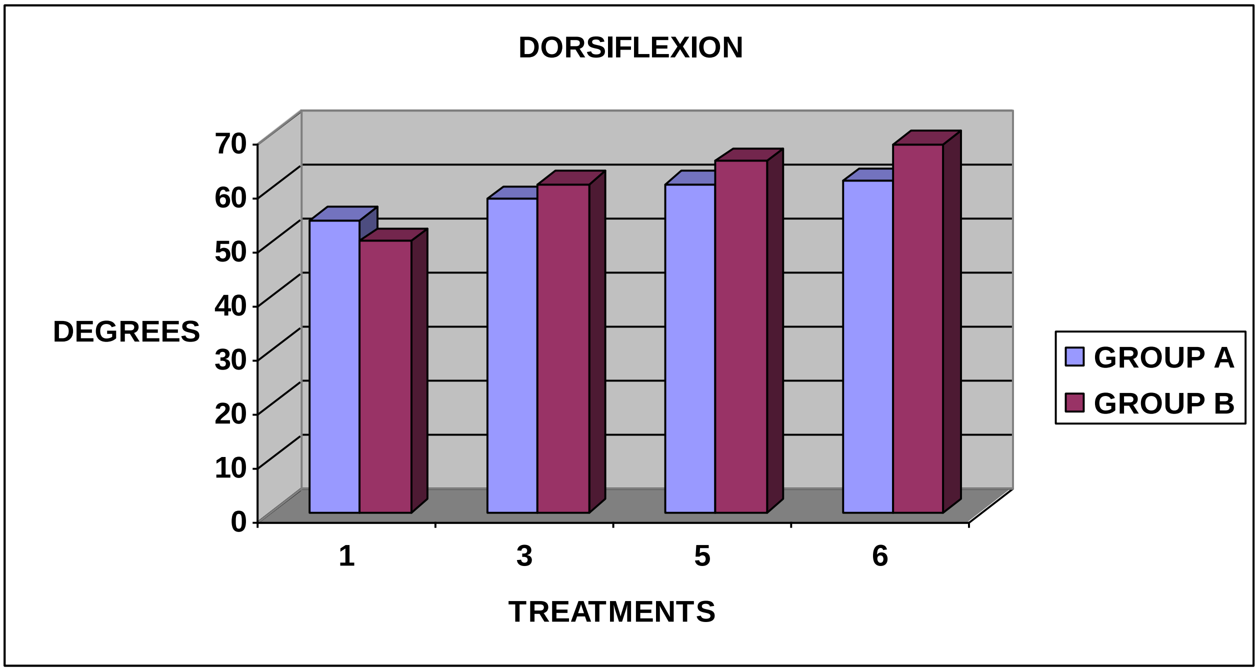


Figure 6 **Inter-group comparisons between Group A and Group B with regards to algometer readings at the first, third, fifth and one week follow up consultations**

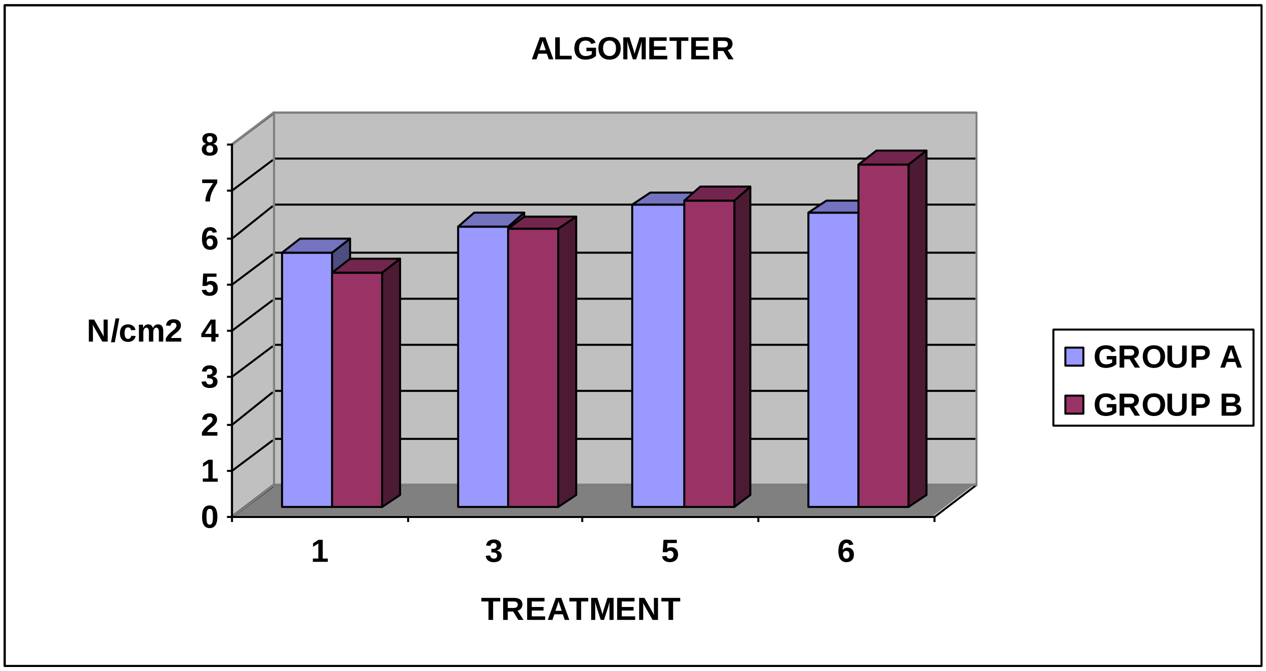
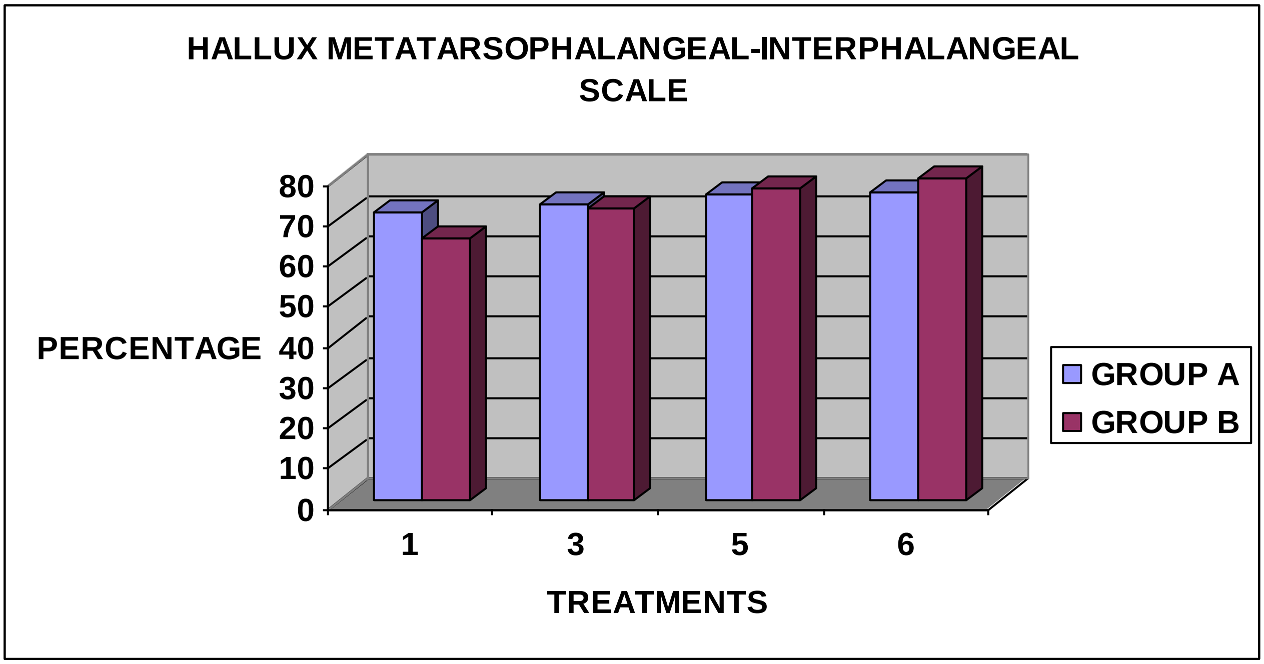


Figure 7 **Inter-group comparisons between Group A and Group B with regards to Hallux Metatarsophalangeal-interphalangeal scores at the first, third, fifth and one week follow up consultations**



4.7 CLINICAL FINDINGS

Figure 8. Mean hallux valgus (HV) and intermetatarsal (IM) angles in Group A and Group B, measured in degrees

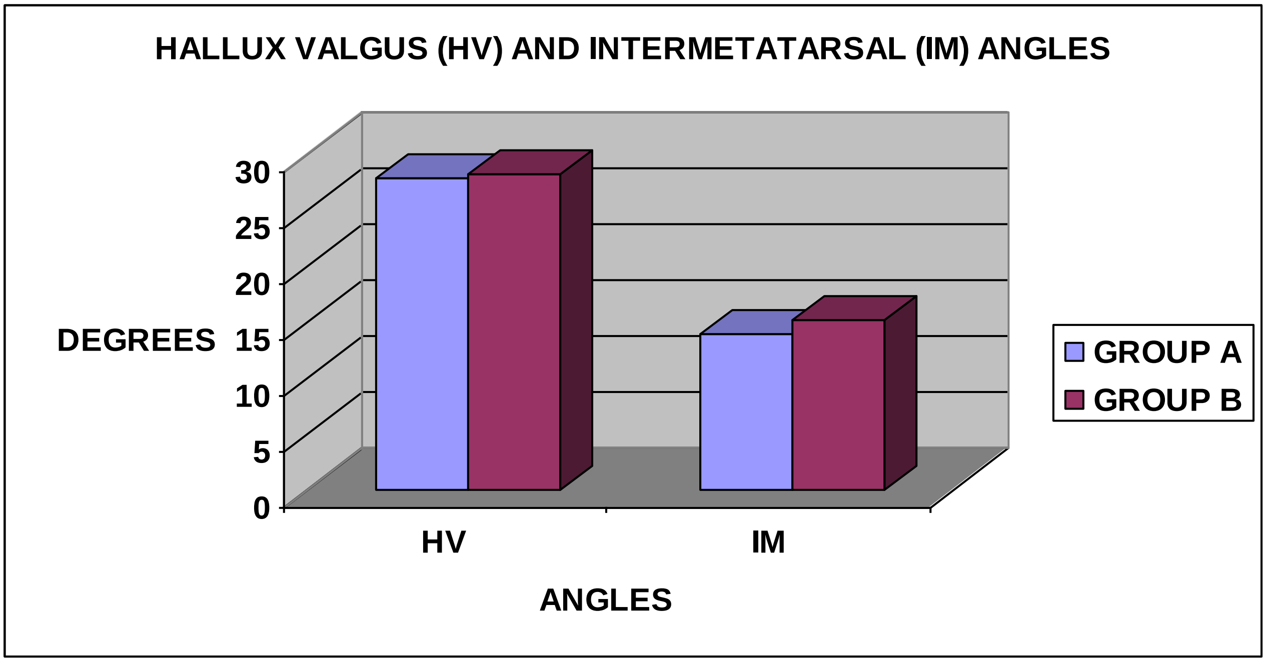


Figure 9. Comparison of HV (x-ray) and HV (goniometer) means.

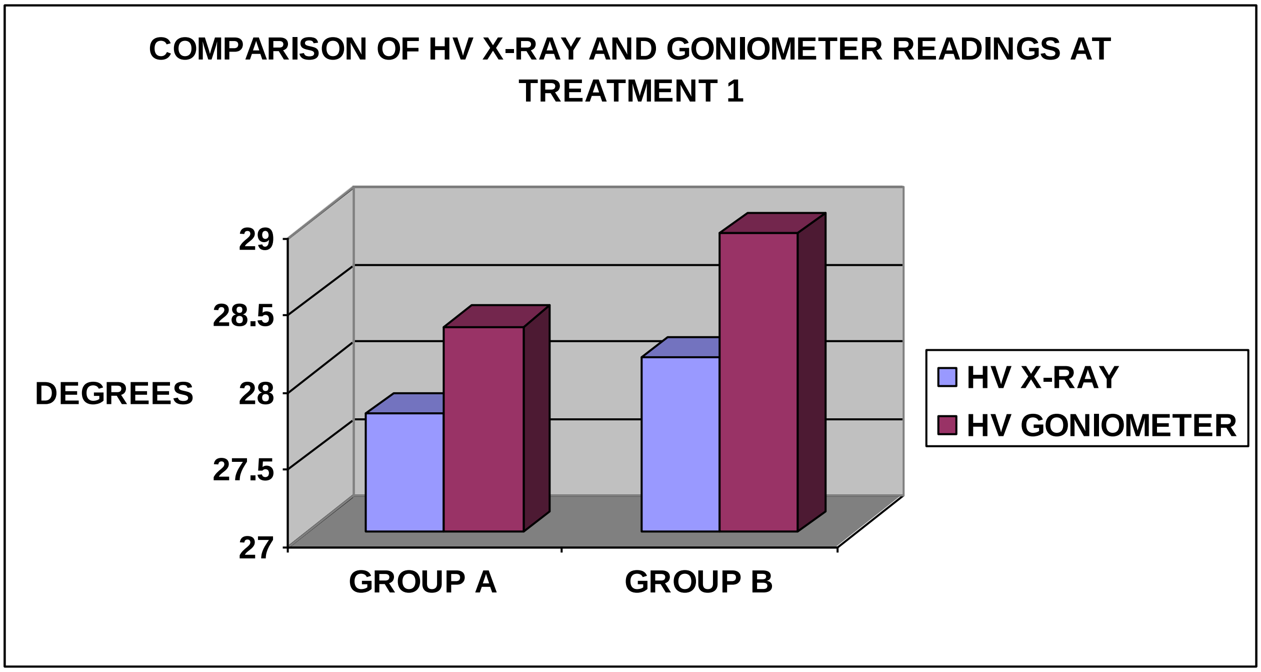
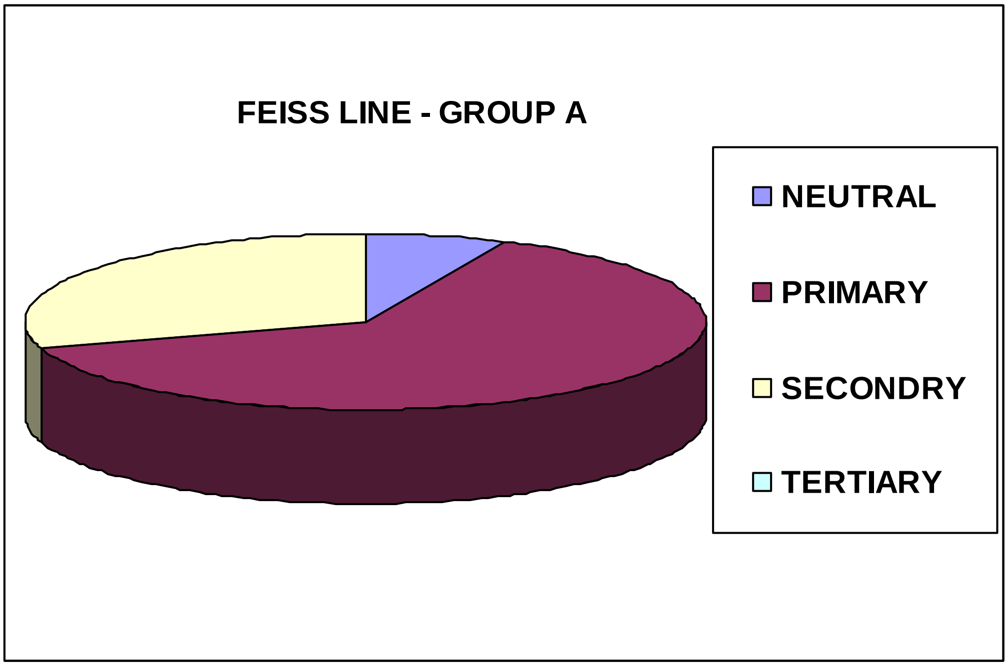


Table 4.37. Comparison of HV angles using X-ray and goniometer at the first consultation using the Paired T-test (parametric testing)

	HV angle (x-ray)	HV angle (goniometer)
Mean	27.95	28.63
Sd	8.21	7.66
Minimum	15	15
Maximum	59	60
P-value	0.354	

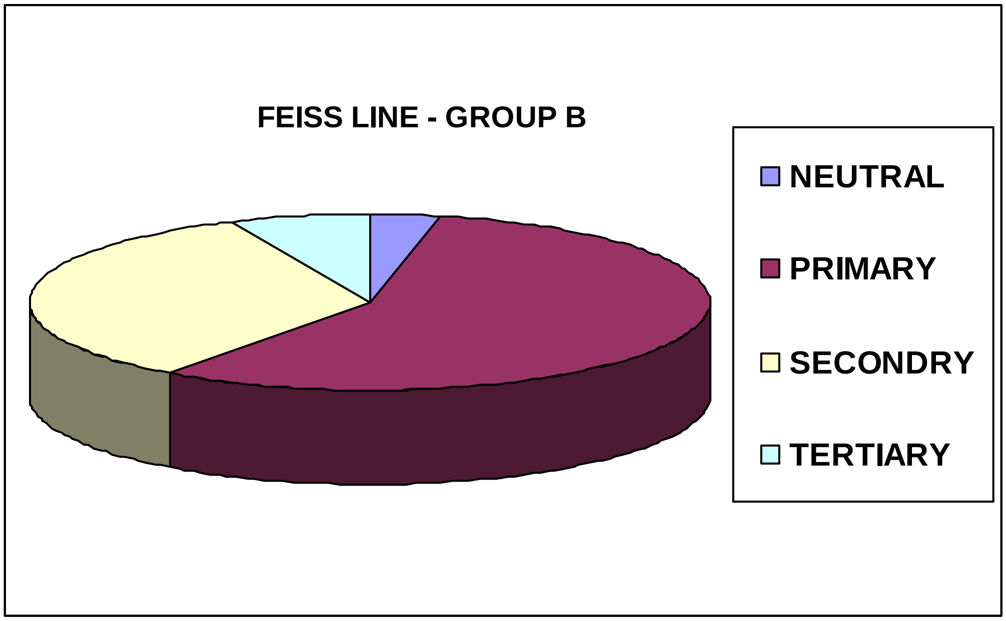
The above p-value (0.354) states that there is no difference between the two procedures for taking HV angle measurements at the first consultation.

Figure 10. **Assessment of the medial longitudinal arch of the foot, using Feiss line, in Group A**



FEISS LINE	GROUP A
NEUTRAL	2
PRIMARY	19
SECONDRY	9
TERTIARY	0
TOTAL	**30**

Figure 11. Assessment of the medial longitudinal arch of the foot, using Feiss line, in Group B.



FEISS LINE	GROUP B
NEUTRAL	1
PRIMARY	17
SECONDRY	10
TERTIARY	2
TOTAL	**30**

CHAPTER 5

DISCUSSION

5.0 INTRODUCTION

this chapter deals with discussion of demographic data and the results gained from the statistical analysis of the data obtained from:

- Subjective measures - NRS-101
  - FFI
- Objective measures - HV goniometer readings
  - plantarflexion readings
  - dorsiflexion readings
  - algometer readings and
  - HAL scores

5.1 DEMOGRAPHICAL DATA

Table 1 shows the age distribution within Groups A and B and as a sample of 60 patients. **Table 2** shows the average age and age ranges of patients in Groups A and B. The average age in Group A was 47.4 years and in Group B, 46.03 years. This demonstrates the relative similarity between the two groups. These average ages are comparable to Guiry's (2001) groups of 49.43 years and 50.86 years respectively. Broodryk's (2000) treatment group (44.7 years) and the placebo group (51.3) varied considerably. In this study 61% of the subjects were over the age of 45, with the majority being over the age of 55 years. This is consistent with current literature, highlighted by Calliet (1997: 163) who is of the opinion that HAVB most frequently occurs in elderly woman.

Table 3 demonstrates the greater incidence of females (90%) compared to males (10%). A high frequency amongst females is well documented in literature (Coughlin, 1997 and Levy and Heatherington, 1990: 827). Jahss (1991: 945) comments on a 9:1 greater incidence of HAVB in woman. Resch (1996) reports on studies in which 90% of patients undergoing HAVB surgery are female. The use of high heeled shoes with pointed toe boxes contribute to the greater incidence of HAVB amongst woman (Jahss,1991: 945)

Table 4 is concerned with the racial distribution patients and demonstrates a predominance of white participants (70%). Indian participants made up 20%, black participants 3.3% and 6.6% were of mixed race. In Broodryk's (2000) study 83.4 % were white and 8% Indian. Guiry (2001) also had 8% Indian subjects, but slightly less whites (81.3%). Methods of advertising, the location of the Chiropractic Day Clinic and the lack of awareness towards chiropractic may be responsible for the biased racial demographics. The researcher did not find any reference for racial demographics of HAVB in South Africa, making comparable analysis impossible.

Table 5 shows that bilateral HAVB deformities were present in 55 of the 60 subjects (91.7%). Broodryk (2000) found bilateral deformities in 78% of cases and Guiry (2001) in 81,6% of subjects. These findings are supported in the current literature, as Klenerman(1991: 65) is of the opinion that HAVB is almost always bilateral, although symptoms may present unilaterally (Yale, 1987:346)

The following predisposing factors are reflected in **Table 6**: a family history, shoes and a history of dancing. This study showed a strong family tendency of 85%, which is considerably higher than Broodryk (2000) of 71,7% and Guiry (2001) of 68.2%. In current literature Coughlin (1997) reports on a study on juvenile in which 94% of the subjects had a strong family history. Klenerman (1991:65) is of the opinion that a strong family history exists in 60% of the cases, whilst Yale (1987:346) is more conservative in estimating that HAVB is family related in 30% of the cases. Despite the controversy on the extent to which a familial tendency impacts on HAVB, there is a majority consensus that Hereditary factors warrant consideration.

In this study, 80% of the participants attributed incorrect shoe wear as a possible cause of their bunions. Current literature shows that there is an increase incidence of HAVB in shod populations (Resch,1996). Reid (1992.148) is of the opinion that high heeled shoes with pointed toe boxes are the main culprits in the development of HAVB.

Dancing was considered a predisposing factor in 33.3 % of cases. Dancing may have a role to play in the development of HAVB (Quirk, 1994) for the following reasons:

- Form of dancing e.g. Ballet. Individuals with a natural tendency for HAVB , appear to experience more rapid deterioration, if actively dancing "on Pointe".
- Overuse as dancers work long hours.
- Incorrect shoes. "On Pointe" dancing is optimized when using tight, pointed toe boxes.

Table 7 demonstrated the incidence of HAVB according to occupation and showed the highest incidence (35%) amongst housewives. The occupations of the participants in the study were varied and difficult to interpret. Guiry (2001) found that a large percentage of patients were secretaries, nurses, and managers or worked in banks. These occupations often prescribe to the use of fashionable high heeled shoes, which are a known contributor to HAVB development (Meyer, 1996; Resch, 1996; Reid, 1992: 145, Calliet, 1997: 164 and Klenerman 1991: 60).

5.2 DATA ANALYSIS

5.2.1 SUBJECTIVE DATA

5.2.1.1. NRS –101

INTER-GROUP ANALYSIS (Tables 8-11)

A comparison of the first consultation of both groups A and B revealed no difference (p= 0.068) which indicates that both groups started off similarly. A comparison of the 3rd, 5th and 6th visits (p = 0.556; p = 0.444 and p = 0.346) also revealed no difference between the groups. The null hypothesis, which states that there is no difference between the groups is therefore accepted.

NRS-101 INTRA-GROUP ANALYSIS (Tables 16, 23-24)

Analysis of visits 1,3,5 and 6 revealed a statistically significant difference ($p < 0.001$) over the 1st to 6th treatments in both groups A and B. Therefore, the alternative hypothesis, which states that there is an improvement between consultations is accepted for both groups A and B.

In Group A significant improvement occurred between visits 1 and 3, 1 and 5 , 1 and 6 and 3 and 6, but no improvement was demonstrated between visits 3 and 5 and 5 and 6. In Group B significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6, 3 and 5 and 3 and 6, but no significant improvement occurred between visit 5 and 6.

COMMENT

Inter-group analysis revealed no difference between groups A and B at the first consultation, indicating that there was no selection bias. At all the following visits no difference was noted between Group A and Group B. This indicates that at each treatment, Group A and Group B had similar effects on pain perception.

Intra-group analysis shows that the perception of pain within each group improved. Group B had higher mean scores at visit 1 (A = 37,37 : B = 43,27) and visit 3 (A = 31.87 : B = 33.78), but the means in Group A were higher at visits 5 (A = 27.25 : B = 25.08) and visit 6 (A = 24.35 : B = 21.17). Brantingham et.al. (1994) refers to an acceptable mild soreness following the BM which may be reflected at visit 3. Group A improved by 34.8% between visits 1 and 6 while group B showed considerably more improvement, 51.07% over the same period.

Group A showed significant improvements except between visits 3 and 5 and 5 and 6 indicating that patient improvement reached a plateau, where after improvement was only gradual (Figure1). Group B showed significant improvements between all treatments barring between visits 5 and 6.

5.2.1.2 FFI

INTER-GROUP(Table 8-11)

A comparison of the first consultation showed that there was a significant difference (p = 0.015), between group A and group B. A comparison of the 3rd,5th and 6th visits (p = 0.058 ; p = 0.283 and p = 0.636) revealed no statistical difference between Group A and Group B. The alternative hypothesis, which indicates that there was a difference between Group A and Group B at the initial consultation was accepted. The null hypothesis, which indicates that there was no difference between Group A and Group B was accepted for FFI scores at the 3rd ,5th and 6th visits.

INTRA-GROUP ANALYSIS (Table 17.25-26)

Analysis of visits 1,3,5 and 6 revealed a statistically significant improvement ($p < 0.001$) over the 1st to 6th treatments in both groups A and B. The alternative hypothesis, which states that improvement occurs between consultations is therefore accepted for both groups A and B.

In both groups A and B a significant improvement was noted between visits1 and 5, 1 and 6, 3 and 5, 3 and 6, but no improvement was demonstrated between visits 1 and 3 and 5 and 6.

COMMENT

A significant difference between groups A and B at consultation one is demonstrated in inter-group analysis. Intra-group analysis showed that Group B had a higher mean (39.08) at visit 1 compared to 30.23 in Group A, a difference of 8.77. At treatment 3 the difference was 6.78 and at visits 5 only 3.62. Visit 6 showed Group B with a lower mean score (A = 22.9; B 21.62). Group A improved by 24% between visits 1 and 6 whilst group B improved by 44.7% over the same time. This shows that even though there was no significant difference in the latter treatments (inter-group analysis), Group B improved more constantly and rapidly (figure 2) in the clinical setting.

5.2.2 OBJECTIVE DATA

5.2.2.1 HALLUX VALGUS ANGLE

INTER-GROUP ANALYSIS (Table 12-15)

A comparison of the first consultation of both groups A and B revealed no difference (p= 0.764) which indicates that both groups started off similarly. A comparison of the 3rd, 5th and 6th visits (p = 0.629; p = 0.748 and p = 0.444) also revealed no significant difference between the groups. The null hypothesis, which states that there is no significant difference between groups is therefore accepted.

INTRA-GROUP DATA (Table18,27-28)

Analysis of visits 1,3,5 and 6 revealed a statistically significant improvement ($p < 0.001$) over the 1st to 6th treatments in both groups A and B. The alternative hypothesis, which states that improvement occurs between consultations is therefore accepted for both groups A and B.

In Group A significant improvement occurred between visits 1 and 5 and 1 and 6, but no improvement was demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6. In Group B significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6 and 3 and 6, but no significant improvement occurred between visits 3 and 5 and 5 and 6.

COMMENT

Inter-group analysis revealed no significant between groups A and B at the first consultation, indicating that there was no selection bias. At all the following visits no significant difference was noted between Group A and Group B. This indicates that at each treatment Group A and Group B had similar effects on the HV angle.

Intra-group analysis shows that the HV angle within each group improved significantly. Group A mean scores improved by 9.9% over 6 consultations, whilst Group B improved by 16.7% (Figure 3). These changes are contrary to Brantingham et.al. (1994) in which the authors claim that the HV angle typically remains the same. These claims were based on clinical experience and not on observable measurements. Guiry (personal communication,2002) noted observable straightening of the big toe in her study (Guiry, 2001), but as no measurements were taken to validate these claims. The increased improvement in HV angle in Group B (16.7%) versus Group A (9.9%) can be due to the mobilization technique employed. The SCSM (Group A) is a rotational type mobilization in which the big toe is actually stressed to exaggerate the deformity for 90 seconds and then returned to the original position over 30 seconds. BM (Group B) uses a distraction of the MPJ combined with an adduction (towards the midline of the body) mobilization, which seems to reduce the HV angle. BM may have more effect on the contracted lateral structures of the first MPJ, the lateral capsule and lateral collateral ligament. These structures are initially flexible and easily correctable , but with time they become contracted (Jahss, 1991: 948) and no longer allow for passive correction (Hattrup and Johnson, 1985)

5.2.2.2 PLANTARFLEXION

INTER-GROUP (Table 12-15)

A comparison of the first consultation of both groups A and B revealed no difference ($p = 0.615$) which indicates that both groups started off similarly. A comparison of the 3rd, 5th and 6th visits ($p = 0.328$; $p = 0.627$ and $p = 0.274$) also revealed no difference between the groups. The null hypothesis, which states that there is no difference between groups is therefore accepted.

INTRA-GROUP (Table19, 29-30)

Analysis of visits 1,3,5 and 6 revealed a statistically significant improvement (A : $p = 0.003$; B : $p < 0.001$) over the 1st to 6th treatments in both groups A and B. The alternative hypothesis, which states that improvement occurs between consultations is therefore accepted for both groups A and B.

In Group A significant improvement occurred between visit 1 and 6, but no improvement was demonstrated between visits 1 and 3, 1and 5, 3 and 5, 3 and 6 and 5 and 6. In Group B significant improvement occurred between visits 1 and 6 and 3 and 6, but no significant improvement occurred between visits 1 and 3, 1 and 5, 3 and 5 and 5 and 6.

COMMENT

Inter-group analysis revealed no difference between groups A and B at the first consultation, indicating that there was no selection bias. At all the following visits no difference was noted between Group A and Group B. This indicates that at each treatment Group A and Group B had similar effects on plantarflexion angle readings.

Intra-group analysis revealed a highly significant value within Group A ($p = 0.003$ and Group B ($p < 0.001$), indicating that both groups experienced a significant improvement in plantarflexion. This study showed that plantarflexion of the MPJ was severely restricted with an average mean of 15.9 ° (Group A) and 17.2 ° (Group B). Despite a constant improvement in mean scores, at visit 6 in which Group A had improved to 20 ° and Group B to 22.17 °, this was still well below normal plantarflexion range of motion of 45 ° at the MPJ (Magee, 1997: 625). This marked decrease in plantarflexion is consistent with current literature (Levy and Hetherington, 1990:829), who are of the opinion that limited range of motion of the MPJ is one of the most consistent findings in HAVB. The cause for the marked decrease in plantarflexion could be due to the following factors:

- Tightening of capsular and ligamentous structures especially on the lateral aspect of the MPJ.
- According to Jahss (1991: 947) as HAVB develops there is an incongruency of the opposing articular surfaces, causing a decreased joint space and marginal proliferation of bone, which is associated with painfull stiffening of the joint.
- In HAVB the FHL displaces laterally (Hattrup and Johnson, 1985), this may result in altered functioning and decreased plantarflexion.

5.2.2.3 DORSIFLEXION

INTER-GROUP ANALYSIS (Table 12-15)

A comparison of the first consultation of both groups A and B revealed no difference ($p = 0.320$) which indicates that both groups started off similarly. A comparison of the 3rd and 5th ($p = 0.418$ and $p = 0.187$) also revealed no difference between the groups. A comparison of the 6th consultation revealed a significant difference ($p = 0.018$) between Group A and Group B. The null hypothesis, which states that there is no difference between groups, was accepted for dorsiflexion readings at the 1st, 3rd and 5th visits. The alternative hypothesis which stated that there was a difference between groups was accepted for dorsiflexion readings at visit 6.

INTRA-GROUP ANALYSIS (Table 20, 31-32)

Analysis of visits 1,3,5 and 6 revealed a statistically significant improvement ($p < 0.001$) over the 1st to 6th treatments in both groups A and B. The alternative hypothesis, which states that improvement occurs between consultations is therefore accepted for both groups A and B.

In Group A significant improvement occurred between visits 1 and 5 and 1 and 6, but no improvement was demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6. In Group B significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6 and 3 and 6, but no significant improvement occurred between visits 3 and 5 and 5 and 6.

COMMENT

Inter-group analysis revealed no difference between groups A and B at the first consultation, indicating that there was no selection bias. At visit 6 there was a significant difference between Group A and Group B. Intra-group analysis shows that dorsiflexion within each group improved significantly, it can be concluded that a significant improvement difference exists between groups A and B at the 6th visit. At visit one the mean scores for Group A (54.03) and Group B (50.23) were considerably low (Figure 5) compared to normal dorsiflexion of 70 ° in the first MPJ. At visit 6, Group A had improved by 13.7 % to a mean score of 61.43, whilst Group B improved significantly by 36% to a mean score of 68.30 and nearly within the normal range of motion of the first MPJ. It can be concluded that BM is significantly more effective than SCSM in increasing dorsiflexion. A possible reason for this is the lengthening of contracted structures about the first MPJ, including the joint capsule, ligaments and muscles.

5.2.2.4 ALGOMETER

INTER-GROUP ANALYSIS (Table 12-15)

A comparison of the first consultation of both groups A and B revealed no difference ($p= 0.193$) which indicates that both groups started off similarly. A comparison of the 3rd and 5th ($p = 0.809$ and $p =0.662$) also revealed no difference between the groups. A comparison of the 6th consultation revealed a significant difference ($p= 0.001$) between Group A and Group B. The null hypothesis, which states that there is no difference between groups was accepted for algometer readings at the 1st, 3rd and 5th visits. The alternative hypothesis, which states that there was a difference between treatments was accepted for algometer readings at visit 6.

INTRA-GROUP ANALYSIS (Table 21, 33-34)

Analysis of visits 1,3,5 and 6 revealed a significant difference ($p < 0.001$) over the 1st to 6th treatments in both groups A and B. The alternative hypothesis, which states that improvement occurs between consultations is therefore accepted for both groups A and B.

In Group A significant improvement occurred between visits 1 and 5 and 1 and 6, but no improvement was demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6. In Group B significant improvement occurred between all visits 1 and 3, 1 and 5, 1 and 6, 3 and 5, 3 and 6 and 5 and 6.

COMMENT

Inter-group analysis revealed no difference between groups A and B at the first consultation, indicating that there was no selection bias. At visit 6 there was a significant difference between Group A and Group B. Intra-group analysis shows that algometer readings within each group improved significantly. It can be concluded that a significant improvement difference exists between groups A and B at visit 6. Mean scores for Group A (5.49) and Group B (5.06),were recorded at the 1st visit. At visit 6, Group A had improved by 15.3 % to a mean score of 6.33, whilst Group B improved significantly by 45.6% to a mean score of 7.37 (figure 6). It can be concluded that BM is significantly more effective than SCSM in reducing tenderness about the first MPJ.

Analysis of the Dunn's Procedure data shows that Group B had significant improvement between all treatment intervals, whilst group A only had significant improvement between visits 1 and 5 and 1 and 6.

5.2.2.5 HAL SCALE

INTER-GROUP (Table 12-15)

A comparison of the first consultation showed that there was a significant difference (p = 0.027), between group A and group B. A comparison of the 3rd,5th and 6th visits (p = 0.628 ; p = 0.424 and p = 0.06) revealed no statistical difference between Group A and Group B. The alternative hypothesis which states that there is a difference between groups was accepted for HAL scores, between Group A and Group B at the initial consultation. The null hypothesis which states that no difference occurs between groups was accepted for HAL scores at the 3rd ,5th and 6th visits.

INTRA-GROUP ANALYSIS (Table 22, 35-36)

Analysis of visits 1,3,5 and 6 revealed a statistically significant improvement ($p < 0.001$) over the 1st to 6th treatments in both groups A and B. The alternative hypothesis which states that improvement occurs between consultations is therefore accepted for both groups A and B.

In Groups B, a significant improvement was noted between visits1 and 5 and 1 and 6, but no improvement was demonstrated between visits 1 and 3, 3 and 5, 3 and 6 and 5 and 6. In Group B, a significant improvement was noted between visits1 and 5 and 1 and 6, 3 and 5 and 3 and 6, but no improvement was demonstrated between visits 1 and 3 and 5 and 6.

COMMENT

A significant difference between groups A and B at consultation one is demonstrated in inter-group analysis. Intra-group analysis showed that Group B had a lower mean 64.76 compared to 71.23 in Group A, a difference of 6.47, at visit 1. At visit 3 the difference was only 1.2. At visit 5 Group B had a higher mean (A = 75.53 ; B = 76.77), this was also evident at visit 6 (A = 76.00 ; B = 79.63). Group A improved by 6.7% between visits 1 and 6, whilst group B improved by 23% over the same time (Figure 7). This shows that even though there was no significant difference in the latter treatments (inter-group analysis), Group B improved more constantly and rapidly in the clinical setting.

5.3 CONCLUSIONS FROM THE ABOVE DATA

The above data concluded that both SCSM and BM were equally effective in the treatment of HAVB, with the exception of algometer and dorsiflexion readings at the sixth visit, in which BM improved significantly more. Intra-group data showed that both treatment groups showed significant improvement between visits one through to six.

For the purposes of this study, the first hypothesis, which stated that there would be no difference between SCSM and BM in the treatment of symptomatic HAVB in terms of subjective findings, was accepted.

The second hypothesis, which stated that there would be no difference between SCSM and BM in the treatment of symptomatic HAVB in terms of objective findings, was accepted.

In clinical terms, it is evident that a trend developed in which the improvement in Group B (Brantingham's Mobilization) was accelerated and more comprehensive than Group A, in all the measurements.

5.4 CLINICAL FINDINGS

5.4.1 RADIOGRAPHIC EXAMINATION

Figure 8 shows the mean values of the HV and IM angles for both groups A and B. The inclusion criteria for this study required the HV angle to be 15 ° and the IM angle greater than 9 °. The mean HV angles were similar and comparable: 27,77 ° (Group A) and 28.13 (Group B). These angles are higher than Guiry's

(2001) two groups: 24.54 ° (Treatment group) and 22.86 ° (Placebo group). The mean IM angles were 13.93 ° in Group A and 15.13 ° in Group B, which again are similar and comparable.

Figure 9 shows a comparison of the HV angle x-ray measurement versus the HV angle goniometer measurement. A parametric paired T-test (personal communication, Mr. Thomas, 2003) was used to compare the x-ray and goniometer forms of measurement. A p-value of 0.354 was obtained. This indicates that there is no difference between HV angle x-ray measurement and HV angle goniometer measurement at the first consultation.

5.4.2 THE MEDIAL LONGITUDINAL ARCH

The Feiss line (Magee,1997: 636) was used to assess the medial longitudinal arch, to determine if the patient had pes planus (flat feet), pes cavus (high arches) or neutral feet (normal arches). This research showed that 90% of patients in Group A and B were found to have primary, secondary or tertiary forms of flat feet (**Figure 10 and 11**). This is in keeping with current literature as Klenerman (1991: 89) is of the opinion that high proportions of people suffering with HAVB have flat valgus feet.

5.5 PROBLEMS ENCOUNTERED WITH THE DATA

5.5.1 SUBJECTIVE MEASUREMENTS

When using questionnaires, one has to consider the possibility of type I and type II errors occurring. A type I error occurs when the patient fills in a questionnaire based on what they recall filling in on the previous questionnaires. Type II errors are calculation errors with regards to the questionnaire results.

The data recovered from the NRS– 101 and the FFI may have been slightly biased if the patients' had tried to please the researcher by choosing a better score.

The FFI was not specific enough to assess the pain and disability, as it pertains to HAVB. This is confirmed by Saag et.al., (1996), who maintain that this questionnaire shows validity in measuring arthritic pain, it's use for other foot conditions is yet to be proven.

5.5.2 OBJECTIVE MEASUREMENTS

THE ALGOMETER

Problems encountered with the algometer:

- The algometer lends itself to potential bias due to instrument error and examiner error.
- The examiner is of the opinion that the use of the algometer may actually exacerbate the condition, which may have been reflected in lower readings at the follow on consultations.
- Although the same reference point was used to take the algometer readings at consecutive consultations, certain factors may have affected the outcome, including the direction of pressure applied through the shaft of the algometer, skin slack, environmental conditions and the emotional state of the patient.

ANGULAR MEASUREMENTATION

Problems encountered using the goniometer

- The examiner was unaware of any standard protocol to measure range of motion about the first MPJ and used a method described by Donatelli (1990, 142)

- ♦ Examiner errors that may have occurred include : visual estimation errors and errors of parallax.
- ♦ When measuring the HV angle, landmarks had to be estimated and this may result in inaccurate readings

HALLUX METATARSOPHALANGEAL-INTERPHALANGEAL SCALE

This scale used subjective and objective data, and may have been prone to all the problems already discussed.

- ♦ The scale had 40 points allocated to subjective pain improvement. This part of the scale may have been effected by patients trying to impress the researcher.
- ♦ The scale had 10 points allocated to footwear requirements, 5 points to inter-phalangeal joint plantarflexion, 5 points to metatarsophalangeal-interphalangeal stability, 5 points to callouses and 15 points to alignment. In total 40 out of a 100 points, on which a mobilization of the MPJ may have little or no effect. It is the researcher’s opinion that the scale is better suited to surgical studies, as opposed to non-invasive forms of therapy.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The purpose of this study was to compare two forms of mobilization in the treatment of symptomatic Hallux abductovalgus (bunions).

The study was a prospective, randomized clinical trial involving sixty subjects, thirty in each group, which were selected by means of convenience sampling from the general population within the greater Durban area. Group A received a Strain counter-strain mobilization (SCSM) of the first metatarso- phalangeal joint, used in conjunction with cryotherapy. Group B received Brantingham's mobilization (BM) of the first metatarso-phalangeal joint, used in conjunction with cryotherapy. Each group received five treatments over a two-week period and were required to attend a one-week follow up consultation for data collection.

Subjective assessment was carried out by means of the Numerical Rating Scale-101 (NRS-101) and the Foot Function Index (FFI). Objective assessment included measuring the pain pressure threshold using a digital algometer, the hallux valgus angle and passive dorsiflexion and planter flexion of the first metatasal phalangeal joint were also measured using a goniometer. The Hallux-metatarsophalangeal-interphalangeal Scale (HAL) included assessment of both subjective and objective measurements. Subjective and objective assessments were performed and data collected on the first, third, fifth and one week follow up consultations.

Statistical analysis was completed at a 95% confidence interval. Inter-group analysis was done, using the Mann-Whitney U-test for subjective data and the unpaired t-test for objective data. Intra-group analysis was carried out using Friedman’s test and Dunn’s procedure.

From the analysis of the data it was concluded that both SCSM and BM were effective in the treatment of HAVB, with the exception of algometer and dorsiflexion readings at the sixth visit, in which BM improved significantly more. Intra-group data showed that both treatment groups showed significant improvement between visits one through to six.

After analysis of the statistical data it is evident that a trend developed in which the improvement in Group B (BM) was accelerated and more comprehensive than Group A (SCSM), in all the measurements. It is the researchers opinion that both mobilizations are effective in the treatment of HAVB, but by employing Brantingham's mobilization one may achieve greater improvement in pressure pain tolerance and range of motion in the first MPJ.

6.2 RECOMMENDATIONS

6.2.1 HOMOGENEITY

The use of a radiographic grading scale as described in Chapter Two may have improved the homogeneity of the sample.

6.2.2 POST-TREATMENT X-RAYS

The use of post-treatment x-rays would have allowed for objective assessment of HV angle at the end of study.

6.2.3 INDEPENDENT OBSERVER

The use of an independent observer to record the subjective and objective data could have eliminated any bias that may have occurred, thus improving the credibility of the study.

6.2.4 OBJECTIVE MEASUREMENT

There is a need to develop a standard procedure for measuring range of motion in the first MPJ so that readings become more valid and comparable. It is also important to determine the validity of using a goniometer for measuring the HV angle in the clinical and research settings. It is a considerably cheaper procedure and has been shown to be accurate in this study.

6.2.5 SUBJECTIVE MEASURES

The use of questionnaires, tested for reliability and validity, pertaining to the assessment of conservative care of the foot is recommended for future studies.

6.2.6 OTHER TREATMENT INTERVENTIONS

The author recommends investigating the use of mobilization of the first MPJ in conjunction with corrective orthotics, in particular Hallux Valgus splints. The author feels that splinting may arrest the progression of the deformity and decrease the reoccurrence rate of the deformity. Brantingham et.al., (1994) suggests the use of multi-treatment protocols for HAVB.

REFERENCES

Bergmann, T.F., Peterson, D.H. and Lawrence, D.J. 1993. Chiropractic Technique. New York: Churchill Livingstone. ISBN 0-443-08752-0.

Brantingham, J., Michaud, T., Deliman, A., Silverman, J., Snyder, R. and Brantingham, C. 1994. Chiropractic management of the painful bunion. Dynamic Chiropractic. 17 June, 30-32.

Broodryk, M. 2000. The efficacy of Strain Counter strain Mobilization in patients with painful Hallux Abducto Valgus Bunions. Masters Dissertation, Chiropractic. Technikon Natal, Durban.

Budiman-Mak, E., Conrad, K.J. and Roach, K.E. 1991. The Foot Function Index: a measurement of foot pain and disability. Journal of Clinical Epidemiology. **44**(6): 561-570.

Cailliet, R. 1997. Foot and Ankle pain. 3rd Edition. Philadelphia: F.A. Davis Company. ISBN 0-8036-0216-2.

Cimons, M. 1999. Bothersome bunions. Runner's World. September, 30-31.

Condon, F., Kaliszer, M., Conhyea, D., O'Donnell, T., Shaju, A., Masterson, E. 2002. The First Intermetatarsal Angle in Hallux Valgus: An Analysis of Measurement reliability and the Error Involved. Foot and Ankle International. **22**(8). 717-721.

Coughlin, M.J. 1997. Hallux Valgus. An Instructional Course Lecture, The American Academy of Orthopeadic Surgeons. The Journal of Bone and Joint Surgery. 46. 932-966.

Coughlin, M.J., Freund, E. 2001. The Reliability of Angualar Measurements in Hallux Valgus Deformities. Foot and Ankle International. **22**(5) 369-379.

Coughlin, M.J., Saltzman, C.L., Nunley, J.A. 2002. Angular Measurements in the Evaluation of Hallux Valgus Deformities: A Report of the Ad Hoc Committee of the American Orthopeadic Foot and Ankle Society on Angular Measurements. Foot and Ankle International. **23**(1) 68-74

Coughlin, M.J. and Shurnas, P.S. 2003. Hallux Valgus in Men Part II: First Ray Mobility After Bunionectomy and Factors Associated with Hallux Valgus Deformity. Foot and Ankle International. **24**(1) 73-78

D'Ambrogio, K.J., Roth, G.B. 1997. Positional Release Therapy. Assessment and Treatment of Musculoskeletal Dysfunction. 1-33, 214-225. ISBN 0-8151-0096-5.

Daniel, W.W. 1987. Applied Non-parametric Statistics. USA: Houghton Mifflin Company. ISBN 0-395-25795-6.

Donatelli, R.A. 1990. The Biomechanics of the Foot and Ankle. Philadelphia: F.A. Davis Company. ISBN – 8036-2696-7.

Dykyj, D. 1989. Pathologic anatomy of Hallux Abducto Valgus. Clinics in podiatric Medicine and surgery. **6**(1) 1-15.

Edmond, S.L. 1993. Manipulation and Mobilization: Extermity and Spinal techniques. St Louis: Mosby-Year bood Inc. ISBN 0-8016-6305-9.

Faber, F.W.M., Kleinrensink, G-J., Verhoog, M.W., Vijn, A.H. Snijders, C.J., Mulder, P.G.H., Verhaar, J.A.N. 1999. Mobility of the First Tarsometatarsal Joint in Relation to Hallux Valgus Deformity: Anatomical and Biomechanical Aspects. Foot and Ankle International. **20**(10) 651-656

Ferrari, J. and Malone-Lee, J.2002. the shape of the metatarsal head as a cause of hallux abductovalgus. Foot and ankle International 23 (3)236-242.

Fisher, A.A. 1986. Pressure threshold meter: its use for quantification of tender spots. Archives Physical Medical Rehabilitation. 67:836-838.

Fisher, A.A. 1987. Pressure threshold measurement for diagnosis of myofascial pain and evaluation of treatment results. Clinical Journal of Pain. **2**(4): 297-314.

Glasoe, W.M., Allen, M.K., Saltzman, C.L. 2001. First Ray Dorsal Mobility in Relation to Hallux Valgus Deformity and First Intermetatarsal Angle. Foot and Ankle International. **22**(2) 98-101.

Grosio, J.A. 1992. Juvenile hallux valgus. The journal of Bone and Joint Surgery. **74**(9): 1367-1374.

Guiry, S. 2001. The Efficacy of a conservative Chiropractic management approach in the treatment of symptomatic Hallux Abductovalgus (Bunions). Masters Dissertation, Chiropractic. Technikon Natal, Durban.

Hattrup, S.J. and Johnson, K.A. 1985. Hallux Valgus: A review. Advanced Orthopaedic Surgery. 8: 404.

Ito, H., Shimizu, A.,Miyamoto, T., Katsura, Y., Tanaka, K. 1999. Clinical Significance of Increased Mobility in the Sagittal Plane in Patients with Hallux Valgus. Foot and Ankle International. 20(1) 29-32.

Jahss, M.H. 1991. Disorders of the Foot and Ankle: Medical and Surgical Management. Philadelphia: W.B. Saunders Company. ISBN 0-7216-3459-1.

Jenson, M.P., Karoly, p. and Braver, S. 1986. The measurement of Clinical Pain Intensity: acomparison of six methods. Pain. **27**:117-126.

Jones, L.H. 1992. Strain and Counter strain. Newark, Ohio: The American Academy of Osteopathy. ISBN 0-9406-6801-7.

Khan, M.T. 1996. The podiatric treatment of Hallux Abducto Valgus and it's associated condition, bunion, with Tagetes patula. Journal of Pharmacy and Pharmacology. **48**(7): 768-770.

Kilmartin, T.E., Barrington, R.L. and Wallace, W.A. 1994. A controlled prospective trial of a foot orhoses for juvenile hallux valgus. British Editorial Society of Bone and Joint Surgery. **76**(2): 210-214.

Kitaoka, H.B., Alexander, I.J., Adelaar, R.S., Nunley, J.A., Myerson, M.S. and Sanders, M. 1994. Clinical Rating systems for the Ankle-hindfoot, Midfoot, Hallux and lesser toes. Foot and Ankle International. **15**(7):349-353.

Klaue, K., Hansen, S.T., and Masquelet, A.C. 1994. Clinical, quantitave assessment of the first tarsometatarsal mobility in the sagittal plane and it's relation to hallux valgus deformity. Foot and Ankle International. **15**(1): 9-13.

Klenerman, L. 1991. The Foot and it's disorders. 3rd Edition. London: Blakewell Scientific Publications. ISBN 0-6320-2951-X.

Kristen, K.H., Berger, C., Stelzig, S., Thalhammer, E., Posch, M., Engel, A. 2002. The SCARF Osteatomy for the Correction of Hallux Valgus Deformities. Foot and Ankle International. **23**(3). 221-229

Kuwano, T., Nagamine, R., Sakaki, K., Urabe, K., Iwamoto, Y. 2002. New Radiographic Analysis of Sesamoid Rotation in Hallux Valgus: Comparison with Conventional Methods. Foot and Ankle International. **23**(9) 811-817.

Lee, K.T. and Young, K. 2001. Measurement of First-Ray Mobility in Normal vs. Hallux Valgus Patients. Foot and Ankle International. **22**(12) 960-969.

Levy, L.A., and Hetherington, V.J. 1990. Principles and Practices of Podiatric Medicine. New York: Churchill Livingstone. ISBN 0-443-08534-X.

Magee, D.J. 1992. Orthopaedic physical assessment. 2nd Edition. Philadelphia: W.B. Saunders Company. ISBN 0-7216-4344-2.

Magee, D.J. 1997. Orthopaedic Physical assessment. 3rd Edition. Philadelphia: W.B. Saunders Company. ISBN0-7216-6290-0.

Maitland, G.D. 1986. Vertebral Manipulation. 5th Edition. London: Butterworth-Heinemann. ISBN 0-7506-13335.

Meyer, R.H. Kenneth A. Johnson Memorial Lecture. The Female Foot. 1996. Foot and Ankle International. **17**(2). 120-124.

Michaud, T.C. 1993. Foot orthoses and other Forms of Conservative Foot Care. Maryland: Williams and Wilkins. ISBN 0-06-830597-4.

Moore, K.L. 1992. Clinically oriented anatomy. 3rd Edition. Baltimore: Williams and Wilkins. ISBN 0-683-06133-X.

Moore, K.L. and Dalley, A.F. 1999. Clinically Orientated Anatomy. 4th Edition. Baltimore: Lippincott: Williams and Wilkins. ISBN 0-683-06141-0

Ombregt, L., Bisschop, P., ter Veer, H.J. and Van de Velde, T. 1999. A system of Orthopaedic Medicine. 7th Edition. W.B. Saunders Company Ltd. ISBN 0-7020-1595-4

Owens, S. and Thordarson, D.B. 2001. The Adductor Hallucis Revisited. Foot and Ankle International. **22**(3):186-191.

Poul, J., West, J., Buchanan, N. and Grahame, R. 1993. Local action of transcutaneous Flurbiprofen in the treatment of soft tissue rheumatism. British Journal of Rheumatology. 32: 1000-1003.

Prieskorn, D.W., Mann, R.A., Fritz, G. 1996. Radiographic Assessment of the Second Metatarsal: Measure of First Ray Hypermobility. Foot and Ankle International. **17**(6)331-333.

Quirk, R. 1994. Common foot and ankle injuries in dance. Orthopaedic Clinics of North America. **25**(1): 123-133.

Reid, D.C. 1992. Sports Injury Assesment and Rehabilitation. New York:Churchill Livingstone. ISBN 0-443-08662-1.

Resch, S. 1996. Hallux Valgus. How I do it. Acta Orthop Scand. **67**(1)84-90.

Rothstein, J.M., miller, P.J. and Roettger, R.F. 1983. Goniometer reliability in a clinical setting: The elbow and Knee measurements. Physical Therapy. 63 :1611-1615.

Saag, K.G., Saltzman, C.L., Brown, K. and Budiman-Mark, E. 1996. The Foot Function Index for measuring rheumatoid arthritis pain: evaluating side to side reliability. Foot and Ankle International. **17**(8): 506-510.

Sammarco, G.J., and Idusuyi, O.B. 2001. Complications After Surgery of the Hallux. Clinical Orthopeadics and related research. 391.59-71,

Schoenhaus, H.D. and Cohen, R.S.1992. Etiology of the Bunion. The journal of foot surgery. 31(1) 25-29.

Selner, J.A., King, S.A., Samuels, D.I. Selner, M.D. and Riley, J. 1999. Tricorrectional bunionectomy for hallux abducto valgus. A comprehensive outcome study. Journal of Americal Podiatric Medical Assosiation. **89**(4): 174-82.

Skinner, H.B. 1995. Current Diagnosis and Treatment in Orthopedics. Conneticut: Appleton and Lange. ISBN 0-8285-1009-4.

Smidt, G.L., 1984. Biomechanics and physical therapy, a perspective. Phsical Therapy. 64: 1807.

Tanaka, Y., Takakura, Y., Fujii, T., Kumai, T., Sugimoto, K. 1999. Hindfoot Alignment of Hallux Valgus Evaluated by a Weightbearing Subtalar X-Ray View. Foot and Ankle International . **22**(10) 640-645.

Tanaka, Y., Takakura, Y., Sugimoto, K., Kumai, T., Sakamoto, T., Kadono, K. 2000. Precise Anatomic Configuration Changes in the First Ray of the Hullux Valgus Foot. Foot and Ankle International. **21**(8). 651-656.

Thordarson, B.D., Krewer, P. 2002. Medical Eminence Thickness with and withoug Hallux Valgus. Foot and Ankle International. **23**(1) 48-50.

Wadsworth, C.T. 1998. Manual Examination and Treatment of the Spine and Extremities. Maryland: Williams and Wilkins. ISBN 0-6830-8600-6.

Weinfield. S.B., Schon, L.C. 1998. Hallux Metatarsophalangeal Arthritis. Clinical Orthopeadics and related research. 349. 9-19.

Yale, J.F. 1987. Podiatric Medicine. Maryland; Williams and Wilkins. ISBN 0-6830-9319-3.

Personal communication: Dr. S Guiry, 15 September 2002.

Appendix 1

DURBAN INSTITUTE OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: Date:

File # : Age :

Sex : Occupation:

Intern : Signature:

FOR CLINICIANS USE ONLY: Initial visit Clinician: Signature : **Case History:**

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

CASE STATUS:

PTT:	Signature:	Date:
CONDITIONAL: Reason for Conditional: Signature:		Date:
Conditions met in Visit No:	Signed into PTT:	Date:
Case History signed off:		Date:

Intern's Case History:

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

	Complaint 1	**Complaint 2**
< Location		
< Onset : Initial:		
Recent:		
< Cause:		
< Duration		
< Frequency		
< Pain (Character)		
< Progression		
< Aggravating Factors		
< Relieving Factors		
< Associated S & S		
< Previous Occurrences		
< Past Treatment		
< **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 incl. xrays

< Environmental Hazards (Home, School, Work)

< Exercise and Leisure

< Sleep Patterns

< Diet

< Current Medication
Analgesics/week:

< 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

PHYSICAL EXAMINATION: SENIOR/RESEARCH

Patient Name :__________________________ **File no :____________** **Date :**
Interns Name : **Signature :**

VITALS:
Pulse rate:
Respiratory rate:
Blood pressure: R L
Temperature:
Height:
Weight: Recent change: Yes No

GENERAL EXAMINATION:

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

Urinalysis:

Clinicians Name: **Signature :**

SYSTEM SPECIFIC EXAMINATION

CARDIOVASCULAR EXAMINATION:
RESPIRATORY EXAMINATION:
ABDOMINAL EXAMINATION:
NEUROLOGICAL EXAMINATION:
COMMENTS:

Clinicians Name: **Signature :**

DURBAN INSTITUTE of TECHNOLOGY

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:	**R**	**L**	***Non weight bearing:***	**R**	**L**
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			

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

	R	L		R	L
Ankle joint: *Plantarflexion*			Subtalar joint: *Varus*		
Dorsiflexion			*Valgus*		
Talocrural: *Long axis distraction*			Midtarsal:*A-P glide*		
First ray: *Dorsiflexion*			*P-A glide*		
Plantarflexion			*rotation*		
Circumduction of forefoot on fixed rearfoot			Intermetatarsal glide		
			Tarso metatarsal joints: *A-P*		
Interphalangeal joints: *LýA dist*			Metatarsophalangeal dorsiflexion (with associated plantar flexion of each toe		
A-P glide					
lat and med glide					
rotation					

Resisted Isometric movements	R	L		R	L
Knee flexion			Pronation (eversion)		
Plantar flexion			Dorsiflexion		
Dorsiflexion			Toe flexion (plantar flexion)		
Supination (inversion)					

Neurological	R	L
Dermatomes		
Myotomes		
Reflexes		
Balance/proprioception		

Special tests	R	L
Anterior draw test		
Talar tilt		
Thompson test		
Homan sign		
Tinel's sign		
Test for rigid/flexible flatfoot		
Kleiger test (med. Deltoid)		

Alignment	R	L
Heel to ground		
Feiss line		
Tibial torsion		
Heel to leg (subtalar neutral)		
Subtalar neutral position:		
Forefoot to heel (subtalar & Midtarsal neutral)		
First ray alignment		
Digital deformities		
Digital deformity flexible		

Palpation

Anteriorly	R	L
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		

21/10/2002

Appendix 4

INFORMED CONSENT FORM Date: August 2002

TITLE OF RESEARCH
A prospective, randomised, comparative investigation into the effectiveness of two treatment protocols for symptomatic Hallux Abductovalgus (Bunions), with respect to subjective and objective findings.

NAME OF RESEARCH STUDENT :	**C.T. Herholdt.**	**(031 – 3037207)**
NAME OF RESEARCH SUPERVISOR:	**Dr C. Korporaal**	**(031 – 2042611)**
	Dr H. Kretzmann	**(031 – 2042244) (Thursday)**

PLEASE CIRCLE THE APPROPRIATE ANSWER:

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

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

PATIENT/SUBJECT Name………………………. Signature……………………….

WITNESS	Name……………………….	Signature……………………….
RESEARCH STUDENT	Name……………………….	Signature……………………….
DATE:	………………………………	

Appendix 5

LETTER OF INFORMATION

Dear Participant

Welcome to my research project.

Title of Research: A prospective, randomised, comparative investigation into the effectiveness of two treatment protocols for symptomatic Hallux Abductovalgus (Bunions), with respect to subjective and objective findings.

NAME OF RESEARCH STUDENT: **C.T. Herholdt (031) 204-2205 or 204-2512**
NAME OF RESEARCH SUPERVISORS: **Dr C. Korporaal (031) 204-2094 or 204-2611**
Dr H. Kretzmann (031) 204-2244 (Thursdays)

Dear patient

Welcome to my research project. You have been selected to take part in a clinical trial comparing two forms of treatment for Bunions. Hallux Abductovalgus Bunions (HAVB) is a common deformity that involves an abnormal deviation of the great toe towards the middle of the foot. It is a common finding in females with a history of wearing high-heeled shoes.

<u>The aim of this study:</u>
Is to compare the efficacy of two chiropractic treatment approaches in the management of painful hallux abductovalgus (bunions).

<u>What will happen during the study period:</u>
You will be allocated into one of two groups by drawing a number, representative of the treatment groups, from a bag. X-rays will be taken to rule out any other conditions, contra indicated to chiropractic care. You will the receive one of two treatments, that are routinely applied in clinical practice. The treatments are safe and are unlikely to cause any discomfort or adverse side effects, as they will follow a protocol similar to that used in clinical practice.

You will receive five treatments over a two-week period and need to attend a one-week follow up consultation. You will be asked to fill in simple questionnaires in order for the progress during the study period to be assessed. All treatments will be performed under the supervision of a qualified Chiropractor.

All patient information is confidential and the results of the study will be made available in the Durban Institute of Technology library in the form of a mini-dissertation.

<u>What do you need you to do:</u>

- You will need to refrain from having any other form of treatment for your bunions throughout the duration of this study, including the use of analgesics and anti-inflammatory drugs.

- You will be asked to refrain from using tight, pointed, narrow and high-heeled shoes throughout the duration of this study as these shoes are known to aggravate this condition.
- You will be asked to inform the researcher if any of the conditions of this study have been breached in any way.
- If you have any of the following conditions you will be excluded from the study, as they are contra-indicated for the treatment protocols used in this research:

Advanced/ Severe Degeneration Joint Disease
Anti- coagulant therapy
Inflammatory Arthritis
Joint instability
Fracture/ Dislocation/ Bone Tumours/ Infections

There are minimal risks involved in the treatment offered in this study, however the overall benefits may include decrease pain and discomfort associated with this condition.

Your treatment will be free of charge and you are free to withdraw at any stage if you wish to do so.

Please don't hesitate to ask questions on any aspect of this study. Your full co-operation will assist the Chiropractic profession in expanding its knowledge of this condition.

Thank you.

Yours sincerely,

C.T. Herholdt.
(Chiropractic intern)

Appendix 6 - Numerical pain Rating scale

NUMERICAL PAIN RATING SCALE 101

PATIENT NAME: …………………………..

FILE NUMBER: ………………………….. DATE: …………………………..

GROUP: …………………………..

Please indicate on the line below the number between 0 and 100 that best describes the pain of your major problem at this point, when it is at its **WORST.** A zero (0) would mean "no pain at all" and one-hundred (100) would mean "pain as bad as it could be."

Please write only one number.

0 ____ 100

Please indicate on the line below the number between 0 and 100 that best describes the pain of your major problem at this point, when it is at its **LEAST.** A zero (0) would mean "no pain at all" and one-hundred (100) would mean "pain as bad as it could be."

Please write only one number.

0 ____ 100

Appendix 7 - Foot Function Index Pain Subscale

FOOT FUNCTION INDEX PAIN SCALE

PATIENT NAME: ……………………………..
FILE NUMBER: …………………………….. **DATE:** ……………………………..
GROUP: ……………………………..

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

Section A

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

Section B: Can you:

1)	Walk in the house	0 1 2 3 4 5 6 7 8 9 10
2)	Walk outside	0 1 2 3 4 5 6 7 8 9 10
3)	Climb stairs	0 1 2 3 4 5 6 7 8 9 10
4)	Stand on tip toe	0 1 2 3 4 5 6 7 8 9 10
5)	Get up from a chair	0 1 2 3 4 5 6 7 8 9 10

Section C: Do you have to

1)	stay inside all day	Yes / No
2)	stay in bed all day	Yes / No

Appendix 8 –Hallux Metatarsophalangeal-Interphalangeal Scale.

PATIENT NAME: ………………………….. FILE NO.: …………………………..

GROUP: …………………………..

Pain (40 points)	
None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0
Function (45 points)	
Activity limitations	
No limitations	10
No limitations of daily activities, such as employment responsibilities, limitation of recreational activities	7
Limited daily and recreational activities	4
Severe limitation of daily and recreational activities	0
Footwear requirements	
Fashionable, conventional shoes, no insert required	10
Comfort footwear, shoe insert	5
Modified shoes or brace	0
MTP joint motion (dorsiflexion plus planterflexion)	
Normal or mild restriction (75 degrees or more)	10
Moderate restriction (30 deg. – 74 deg)	5
Severe restriction (less than 30 deg)	0
IP joint motion (planterflexion)	
No restriction	5
Severe restriction (less than 10 deg)	0
MTP-IP stability (all directions)	
Stable	5
Definitely unstable or able to dislocate	0
Callus related to hallux MTP-IP	
No callus or asymtomatic callus	5
Callus, symptomatic	0
Alignment (15 points)	
Good, hallux well aligned	15
Fair, some degree of hallux malalignment observed, no symptoms	8
Poor, obvious symptomatic malalignment	0

100 Points total **SCORE:**

Appendix 9: Algometer and Goniometric measurements

PATIENT NAME: **…………………………..** **FILE NO.:** **…………………………..**

GROUP: **…………………………..**

DATE:		**ALGOMETER READING:**				**GONIOMETRIC READING**
VISIT 1:						PLANTERFLEXION DORSIFFLEXION
VISIT 3:						PLANTERFLEXION DORSIFFLEXION
VISIT 5:						PLANTERFLEXION DORSIFFLEXION
VISIT 6						PLANTERFLEXION DORSIFLEXION

DATE:		**HAV ANGLE measurement**			
VISIT 1:					
VISIT 3:					
VISIT 5:					
VISIT 6:					