THE RELATIVE EFFECTIVENESS OF MUSCLE ENERGY TECHNIQUE COMPARED TO MANIPULATION IN THE TREATMENT OF CHRONIC STABLE ANKLE INVERSION SPRAINS

By

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I, Lynette Colleen Joseph, do declare that this dissertation is representative of my own work in both conception and execution.

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FOR

EXAMINATION

ARTICLE

FOR

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DEDICATION

To my Lord and Saviour Jesus Christ, The Father of mercy and the God of all comfort.

&

To our little angel
Ethan Daniel Joseph
(Jedidiah)

8 May 2003- 8 June 2005

It broke our hearts to lose you
But you did not go alone
For all our love went with you
The day God called you home
~Anon~

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ABSTRACT

An inversion ankle sprain can be defined as an injury caused by landing forcefully on an inverted, plantarflexed and internally rotated foot. This results in the fibres of the surrounding ligaments to become ruptured without disturbing the continuity of the ligament. Chronic stable ankle sprains was defined as the recurrent giving way of the ankle and there may be residual pain and swelling with no mechanical instability.

According to literature, mechanisms involved in the development of chronic ankle sprains are: the lack of appropriate and early immobilization in severe cases, the development of scar tissue, lack of strengthening exercises or the development of hypermobility.

Many treatments have been suggested to address these factors and would include: peripheral manipulation of the ankle joint, Muscle Energy Technique, muscle strengthening and stretching, proprioceptive training and deep transverse friction massage. Of the above mentioned treatments, Muscle Energy Technique has not been researched in a clinical setting for the treatment of chronic stable ankle inversion sprains.

Therefore the purpose of this study was to investigate the relative effectiveness of Muscle Energy Technique compared to Manipulation in the treatment of chronic stable ankle inversion sprains.

The study is a prospective, randomized clinically controlled study in which forty participants, between the ages of 18-50, were screened according to the inclusion and exclusion criteria, selected and randomly divided into two groups. One group of twenty received Manipulation of the talocrural joint, while the other group of twenty received Muscle Energy Technique. Patients received six treatments and were required to return for a follow-up consultation for data collection thereafter over a three-week period.

Subjective and objective measurements were taken at the beginning of the first, fourth and follow-up visits. Subjective measurements included the Numerical Pain Rating Scale, McGill Pain Questionnaire and the Functional Evaluation Scale. Objective measurements included the Inclinometer readings and the modified Rhomberg's test.

Statistical analysis of the data was performed using the SPSS version 11.5 software suite version. Demographics and baseline outcome measures were compared between the two treatment groups using chi square tests and independent t-tests where appropriate. Repeated measures ANOVA was used to analyse the treatment difference between the two groups. Repeated contrasts were used to compare the groups at each time point. A p value of < 0.05 was classified as statistically significant.

The results of this study demonstrated a significant improvement in terms of range of motion, pain perception and proprioception in both the Manipulation (group 1) and the Muscle Energy Technique (group 2) group.

In terms of subjective data, Group 2 showed a more rapid decrease in pain perception between the fourth and follow-up consultation than Group 1. Treatment with both of these techniques had caused a decrease in Numerical Pain Rating Scale score which corresponded with a decrease in the McGill Pain Questionnaire score and an increase in Functional Evaluation Scale score, and an increase in proprioception with eyes open. In terms of objective findings, no significant difference was noted between the two groups. It was also found that an increase in dorsiflexion was positively correlated to an increase in proprioception with eyes-closed.

It can therefore be concluded that Muscle Energy Technique appears to be a reliable intervention in the treatment of chronic stable ankle inversion sprains and should be considered as an effective adjunct to manipulation.

GLOSSARY

Adhesions: Adhesions due to trauma result from inflammation and subsequent repair with an increase in collagen leading to the formation of “scar tissue” or fibrosis (Gatterman, 1995:45).

Chronic: A condition that has been present for 7 weeks or more, as defined by the Quebec Task Force (Spitzer, 1987).

Muscle energy technique: A manual medicine treatment procedure that involves the voluntary contraction of the patients muscle in a precisely controlled direction, at varying levels of intensity against a distinctly executed counterforce applied by the operator (Greenman, 1989: 88).

Sprain: Joint injury in which some fibres of a supporting ligament are ruptured, but the continuity of the ligament remains intact (Gatterman, 1995:415).

Chronic Stable Ankle Sprains: Can be defined as recurrent giving away of the ankle and may have residual pain and swelling (Hertling and Kessler, 1996) with no mechanical instability (Veeneema, 2000).

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CHAPTER ONE

CHAPTER- 1

1.1. INTRODUCTION

Ankle sprains are a common injury with 23 000 inversion sprains experienced per day in the United States (Salamon, 2004). It is estimated that 1/10 000 persons per day sprain their ankles in the general population (Reid 1992: 215). Studies have shown that roughly 85% of ankle injuries involve some degree of sprain of the ankle ligaments and of these 85% are inversion sprains as cited by Garrick and Schelkun (1997). More than 40% of ankle sprains have the potential to cause chronic problems (Garrick and Schelkun, 1997). According to Brantingham et al. (1993) unresolved chronic ankle pain that develops secondary to ankle inversion sprains is a condition that is commonly seen.

The ankle joint (talocrural joint or mortise) is described as a hinge joint that is stabilized by bony and soft tissue structures (Baker et al., 1995). Veeneema (2000) states that the ankle joint is formed by the articulation of the distal tibia and fibula with the talus. He further illustrates that the configuration of the distal tibia and fibula, which is in the form of an inverted "U", together with the saddle-shaped talar dome, defines the ankle mortise (Veeneema, 2000), and allows for dorsiflexion and plantarflexion (Trojian and Mckeag, 1998). Calliet (1997:3-4) states that during dorsiflexion, the wider anterior portion of the talus comes between the two malleoli (or mortise) and wedges between them. Plantarflexion causes the smaller posterior portion to the talus to be within the mortise allowing for lateral motion to occur. Therefore in the plantarflexed position, the talus has movement that makes the joint "unstable" (Calliet, 1997:3-4).

The ankle joint is stabilized medially by the deltoid ligament (consisting of the calcaneotibial, the tibionavicular and the anterior and posterior talotibial ligaments) and laterally by the lateral ligament complex (Calliet, 1997:3-4). The lateral ligament complex of the ankle, which is at risk during forced inversion consists of the anterior talofibular ligament (ATFL), the calcaneofibular ligament (CFL) and the posterior talofibular ligament (PTFL) (Bassewitz and Shapiro, 1997).

Mack (1982) states that bony stability is greater laterally than medially thereby, predisposing toward inversion sprains rather than eversion sprains. The lateral ligamentous structures are therefore the most frequent site of injury (Baker et al. 1995). The typical mechanism of injury is one of inversion, plantarflexion and internal rotation (Garrick, 1997 and Bennett, 1994). This is a position that renders the ATFL, which is the primary lateral stabilizer most susceptible to injury (Veeneema, 2000). Brantingham et al. (1993) lists the following reasons as suggested mechanisms for the development of chronic ankle sprains: lack of appropriate and early immobilization in severe cases, development of scar tissue, lack of appropriately prescribed mobility and strengthening exercises and/ or development of hypermobility.

Mack (1982) suggests the use of stress tests that can be conducted during the physical examination to assist the researcher in determining the stability of an ankle following an ankle sprain. He describes the anterior drawer test and the talar tilt tests as diagnostic tools to indicate anterior and lateral instability respectively. Baker et al. (1995) advises the conservative management of ankles that are stable i.e. that offer resistance to both the anterior and varus stress tests.

Results from studies conducted by Green et al. (2001) and Denegar et al. (2002) suggest that restrictions of the talocrural arthrokinematics may be common following lateral ankle sprains thus resulting in the limitation of dorsiflexion range of motion (Baker et al., 1995 and Baumhauer, 1995). Green et al. (2001) reported a more rapid restoration of dorsiflexion range of motion with passive mobilization of the talus. Intra- articular adhesions and capsular contracture together with end range of motion pain can also cause patients to lack sufficient range of motion for even normal activities (Bassewitz and Shapiro, 1997). Kesson and Atkins (1998:79) suggest manipulation to rupture unwanted scar tissue for the treatment of chronic ligamentous sprains of the lateral collateral ligaments of the ankle i.e. the ATFL, CFL and the PTFL. Manipulation has been recommended as a treatment of choice for joint dysfunction. A study conducted by Pellow and Brantingham (2001) showed significant reduction in pain, improved ankle range of motion and ankle function with adjusting of the ankle in subacute and chronic grade I and II ankle inversion sprains. A previous study by Brantingham et al. (1993) documented the successful use of manipulation of the subtalar and mobilization of the midtarsal joints in chronic ankle pain.

Muscle energy technique (MET) is defined as a manual medicine treatment procedure that involves the voluntary contraction of the patients muscle in a precisely controlled direction, at varying levels of intensity, against a distinctly executed counterforce applied by the operator (Greenman, 1989: 88). It has been hypothesized that MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and to decrease local edema and to mobilize a restricted articulation (Greenman, 1989:88). Chaitow (1996: 123), states that joints which have no obvious muscle control, have responded "dramatically well" to MET, although no studies were quoted to substantiate these claims. To date there have been no studies investigating the effectiveness of Muscle Energy Technique in the treatment of chronic stable ankle inversion sprains. Muscle energy technique has found an increasing audience with clinicians (Gibbons and Tehan, 1998) but very little has been published about this intervention (Wilson et al., 2003) even though it has been claimed to be effective in mobilising joints (Chaitow, 1996:118).

Further studies evaluating treatment regimens are needed to identify effective methods to reduce the long-term functional limitations of ankle sprains in the general clinic population (Braun, 1999). Since manipulation has been researched and found to be effective, the result of this study would determine the effectiveness of Muscle Energy Technique, a suggested adjunct for the treatment of stable chronic ankle inversion sprains.

1.2. OBJECTIVES

Objective 1: To determine the effectiveness of Muscle Energy Technique compared to manipulation in the treatment of chronic stable ankle inversion sprains in terms of subjective data.

Objective 2: To determine the effectiveness of Muscle Energy Technique compared to manipulation in the treatment of chronic stable ankle inversion sprains in terms of objective data.

1.3. STATEMENT OF HYPOTHESIS

1.3.1. First Hypothesis

It is hypothesized that the use of Muscle Energy Technique in the treatment of chronic stable ankle inversion sprains will prove to be an effective treatment in terms of subjective and objective findings.

1.3.2. Second Hypothesis

It is hypothesized that manipulation will be relatively more effective than Muscle Energy Technique in the treatment of chronic stable ankle inversion sprains in the terms of subjective and objective findings.

CHAPTER TWO

CHAPTER- 2

2.1. INTRODUCTION

Ankle inversion sprains are the most common injury in the ankle especially in athletes (Brantingham, 1993). In a study conducted by Garrick (1977), it was found that 85% of injuries were sprains with a high proportion of sprains involving the lateral structures. Regardless of whose statistics one reads, the ankle sprain is a major problem.

Lateral ankle sprains occur as a result of landing on a plantarflexed and inverted foot (Hockenbury et al., 2002), thus resulting in injury to the lateral ligament complex. According to Hertel (2000) despite extensive clinical and basic science research, the recurrence rate of ankle sprains remains high. In a survey conducted by Braun (1999) in which 467 patients with ankle sprains were evaluated, it was concluded that further studies are required to identify effective means of treatment to reduce long term functional limitations of ankle sprains in the general population.

Peripheral manipulation has been recommended for the treatment of chronic ligamentous sprains of the lateral collateral ligaments at the ankle (Kesson and Atkins, 1998) to improve range of motion and ankle function and to decrease pain (Pellow and Brantingham, 2001).

Muscle Energy technique (MET) is a manual medicine treatment procedure that has been hypothesized to lengthen and strengthen muscles, increase fluid mechanics and decrease local edema and to mobilize a restricted articulation (Greenman, 1989). Chaitow (1996) states that joints which have no obvious muscle control have responded very well to muscle energy technique, although, no studies were quoted to substantiate these claims.

2.2. PREVALENCE AND INCIDENCE

Ankle sprains are common presenting complaints in both emergency departments and family physician offices (Wexler, 1998:1). Ankle sprain is the commonest sport injury particularly in activities involving running and jumping (Zelisko et al., 1982 and Hopper 1986). It is estimated that 20-25% of all time-loss injuries, in running or jumping sport, are as a result of ankle injuries (Mack 1982). Kuwada (1995) states that ankle sprains affect athletes at some stage in their athletic career, however, it is a condition that can affect all people.

According to Wexler (1998), approximately 1 million ankle injuries occur annually in the United States and most of them are ankle sprains resulting from inversion sprains. Studies have shown that roughly 85% of ankle injuries involve some degree of sprain of the ankle ligaments. Of these, 85% are inversion sprains of the lateral ligaments (Garrick, 1977:1). In the aforementioned epidemiological survey of ankle sprains, Garrick mentions that both men and women appear to be equally affected.

Most patients who have experienced and ankle sprain are treated conservatively and the outcome is usually satisfactory. However a subset may continue to experience pain after what appears to be a routine sprain (Bassewitz et al., 1997:1).

2.3. ANATOMY, BIOMECHANICS AND MECHANISM OF INJURY

2.3.1. Bones and Ligaments

Hockenbury et al. (2001) describes the ankle joint as a simple hinge joint, the stability of which depends on both joint congruency and the supporting ligamentous structures. Veeneema (2000) explains that the ankle joint is formed by the articulation of the distal tibia and fibula with the talus. He further illustrates that the configuration of the distal tibia and fibula, which is in the form of an inverted "U", together with the saddle-shaped talar dome, defines the ankle mortise (Veeneema, 2000). The tibia and fibula are bound together by the anterior inferior tibiofibular ligament, the posterior inferior tibiofibular ligament and the interosseous membrane that runs between the two long bones (Wexler, 1998:1). The body of the talus is wedged shaped with the widest portion anterior (Calliet, 1997: 2). During dorsiflexion, the wider portion of the talus is brought into contact with the narrower position between malleoli and therefore becomes gripped more tightly (Mack, 1982:1). As the ankle goes into plantarflexion, the narrower posterior portion of the talus is brought into contact with the wider anterior portion of the tibia which permits a small amount of free play in the ankle joint as the wedge effect is lost (Mack, 1982:1). Therefore in the plantarflexed position, the talus has movement that makes the joint unstable, placing all the support on the ligaments (Calliet, 1997:2).

The ankle joint is stabilized medially by the deltoid ligament (composed of the calcaneotibial, the anterior talotibial, the posterior talotibial and the talonavicular ligaments) and laterally by the lateral ligament complex (Calliet, 1997:1). The lateral ligament complex of the ankle which is at risk during inversion, consists of the anterior talolfibular ligament (ATFL), the calcaneofibular ligament (CFL) and the posterior talofibular ligament (PTFL) (Bassewitz, 1998). These ligaments are responsible for offering resistance against inversion and internal rotation stress (Hockenbury et al., 2001). The ATFL and PTFL resist anterior or posterior displacement of the talus in the ankle mortise (Veeneema, 2000).

Bassewitz et al. (1997) explains that the ankle is at highest risk when it is plantarflexed, since the foot has a longer lever arm and there is less inherent bony and ligament stability when the ankle is in this position. Therefore the ATFL, which is most exposed during plantarflexion, is the ligament most commonly injured.

2.3.2. Biomechanics

Movement at the ankle joint itself actually occurs only in the vertical plane (i.e. dorsiflexion and plantarflexion). Inversion and eversion takes place at the subtalar joint. This joint is stronger than the ankle joint and as a result, most inversion or eversion injuries occur at the ankle rather than at the subtalar joint (Wexler, 1998:2).

The axis deviates approximately six degrees from both the transverse and frontal planes as it passes in an anteromedial direction. A small amount of supination and pronation is present with ankle motion as a result of the joint's axis angle to the body planes. The range of motion of the ankle is approximately eighty degrees. For normal gait to occur, at least ten degrees of dorsiflexion and twenty degrees of plantarflexion are needed (Oloff, 1994:72).

2.3.3. Mechanism of Injury

Lateral ankle sprains occur as a result of landing on a plantarflexed and inverted foot (Hockenbury et al., 2002), a position that renders the ATFL, which is the primary lateral stabilizer most susceptible to injury (Veeneema, 2000). Mack (1982) explains that bony stability is greater medially than laterally thereby predisposing toward inversion rather than eversion. He further illustrates that as inversion increases, the medial malleolus may lose its stabilizing function and actually act as a fulcrum for further inversion.

During periods of ankle unloading, the ankle rests in a position plantarflexion and inversion. If the unloaded foot meets the ground or another object unexpectedly,ground, lateral ligament injury may occur (Hockenbury et al., 2002). Ankle sprains can occur during athletic competition or practice, other sports (such as soccer, volleyball, tennis, baseball, karate, judo and football), while walking on uneven surfaces or stepping into a hole (Kuwada, 1995:653). Brantingham et al. (1993) lists the following reasons as suggested mechanisms for the development of chronic ankle sprains: lack of appropriate and early immobilization in severe cases, development of scar tissue, lack of appropriately prescribed mobility and strengthening exercises and development of hypermobility.

20 – 40% of patients that have been treated conservatively continue to complain of residual pain and instability (Calliet, 1997:211), as well as stiffness, weakness and loss of proprioception (Bassewitz et al., 1997:2). Subsequent losses of joint range particularly dorsiflexion, and muscle strength results in significant gait dysfunction (Collins et al., 2004:77). Lack of proprioceptive control may delay the involuntary response to an inversion strain and cause re-injury, even with relatively minor stresses (Bassewitz et al., 1997:2).

2.4. PROPRIOCEPTION

In proprioception, input is received from the peripheral afferents (muscle spindles, joint receptors, cutaneous receptors and golgi tendon organs (Lephart et al., 1998), and provides information on limb awareness, position, force and heaviness (Docherty et al., 2004). A subjective feeling of ankle instability or recurrent symptomatic ankle sprains (or both), due to proprioceptive and neuromuscular deficits is referred to as functional instability. Neuromuscular deficits may be manifested as impaired balance, reduced joint position sense, slower firing of the peroneal muscles to inversion perturbation of the ankle, slowed nerve conduction velocity, impaired cutaneous sensation, strength deficits and decreased dorsiflexion range of motion (Hertel, 2000).

In a study conducted by Forkin et al. (1996), in which 11 collegiate gymnasts were screened to determine if chronic ankle sprains decreased ankle proprioception, it was found that 63% displayed a balance deficit. The ability to detect passive plantarflexion of the injured ankle in comparison to the uninjured side was also analyzed in these gymnasts. These patients exhibited a diminished ability to sense passive ankle motion on the injured side as opposed to the uninjured side.

2.5. ASSOCIATED INJURIES AND DIFFERENTIAL DIAGNOSIS

Although the ankle sprain is generally associated with injury to the lateral ankle ligaments alone, other structures are often injured in conjunction with this injury (Fallat et al., 1998). Inversion ankle sprains must be differentiated from various other pathologies including tibiofibular syndesmosis sprain, bifurcated ligament injury, Achilles tendon rupture, peroneal tendon dislocation, flexor hallucis longus injury, lateral periostitis, os trigonum injury, anterior tibialis tendon injury and fractures (Trojian and McKeag, 1998).

2.5.1. Tibiofibular Syndesmosis Sprains

Syndesmosis injury occurs with external rotation injuries that frequently accompany an inversion sprain (Bassewitz and Shapiro, 1997). According to a retrospective study by Hopkinson et al. (1990), in which clinical records and radiographs of 1344 ankle sprains were reviewed, a 1% incidence of syndesmosis sprains could be clinically detected.

The study identified the following characteristics in ankle sprains that indicated the involvement of the tibiofibular syndesmosis:

- Latent diastasis of the ankle which have prolonged postinjury pain with weight bearing as compared to other ankle sprains.
- Interosseous calcification along the tibiofibular syndesmosis which is noticeable on radiographs several weeks after injury.
- Tibiofibular syndesmosis sprains do not appear to cause the patient to be susceptible to recurrent ankle injury or chronic ankle problems.

The squeeze, external rotation stress and side-to-side tests are important in the diagnosis of syndesmosis sprains (Trojian et al., 1998).

2.5.2. Achilles Tendon Rupture

Achilles tendon is usually ruptured with rapid plantarflexion (Trojian and Mckeag, 1998). The site of rupture is the area of poor circulation 2 to 6cm above the os calcis. Patients would feel a sharp pain and often state that it sounded like someone shot them.

Chronic Achilles tendon rupture may present with significant atrophy of the gastrocnemius-soleus complex and inability to toe off (Subotnick, 1999:242).

2.5.3. Peroneal Tendon Injury

Patients that present with a dorsiflexion injury associated with a painful snapping sensation should be suspected of having a tear of the peroneal tendon. Pain without mechanical symptoms should be treated with a trial of immobilization and non-steroidal anti-inflammatory before considering surgery (Bassewitz and Shapiro, 1997).

Subluxation or dislocation of these tendons is not common but can happen with an inversion sprain. Palpation over the tendon with active dorsiflexion and eversion of the foot and ankle, would reveal subluxation of the tendon or would elicit pain (Trojian and McKeag, 1998 and Subotnick, 1999:247). Conservative treatment consists of a U-shaped felt pad with ankle taping for 1^{o} dislocation. Surgical referral is warranted if pain and instability persists (Trojian and McKeag, 1998).

2.5.4. Flexor Hallucis Longus Injury

The flexor hallucis longus decreases the rapid internal rotation of the lower extremity at contact. Together with the flexor digitorum longus, the flexor hallucis longus stabilizes the metatarsophalangeal joints during toe-off (Subotnick, 1999:232). Injury to this ligament is seen in dancers or other athletes who stand on tiptoe or on the balls of their feet (Trojian and McKeag, 1998). Trojian and McKeag add that palpation of the sheath with active and passive ranges of motion of the hallux will reproduce symptoms. The treatment is conservative and entails the use of ice, non-steroidal anti-inflammatory drugs and an inflexible shoe.

2.5.5. Lateral Periostitis

Lateral periostitis, also known as jumpers' ankle, can occur in high jumpers prior to takeoff in the planted foot. The foot is dorsiflexed and everted suddenly, thereby causing trauma to the talus from the distal fibula. Symptoms are similar to those of a lateral sprain but without anterior talofibular ligament tenderness. Palpaton of the lateral talus with the foot in plantarflexion and inversion elicits pain (Trojian and McKeag, 1998).

2.5.6. Os Trigonum Injury

Os Trigonum syndrome, or fracture of the lateral process of the calcaneus, is sometimes seen with a strong plantarfexed motion. In a small percentage of patients, a detached process is present and it must be determined if this is a growth plate abnormality due to lack of fusion or if the player has a history of previous injury (Subotnick, 1999:699-700). Resisted eversion will be pain free but forceful passive plantarflexion should reproduce symptoms (Trojian and McKeag, 1998).

2.5.7. Anterior Tibialis Tendon Injury

80% of the dorsiflexion power of the ankle is attributed to the anterior tibialis tendon (Trojian and Mckeag, 1998). Sudden plantarflexing eversion injuries may cause partial or complete rupture of the anterior tibial tendon, which may require surgical repair (Subotnick, 1999:230). Subotnick also explains that excessive pronation elongates the anterior tibial tendon as the medial longitudinal arch drops causing stress overload with tenosynovitis or partial rupture. Treatment involves a short leg cast in 15^{o} plantarflexion for one to three weeks. Steroid injection may also be helpful (Trojian and McKeag, 1998).

2.5.8. Fractures

Approximately 15% of patients evaluated for ankle injuries presented with a clinically significant fracture. The Ottawa ankle rules are therefore recommended as an essential tool for proper management (Steele and Kelly, 2005).

i) Malleolar Fractures- may be at or above the joint line and may lead to a widened mortise (Anderson, 2002). Reid (1992:264) classifies the malleolar fractures as follows:

1. Below the level of the joint (excellent prognosis).
2. At the level of the joint (anatomic reduction is necessary).
3. Above the level of the joint (reduction is necessary due to instability).

ii) Osteochondral talar dome lesion- Pain and effusion along the talocrural joint line should raise suspicion of an osteochondral talar dome lesion. This lesion results from direct trauma between the talus and tibia and is usually located posteromedially (Wolfe et al., 2001).

iii) Fifth Metatarsal fracture- Tenderness along the base of the fifth metatarsal may indicate avulsion of the peroneal brevis tendon (Wolfe et al., 2001). The fifth metatarsal fracture usually represents a stress reaction, although acute fractures do occur with inversion sprains (Reid, 1992:160).

iv) Radiographs- According to the Ottawa Ankle rules, radiographs should be obtained to rule out fractures when a patient presents with bone tenderness in the posterior half of the lower 6cm of the fibula or tibia or an inability to bear weight immediately after the injury and in the emergency department (Wolfe et al., 2001). They further state that the implementation of the Ottawa rules has reduced unnecessary radiography, decreased waiting time for patients and lowered diagnostic costs. Radiological examination should include anteroposterior, lateral and mortise views (Steele and Kelly, 2005 and Bassewitz and Shapiro, 1997).

A foot radiograph is required only if there is any pain in midfoot zone and any of these findings:

1. Bone tenderness at the base of the fifth metatarsal or at the navicular.
2. Inability to bear weight both immediately and in the emergency department. (Adopted from Stiell et al., 1995)

2.6. TREATMENTS

2.6.1. Mobilization and Muscle Energy Technique

Green et al. (2001) reported that early posterior talocrural joint mobilization in the treatment of lateral ankle sprains resulted in more rapid restoration of dorsiflexion range of motion and normal walking gait than conservative treatment (ice, compression, elevation and the use of crutches). Veeneema (2000) suggests that emphasis should be on early joint mobilization, muscle strengthening, achilles tendon stretching and proprioceptive training after the use of the RICE principle. Range of motion must be regained before functional rehabilitation (Wolfe et al., 2001).

Muscle energy technique (MET) has been defined as a manual medicine treatment procedure that involves the voluntary contraction of the patients muscle in a precisely controlled direction, at varying levels of intensity, against a distinctly executed counterforce applied by the operator (Greenman, 1989: 88). It has been hypothesized that MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and to decrease local edema and to mobilize a restricted articulation (Greenman, 1989:88). Chaitow (1996: 123) claims that joints that have no obvious muscle control, have responded "dramatically well" to MET, although no studies were quoted to substantiate these claims. Studies conducted by Denegar et al. (2002) and Green et al. (2001) suggest that there is decreased dorsiflexion in the ankle following lateral ankle sprain due to restriction in the talocrural joint. Hertling and Kessler (1996) explain that any stress to ligaments around a joint results in firing of specific receptors in the joint and through the reflex arc, producing contracture of muscles overlying the joint. They suggest that mobilization be used to restore restricted movement in chronic ankle sprains. Therefore in keeping with reciprocal inhibition (i.e. when a muscle contracts, its antagonist relaxes) the gastrocnemius-soleus complex (i.e. the plantarflexors) was contracted to aid in increasing dorsiflexion in the ankle. To date there have been no studies investigating the effectiveness of Muscle Energy Technique in the treatment of chronic stable ankle inversion sprains.

2.6.2. Manipulation

Manipulation is a manual procedure that involves a direct thrust to move a joint past the physiologic range of motion without exceeding the anatomic limit (Gatterman, 1995:12). Kesson and Atkins (1998:79) suggest manipulation to rupture unwanted scar tissue in chronic conditions. Intra- articular adhesions and capsular contracture together with end range of motion pain causes patients to lack sufficient range of motion for even normal activities (Bassewitz and Shapiro, 1997). Subotnick (1999:436) explains that because manipulation is kept within physiologic limits, there is no trauma to the joint and hence minimal pain. Peripheral manipulation is recommended for the treatment of chronic ligamentous sprains of the lateral collateral ligaments of the ankle (Kesson and Atkins, 1998:79) i.e. the ATFL, CFL and the PTFL.

Twenty asymptomatic patients participated in a study conducted by Nield et al. (1993) to determine the effect of manipulation on dorsiflexion range of motion. The manipulation studied was a longitudinal talocrural manipulation. There was no statistically significant change in dorsiflexion range of motion following manipulation. It was suggested that future research investigate the effects of manipulation in symptomatic population.

A few years later in a single-blind, comparative, controlled pilot study conducted by Pellow and Brantingham (2001) it was concluded that manipulation of the ankle reduced pain significantly, improved range of motion and ankle function in the treatment of subacute and chronic grade I and II ankle inversion sprains.

2.6.3. Proprioception, Muscle Strengthening and Stretching

Mechanical instability of the talocrural joint, peroneal muscle weakness and motor in-coordination due to impaired proprioception, have been suggested as

possible causes of functional instability of the ankle following inversion sprains (Ryan, 1994).
In a critical review study by Ogilvie-Harris and Gilbart (1995) it was concluded that more studies are needed on muscle rehabilitation and restoration of proprioception. Jerosch and Bischof (1996) state that proprioception is one of the key issues for controlling joint motion and joint stability. They concluded in their study that a proprioceptive deficit was frequently evident after injuries of the ankle joint.

Baker and Todd (1995) state that a program of peroneal muscle tendon strengthening, Achilles tendon stretching and neuromuscular proprioceptive training should be initiated under the therapist's supervision.

Needham (2001:109) studied the effectiveness of ankle manipulation combined with static stretching of the gastrocnemius-soleus complex compared to manipulation alone in the treatment of subacute and chronic grade I and II ankle inversion sprains and did not find a statistically significant benefit of stretching.

Young (2005) advises that the treatment plan should aim to regain range of motion, strength and proprioception. He further elaborates by recommending isometric exercises to start strengthening which would then advance to the use of elastic bands or surgical tubing.

2.6.4. Deep Transverse Friction Massage

Deep transverse friction massage is indicated for chronic conditions of soft tissues (tendons, ligaments or muscles) arising from abnormal modelling of fibrous elements in response to fatigue stresses or accompanying resolution of an acute inflammatory disorder such as an ankle sprain (Hertling and Kessler, 1996).

In a study conducted by Dogan (2003) it was concluded that deep transverse friction massage was a reliable intervention in the treatment of chronic grade I and II inversion ankle sprain and in some aspects more effective than placebo.

2.6.5. Braces and Taping

Early application of a focal compression device is the paramount measure for preserving range of motion and strength. Other important measures include early mobilization, contrast baths, strength exercise, and on return to activity, prophylactic bracing (Garrick and Schelkun, 1997). Ankle bracing may or may not be recommended to protect patients from recurrent sprains after physical therapy (Kuwada, 1995). Baker and Todd (1995) recommend taping the ankle to provide effective support and decrease swelling. Kuwada (1995) suggests an appropriate ankle brace should be used for the athlete and patient, but they should be warned that this would not neutralize severe forces acting on the ankle joint during a serious accident. He further warns that despite sturdy ankle braces, ankle sprains can and do occur.

Young (2005) states that immobilization using ankle braces can both help and hinder healing. In an acute injury, it can protect the weakened, painful area, but prolonged immobilization leads to muscle atrophy and loss of motion.

In a critical review in which 150 articles were reviewed, it was found that early mobilization aided by the use of bandages or strapping seemed to provide the best results, by providing a faster recovery rate (Ogilvie-Harris and Gilbart, 1995).

2.6.6. Surgical Repair

When conservative measures have been exhausted and the patient is not satisfied with his/her condition, surgical correction is a reliable and viable treatment for the correction of painful, unstable ankles. It is suggested that serious consideration should be given to surgical correction by ankle stabilization depending on whether the patient is an athlete or if his/her job requires considerable foot and ankle stability (Kuwada, 1995).

Operative intervention is reserved for patients who have persistent symptoms despite at least 12 weeks of rehabilitation. Arthroscopic surgery has been suggested for patients with pain, swelling and decrease range of motion or crepitus without mechanical instability (Baker and Todd, 1995).

CHAPTER THREE

CHAPTER 3 – METHODOLOGY

3.1. INTRODUCTION

This chapter deals with the study methodology, which includes patient recruitment, sampling and group allocation, inclusion and exclusion criteria, patient procedure, treatment application, measurements and data analysis.

This study was designed as a prospective, comparative, randomised clinical trial which compared two groups of patients who suffered from chronic ankle inversion sprains. One group received manipulation while the other group received muscle energy technique. Data collected from the two groups was statistically analysed to determine which treatment protocol was more effective as well as to identify differences within a specific group.

3.2. SAMPLING PROCEDURE

3.2.1 Patient Recruitment

The selection of patients was by means of convenience sampling. Patients were selected from those who responded to advertisements (Appendix M) placed in local newspapers, sport clubs, shopping centres, gyms, pharmacies and notice boards around DIT campus, pamphlet distribution and word of mouth. The study was available to any person who could arrive for treatment at the Chiropractic Day Clinic at the Durban Institute of Technology presenting with chronic stable ankle inversion sprains (i.e. complaining of a history of ankle sprains and resulting residual ankle symptoms). No restrictions were placed on the patient's race, sex, occupation, or residential area. All patients were between the ages of 18-50 and were screened to make sure that they satisfied the criteria required in order to participate in this study.

3.2.2 Patient sampling, group allocation and treatment

Patients were screened initially to determine whether they could participate in the study thereafter a detailed case history (appendix A), a relevant physical examination (appendix B) and foot and ankle regional examination (appendix C) were completed.

The selected 40 patients were then randomly allocated into two groups by drawing the group code (1 or 2) which was written on a piece of paper, folded and placed in an envelope which was shaken to mix the pieces of paper.

Group 1 received manipulation of the ankle joint (appendix D) as described by Kirk et al. (1994). Group 2 received muscle energy technique (see appendix E) as described by Greenman (1989; 329 - 330)

Each group consisted of 20 patients. Other patients who responded to the advertisement and fitted the inclusion criteria replaced patients who dropped out to attain the 40 minimum patients needed.

3.2.3. Inclusion and Exclusion Criteria

3.2.3.1 Inclusion Criteria

1. Participants have to be between the ages of 18 and 50.
2. All patients have to read the patient information sheet (Appendix G) and give their informed consent (Appendix H) before participating in the study.
3. Each patient has to be diagnosed with chronic stable ankle inversion sprains on the basis of:
    I. Pain rating from 3-6 on the Numerical Pain Rating Scale
    II. Episodes of giving way
    III. Stiffness

If **2** of the **3** of the above symptoms were experienced, then it was taken that the patient had a chronic stable ankle inversion sprain.

4. On the initial consult the patient’s most recent sprain must have occurred at least 7 weeks prior to presentation.

3.2.3.2. Exclusion Criteria (adopted from Pellow and Brantingham 2001:13)

1. Presence of severe vascular disease, arthritis, fractures of the lower extremities.
2. Patients on anti-inflammatory or anti-coagulant medication.
3. If any contra-indications to adjusting the ankle were found.
4. A patient who required X-rays to rule out a suspected pathology or as indicated by the Ottawa Ankle Rules (Appendix F) (Stiell et al., 1994).
5. Gross mechanical instability (grade III ankle sprains) and syndesmosis injury was excluded from the study.
6. Any patient not prepared to sign the indemnity form from the Durban Institute of Technology (DIT) or the permission to be treated section of the appropriate paperwork.

3.2.4 Patient Procedure

Patients were given an information sheet outlining the research purpose (see appendix G). Each patient signed an informed consent form (see appendix H) to indemnify the DIT and the clinic from any matter, which may have arisen from the research.

Each patients history was taken and a relevant general physical examination was performed and the inclusion and exclusion criteria, mentioned above, were then used to determine whether the patients could participate in the study

Patients accepted into the study in terms of exclusion and inclusion criteria were required to complete the following subjective and objective data questionnaires and measurements:

Subjective Information

1. The Numerical Pain Rating Scale 101 (NRS 101) (Appendix I) which has been found to be a practical, reliable and statistically sensitive scale to assess chronic pain in patients (Jensen et al., 1987).
2. The Short-form McGill Pain Questionnaire (Appendix J) that has been shown to be sufficiently sensitive to demonstrate differences due to treatment at statistical levels (Melzack, 1987).
3. The Functional Evaluation Scale that was developed by Kaikkonen et al., (1994) (Appendix K). This scale has been found to demonstrate excellent reproducibility and can significantly differentiate between healthy controls and symptomatic patients in terms of subjective, objective and functional evaluation in ankle injuries.

Objective Information

1. The digital inclinometer that has been shown to be valid and reliable in assessing range of motion (Johnson et al., 1999) was used to determine changes in pain-free range of motion.
2. A 30 second stork standing test was used to determine if there was an improvement of proprioception, in the affected ankle. The patient was asked to stand on the floor on the affected leg for 30 seconds with the contralateral foot raised off the floor. The task was conducted with eyes opened and then with the eyes closed. Patients were timed to determine how long they could keep their balance (Forkin et al., 1996).

The procedure was repeated before the initial treatment, at the fourth consultation, and at the follow-up consultation (Appendix L).

3.3. SOLVING THE SUB-PROBLEMS AND HYPOTHESES

The purpose of this study was to determine the effectiveness of Muscle Energy Technique compared to manipulation of the ankle mortise joint in the treatment of chronic stable ankle inversion sprains.

3.3.1 The first Sub-problem

The first sub-problem was to compare the relative effectiveness of Muscle Energy Technique to Manipulation in the treatment on chronic stable ankle inversion sprains in terms of subjective clinical findings.

3.3.2 The second Sub-problem

The second sub-problem was to compare the relative effectiveness of Muscle Energy Technique to Manipulation in the treatment of chronic stable ankle inversion sprains in terms of objective clinical findings.

3.4. Statistical Analysis

To determine the manner in which the data should be statistically analysed, a statistician was consulted. The sample size of the research group was 40 (20 per group). Statistical analysis for both objective and subjective data was performed using a 5 % level of significance.

Data was captured in MS Excel and exported into SPSS version 11.5 (SPSS Inc, Chicago, III, USA). Demographic data and baseline outcome measures were compared between the two groups using chi square tests and independent t-tests where appropriate. Repeated ANOVA was used to analyse the treatment difference between the two groups.

Pearson's correlation was done on the change between baseline and final measurement to assess whether any relationships between changes in outcome measures could be found.

CHAPTER FOUR

CHAPTER FOUR

4.1 STATISTICAL METHODOLOGY

SPSS version 11.5 was used for the analysis of data (SPSS Inc, Chicago, Ill, USA). Demographics and baseline outcome measures were compared between the two treatment groups using chi square tests and independent t-tests where appropriate. Repeated measures ANOVA was used to analyse the treatment difference between the two groups. Repeated contrasts were used to compare the groups at each time point. Pearson's correlations were done on the change between baseline and final measurement to assess whether any relationships between changes in outcome measurements could be found. A p value of <0.05 was classified as statistically significant.

4.1.2. Results

Sample characteristics

The sample consisted of 40 participants with chronic stable ankle inversion sprains. The mean age of the group was 29.4 years (SD 9.02 years) with a range between 18 and 50 years. There were 19 males (47.5%) and 21 females (52.5%). The population group consisted mainly of Indians (70%, n=28), followed by 27.5% Blacks (n=11) and 2.5 % White (n=1).

Comparison of demographic and baseline characteristics by treatment group.

Participants were randomized into 2 equal treatment groups (n=20 each). There was no significant difference between the groups in terms of gender (Table 1, p=0.205), population group (Table 2, p =0.375) or age (Table 3, p=0.469).

Table 1: Comparison of gender proportions between the treatment groups (n=40)

			GROUP		Total
			manipulation	muscle	
SEX	male	Count	12	7	19
		% within GROUP	60.0%	35.0%	47.5%
	female	Count	8	13	21
		% within GROUP	40.0%	65.0%	52.5%
Total		Count	20	20	40
		% within GROUP	100.0%	100.0%	100.0%

Table 2: Comparison of racial proportions between the treatment groups (n=40)

			GROUP		Total
			manipulation	muscle	
RACE	White	Count	0	1	1
		% within GROUP	.0%	5.0%	2.5%
	Black	Count	7	4	11
		% within GROUP	35.0%	20.0%	27.5%
	Indian	Count	13	15	28
		% within GROUP	65.0%	75.0%	70.0%
Total		Count	20	20	40
		% within GROUP	100.0%	100.0%	100.0%

Table 3: Comparison of mean age between the treatment groups (n=40)

	GROUP	N	Mean	Std. Deviation	Std. Error Mean	P value
AGE	manipulation	20	30.45	10.262	2.295	0.469
	muscle	20	28.35	7.721	1.726	

Chronicity was similar between the groups (p=0.840, Table 4), as was the reason for their injury (Table 5, p=0.527).

Table 4: Comparison of chronicity proportions between the treatment groups (n=40)

			GROUP		Total
			manipulation	muscle	
CHRONIC	7wks - 6 months	Count	4	4	8
		% within GROUP	20.0%	20.0%	20.0%
	6 months - 1 yr	Count	1	2	3
		% within GROUP	5.0%	10.0%	7.5%
	1 yr - 5 yrs	Count	8	10	18
		% within GROUP	40.0%	50.0%	45.0%
	6-9 yrs	Count	4	2	6
		% within GROUP	20.0%	10.0%	15.0%
	>=10 yrs	Count	3	2	5
		% within GROUP	15.0%	10.0%	12.5%
Total		Count	20	20	40
		% within GROUP	100.0%	100.0%	100.0%

Table 5: Comparison of sport and non-sport proportions between the treatment groups (n=40)

			GROUP		Total
			manipulation	Muscle	
Injury due to	sport	Count	12	9	21
		% within GROUP	60.0%	45.0%	52.5%
	non sport	Count	8	11	19
		% within GROUP	40.0%	55.0%	47.5%
Total		Count	20	20	40
		% within GROUP	100.0%	100.0%	100.0%

4.2 DISCUSSION OF DEMOGRAPHIC DATA

Table 3 presents the average age of participants in each group. It demonstrates that the average age distribution was uniform in each group. In group one (Manipulation), the mean age was 30.45 as compared to group two (Muscle Energy Technique) which was 28.35 years old. Although the age range was 18-50 the average age was low. This could have been as a result of the majority of patient recruitment occurring within the framework of a tertiary education setting predisposing to a slightly higher participation of students in the study.

Gender distribution (**Table 2**) was comparatively equal; 52.5% of patients being female and the remaining 47.5% being males. This pattern of gender distribution correlates exactly to that found in Dogan's study (2003: 76). This is however, in contrast to Needham (2001:77) and Coetzer's (1999:70) studies, which had double the number of male to female patients.

Racial proportion showed that 70% of patients were Indian, 27.5% were Black and 25% were White. This is largely due to the fact that the study was conducted in a largely Indian community.

Chronicity proportions (**Table 4**) were similar between the groups. 20% of patients in group 1 and group 2 complained of the initial ankle sprain having occurred between the 7-week and 6-month duration. 5% in group 1 and 10% in group 2 being in the 1- 5 year duration, 20% in group 1 and 10% in group 2 being between the 6 - 9 year duration and 15% in group 1 and 10% in group 2 being longer than a 10 year duration.

Sport and non-sport proportion (**Table 5**) showed that 52.5% attributed the initial ankle sprain to a sporting injury while the remaining 47.5% attributed their ankle sprain to a non-sporting injury.

Table 6: Comparison of mean baseline outcome variables between the treatment groups (n=40)

	GROUP	N	Mean	Std. Deviation	Std. Error Mean	P value
NRS	manipulation	20	41.63	11.706	2.617	0.391
	muscle	20	45.00	12.876	2.879	
MCGILL score	manipulation	20	6.50	4.274	.956	0.104
	muscle	20	9.85	7.916	1.770	
FES score	manipulation	20	68.25	14.075	3.147	0.306
	muscle	20	63.25	16.325	3.650	
PLANTAR	manipulation	20	31.75	9.618	2.151	0.132
	muscle	20	27.80	6.279	1.404	
DORSI	manipulation	20	25.65	8.197	1.833	0.916
	muscle	20	25.35	9.604	2.148	
OPEN	manipulation	20	22.65	9.455	2.114	0.494
	muscle	20	20.55	9.790	2.189	
CLOSED	manipulation	20	8.90	5.767	1.289	0.231
	muscle	20	6.75	5.389	1.205	

Baseline outcome variables were not significantly different between the groups (**Table 6**). Thus the two groups were similar at baseline and the randomization process was complete. This means that any differences between groups after treatment are due to the treatment itself.

4.3 EVALUATION OF THE TREATMENT EFFECT

4.3.1. Numerical Pain Rating Scale (NRS)

NRS showed a significant decrease over time in both groups (p<0.001). There was no overall time*group interaction (p=0.133), however, the interaction was significant between time 2 and 3 (p=0.044). **Figure 1** shows that between time 2 and 3 the muscle energy group showed the steeper rate of descent.

Table 7: Within and between subject's contrasts for NRS

Effect	Statistic	p value
Time	Wilk's lambda=0.085	<0.001
Time*group (overall)	Wilk's lambda=0.897	0.133
Time*group (1 vs. 2)		0.232
Time*group (2 vs. 3)		0.044
Group	F=1.512	0.226

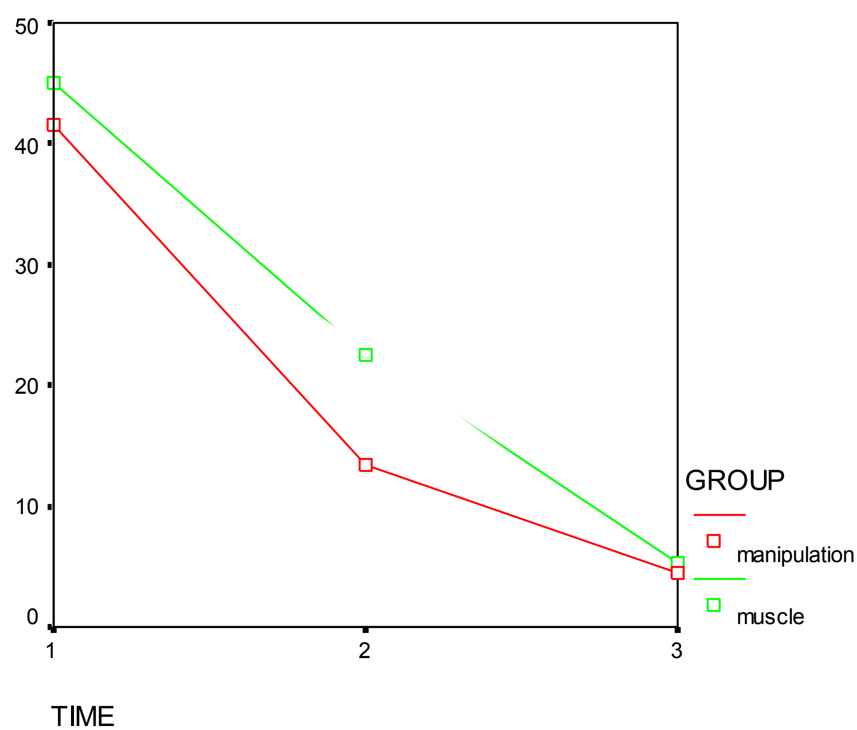


Figure 1: Profile plot of mean NRS over time by group

The statistically analysed data obtained from the NRS is found in **Table 7** and **Figure 1**.

The results showed a statistically significant improvement within each group between the initial, fourth and follow-up consultation. This suggests that each score of the NRS has decreased and indicates a decrease in pain as perceived by the patient and therefore an improvement in the condition of the ankle.

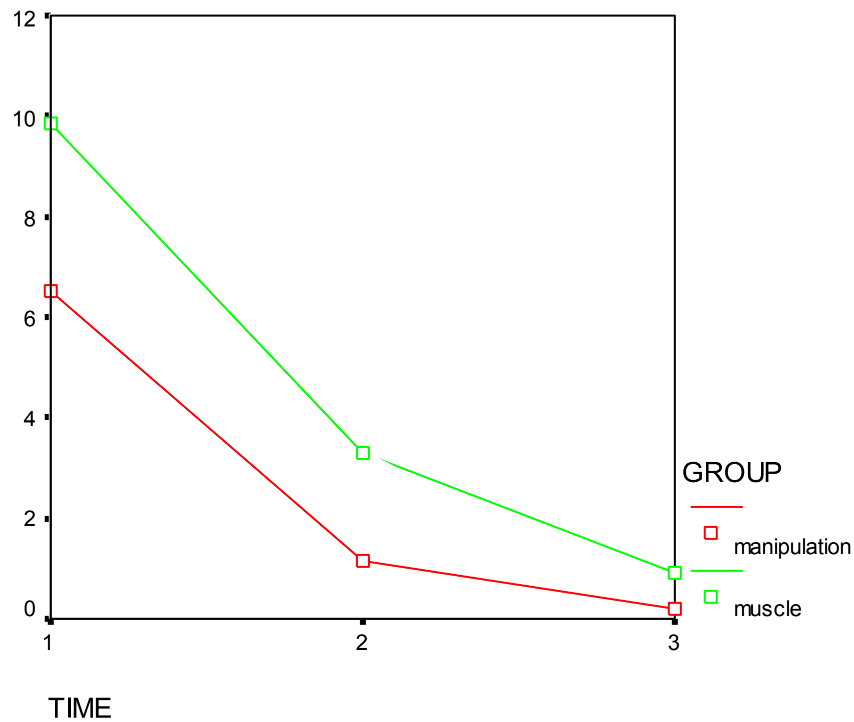
Between time periods 2 and time periods 3, however, the MET group showed a steeper descent. This indicates a faster decrease of pain in group 2 compared to group 1 between the fourth and follow-up consultation.

4.3.2. McGill Pain Questionnaire Score

Both groups showed a significant decrease in McGill pain score over time ($p<0.001$). Repeated contrasts showed no significant interaction at any time point, however, the interaction approached statistical significance between time periods 2 and 3, where **Figure 2** shows that the rate of descent was slightly steeper in the muscle energy group than the manipulation group.

Table 8: Within and between subject's contrasts for McGill Pain score

Effect	**Statistic**	**p value**
Time	Wilk's lambda=0.352	<0.001
Time*group (overall)	Wilk's lambda=0.910	0.174
Time*group (1 vs. 2)		0.498
Time*group (2 vs. 3)		0.096
Group	F=3.299	0.077



<u>Figure 2: Profile plot of mean McGill score over time by group</u>

The statistically analysed data for the Short-form McGill Pain Questionnaire is found in **Table 8** and **Figure 2**.

Both groups showed a statistically significant improvement between the initial, fourth and follow-up consultations. This suggests that each score on the Short-form McGill Questionnaire has decreased and indicates a decrease in pain perception and therefore an improvement in the condition of the ankle treated.

Between time periods 2 and periods 3, however, (**figure 2**), there is a slightly steeper descent in the MET group than the manipulation group. This indicates a slightly more rapid decrease in pain as perceived by the patients in the MET group.

4.3.3. Functional Evaluation Scale score (FES)

Both groups showed an increase in FES score over time ($p<0.001$). There was no treatment effect overall or at any time points. **Figure 3** shows that the profiles of the two groups were parallel over time.

Table 9: Within and between subject's contrasts for FES score

Effect	**Statistic**	**p value**
Time	Wilk's lambda=0.159	<0.001
Time*group (overall)	Wilk's lambda=0.987	0.790
Time*group (1 vs. 2)		0.742
Time*group (2 vs. 3)		0.616
Group	F=2.220	0.144

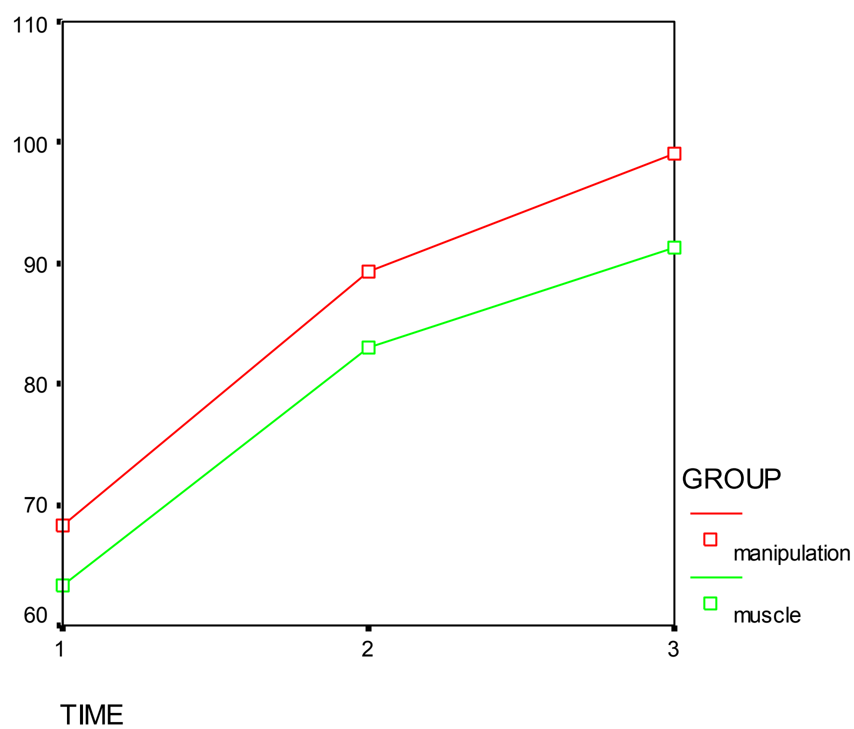


Figure 3: Profile plot of mean FES score over time by group

The statistically analysed data for the Functional Evaluation Scale is found **Table 9** and **Figure 3**.

Both group 1 and group 2 showed an increase in FES scores over time. There was no statistically significant difference in either group. This indicates that there was an improvement in the condition of the ankle being treated as perceived by the patients in both groups.

4.3.4. Dual Inclinometer Readings

Plantarflexion

There was a statistically significant increase in plantarflexion in both groups over time ($p<0.001$). There was no evidence of a different treatment effect in the two groups, since the time by group interactions overall and in the repeated contrasts were not significant. **Figure 4** also shows parallel profiles over time in both groups.

Table 10: Within and between subject's contrasts for Plantarflexion

Effect	Statistic	p value
Time	Wilk's lambda=0.415	<0.001
Time*group (overall)	Wilk's lambda=0.966	0.357
Time*group (1 vs. 2)		0.716
Time*group (2 vs. 3)		0.616
Group	F=1.106	0.300

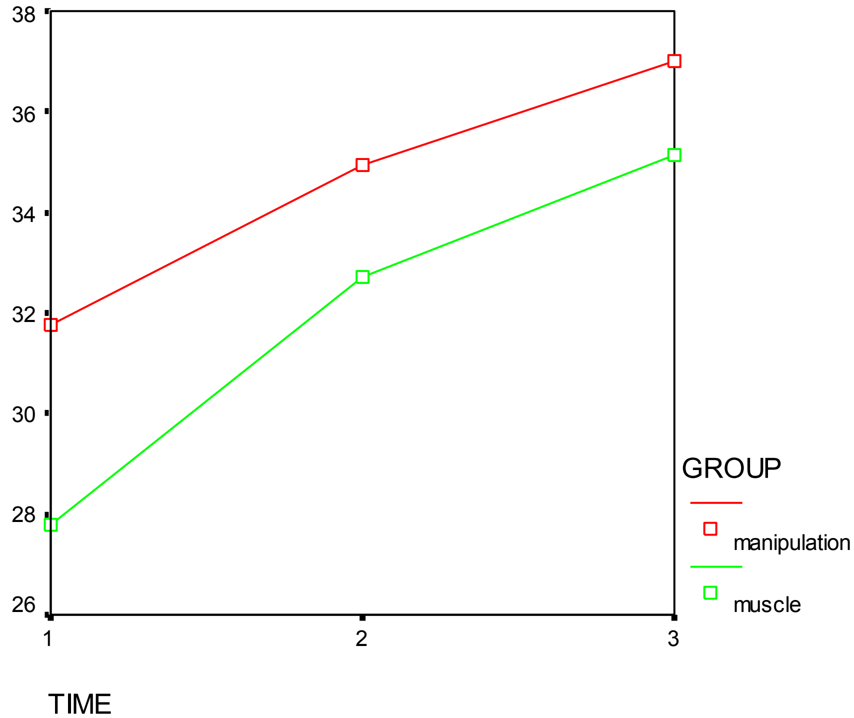


Figure 4: Profile plot of mean plantarflexion over time by group

Dorsiflexion

Table 11 shows that there was a significant time effect in both groups (p<0.001). There was no evidence of an interaction or treatment effect overall or at any of the time points. However, **Figure 4** shows that the profiles of the two groups crossed over between time 1 and 2, with the muscle energy group showing a steeper increase than the manipulation group. The interaction was however not statistically significant (p=0.256).

Table 11: Within and between subject's contrasts for Dorsiflexion

Effect	**Statistic**	**p value**
Time	Wilk's lambda=0.304	<0.001
Time*group (overall)	Wilk's lambda=0.965	0.522
Time*group (1 vs. 2)		0.256
Time*group (2 vs. 3)		0.889
Group	F=0.137	0.713

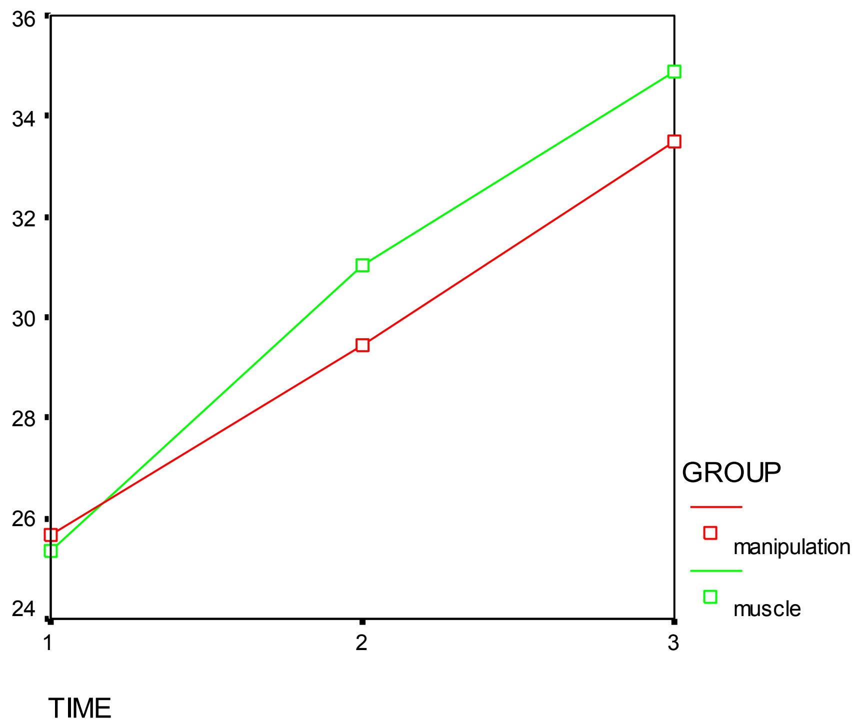


Figure 5: Profile plot of mean dorsiflexion over time by group

The statistically analysed data for the dual inclinometer is found in **Tables 10 and 11** and **Figures 4 and 5**.

There was a statistically significant increase in plantarflexion in both groups over time. There was no difference in treatment effect in either group 1 or group 2. This indicates an increase in plantarflexion range of motion in both groups.

The results also indicate a statistically significant increase in dorsiflexion in both groups. There was a crossover between time 1 and time 2 with the MET group improving more rapidly than the manipulation group but this was not statistically significant.

4.3.5. The Modified Rhomberg Test

Proprioception-eyes open

Both groups improved significantly over time (p<0.001). There was no difference between the two groups over time overall (p=0.743) or at any time point. Thus both groups improved to the same extent with regard to this outcome. This is confirmed in **Figure 6**, where parallel profiles of both groups are shown.

Table 12: Within and between subject's contrasts for open

Effect	Statistic	p value
Time	Wilk's lambda=0.561	<0.001
Time*group (overall)	Wilk's lambda=0.984	0.743
Time*group (1 vs. 2)		0.949
Time*group (2 vs. 3)		0.439
Group	F=0.686	0.413

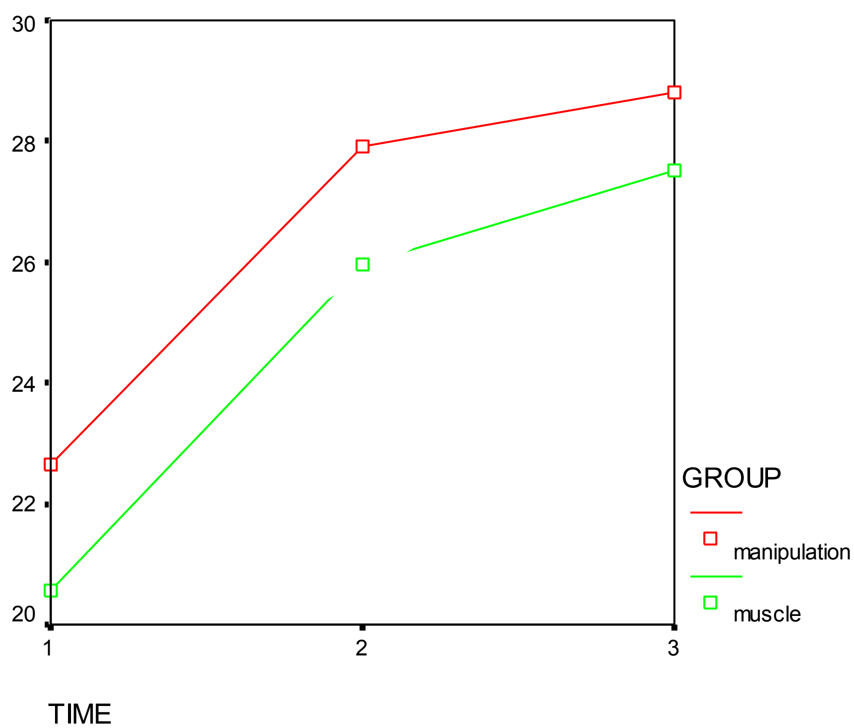


Figure 6: Profile plot of mean proprioception –open eyes over time by group

Proporioception – eyes closed

Although both groups showed a significant increase over time ($p<0.001$), there was no difference in the rate of change over time between the groups. Thus there was no evidence of a treatment effect for this outcome. **Figure 7** shows that the two groups have parallel profiles over time.

Table 13: Within and between subject's contrasts for closed

Effect	Statistic	p value
Time	Wilk's lambda=0.263	<0.001
Time*group (overall)	Wilk's lambda=0.966	0.934
Time*group (1 vs. 2)		0.932
Time*group (2 vs. 3)		0.711
Group	F=0.917	0.344

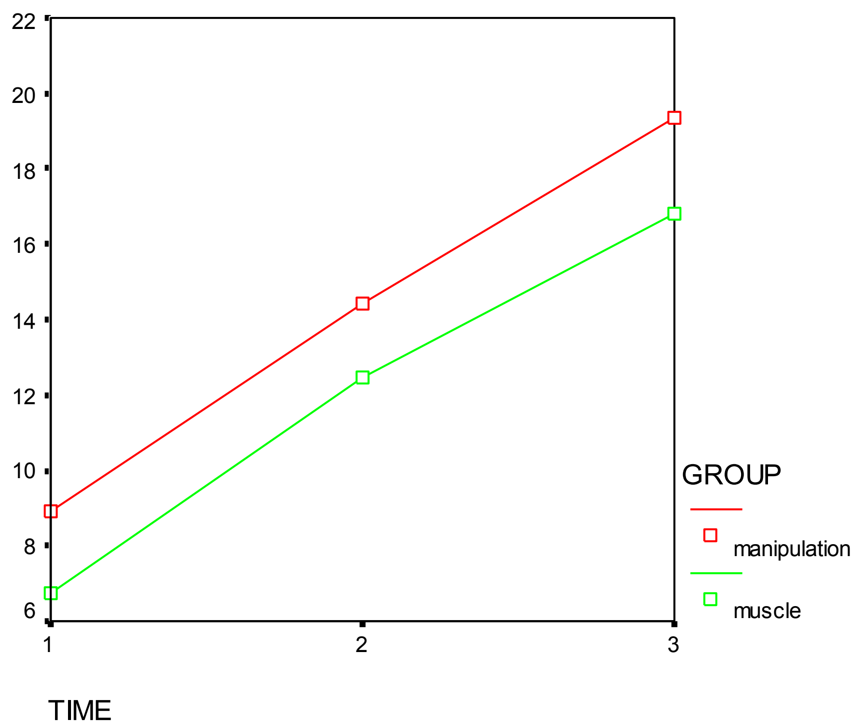


Figure 7: Profile plot of mean proprioception –closed eyes over time by group

The statistically analysed data for the Modified Rhomberg's test is found in **Tables 12 and 13** and **Figures 6 and 7**.

Both groups showed a statistically significant improvement in the readings taken at the first, fourth and follow-up consultation. The readings increased in both groups when the test was performed with eyes open and then with eyes closed on the affected ankle. This indicates that there was a continuous improvement of balance on the affected ankle both in group 1 and group 2.

4.3.6. Correlations between treatment outcomes

Pearson's correlation analysis was done to examine relationships between the changes over time in all the outcomes measured. **Table 14** shows the correlation coefficients and p values. This was done both groups combined (n=40) since there were no significant differences in the changes over time between the groups.

Table 14 shows that as NRS decreased, so did McGill pain score (r=0.582, p<0.001). As NRS decreased, FES score increased (r=-0.581, p<0.001), and proprioception –eyes open also significantly increased (r=-0.510, p=0.001). As McGill pain score decreased, FES increased (r=-0.392, p=0.012), and proporioception with eyes open also increased (r=-0.507, p = 0.001). FES score and proprioception with eyes open were positively correlated (r=0.514, p=0.001). Plantarflexion was not correlated significantly with any other outcome. Dorsiflexion was significantly positively correlated with proprioception with closed eyes (r=0.453, p=0.003).

Table 14: Pearson's correlation between changes in outcome variables over 3 time points

		Change in NRS	Change in McGill	Change in FES	Change in plantaflexion	Change in dorsiflexion	Change in open	Change in closed
Change in NRS	Pearson Correlation	1	.582(**)	-.581(**)	-.225	-.195	-.510(**)	-.102
	Sig. (2-tailed)	.	.000	.000	.164	.228	.001	.532
	N	40	40	40	40	40	40	40
Change in McGill	Pearson Correlation	.582(**)	1	-.392(*)	-.213	-.023	-.507(**)	.156
	Sig. (2-tailed)	.000	.	.012	.187	.887	.001	.338
	N	40	40	40	40	40	40	40
Change in FES	Pearson Correlation	-.581(**)	-.392(*)	1	.311	.176	.514(**)	.051
	Sig. (2-tailed)	.000	.012	.	.050	.278	.001	.755
	N	40	40	40	40	40	40	40
Change in plantarflexion	Pearson Correlation	-.225	-.213	.311	1	-.154	.105	-.070
	Sig. (2-tailed)	.164	.187	.050	.	.343	.518	.666
	N	40	40	40	40	40	40	40
Change in dorsiflexion	Pearson Correlation	-.195	-.023	.176	-.154	1	.041	.453(**)
	Sig. (2-tailed)	.228	.887	.278	.343	.	.802	.003
	N	40	40	40	40	40	40	40
Change in Proprioception – open eyes	Pearson Correlation	-.510(**)	-.507(**)	.514(**)	.105	.041	1	-.101
	Sig. (2-tailed)	.001	.001	.001	.518	.802	.	.534
	N	40	40	40	40	40	40	40
Change in Proprioception – closed eyes	Pearson Correlation	-.102	.156	.051	-.070	.453(**)	-.101	1
	Sig. (2-tailed)	.532	.338	.755	.666	.003	.534	.
	N	40	40	40	40	40	40	40

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

4.3.7. Summary

Thus there was minimal evidence for a treatment effect of the muscle energy technique over and above manipulation. Both techniques worked well and showed statistically significant improvement of all outcomes over the three time points (three weeks). For NRS there was a statistically significant treatment benefit of the muscle energy technique over and above manipulation, but this was only evident between time 2 and 3, and overall the benefit was not significant. Non-significant suggestions of a beneficial effect of the muscle energy treatment were seen with the McGill pain score between time 2 and 3, and with dorsiflexion between time 1 and 2.

Treatment with either of these techniques caused a decrease in NRS scores that corresponded with a decrease in McGill pain scores and an increase in FES scores, and an increase in proprioception with eyes open. Those patients who experienced an increase in dorsiflexion also experienced an increase in proprioception with closed eyes.

A larger trial comparing these two techniques is warranted to further confirm the suggested trends observed in this study. However, the data from this study suggests that treatment with either of these techniques is equally beneficial to the patient.

CHAPTER FIVE

CHAPTER 5

5.1. CONCLUSION

The results of my study showed that Muscle Energy Technique is as effective as Manipulation (an already researched treatment tool) in the treatment of chronic stable ankle inversion sprains with regards to increasing range of motion and proprioception.

Hertling and Kessler (1996:424) state that with recurrent ankle sprains there can be a loss of protective reflex muscle stabilization. Stress to a joint capsule or to a joint ligament results in firing of specific receptors in the structure, through the reflex arc, to produce contraction of the muscles overlying the stressed structure. Dorsiflexion range of motion can potentially be limited by tightness in the muscles that plantarflex the ankle, particularly the gastrocnemius-soleus complex, capsular and soft tissue restrictions, loss of normal posterior glide of talus in the mortise and loss of other accessory motions at the tibiofibular, subtalar and midtarsal joints (Denegar et al., 2002). Neuromuscular deficits may be manifested as impaired balance, reduced joint position sense, slower firing of the peroneal muscles to inversion perturbation of the ankle, slowed nerve conduction velocity, impaired cutaneous sensation, strength deficits and decreased dorsiflexion range of motion (Hertel, 2000).

Reciprocal inhibition (The form of Muscle Energy Technique used in this study), involves the physiological response of the antagonists of a muscle that has been isometrically contracted. When a muscle is isometrically contracted, its antagonist will be inhibited and will relax immediately following this. Thus the antagonist of a shortened muscle or group of muscles may be isometrically contracted, in order to achieve a degree of ease and additional movement in the shortened tissues (Chaitow 1996:3). Therefore Muscle Enegy Technique had satisfied the **first hypothesis** by improving plantarflexion and dorsiflexion range of motion, proprioception (objective measures) and decreasing pain perception (a subjective measure).

The **second hypothesis** however, cannot be accepted as Manipulation was found to be as effective as Muscle Energy technique in terms of objective findings. Also with regards to the **second hypothesis**, Muscle Energy

Technique was found to be more effective than Manipulation in decreasing pain as perceived by the patient. Pain perception improved more rapidly in the MET group between the fourth and follow-up consultation. The improvement in pain perception corresponded to an increase in Functional Evaluation Scale scores. This implies that a decrease in pain perception resulted in an improvement of functioning of the ankle as perceived by the patient.

In addition to a decrease in pain perception, patients in both groups experienced a statistically significant increase in dorsiflexion which resulted in an increase in proprioception with eyes-closed.

A study conducted by Pellow and Brantingham (2001) showed significant reduction in pain, improved ankle range of motion and ankle function with adjusting of the ankle in subacute and chronic grade I and II ankle inversion sprains. Therefore manipulation has been established as a successful treatment for chronic ankle sprains.

According to the results of this study, Muscle Energy Technique is an effective adjunct to Manipulation in the treatment of chronic stable ankle inversion sprains. The researcher recommends it as an effective tool that can be added to the list of possible treatment protocols utilised by chiropractors.

5.2. LIMITATIONS OF THIS STUDY AND RECOMMENDATIONS

a) Subjective Measurements

The subjective questionnaires were limited by the patients understanding of how to complete them. A few patients had difficulty with understanding words used to describe types of pain in the McGill questionnaire. This could have led to those patients under- or over scoring on the questionnaire.

With subjective measurements, there is potential for patient bias to please the researcher.

Recommendation

The researcher should clearly explain to the patient how to complete the questionnaires. It should also be stressed that patients should not fill in the questionnaire to please the researcher.

b) Objective Measurements

Objective measurements in the form of inclinometer for range of motion and the Modified Rhomberg test for proprioception may have been subject to observer error and bias.

The inclinometer was placed in reference to the same anatomical structure, but inaccuracies (such as placement of the instrument) can occur due to human error.

Recommendation

In future studies, objective data should be randomly checked by an independent observer to make certain that the readings are accurate.

c) Demographics

The ethnic distribution in this study did not represent the South African population.

Even though the study only accepted chronic stable ankle inversion sprains, there was a big difference in terms of chronicity.

Recommendation

Further studies should attempt to achieve a better representation of the South African population. This should also include prevalence and incidence studies.

Studies should have a minimum and maximum time for chronicity.

<u>d) Other</u>

Due to interruption by public and institutional holidays, as well as poor patient compliance due to the length of the study, treatments were not uniformly spaced.

Recommendation: The study should be planned better to avoid any holidays, with fewer treatments and a larger sample group to ensure more compliance by patients.

It was found that many patients had an aggravation of pain due to prolonged standing or walking long distances.

Recommendation: Patients need to be educated on protection of the ankle and the limitation of prolonged walking or standing during the course of the study.

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APPENDIX A

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 Summary signed off:		Date:

Imterm'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 B

Durban Institute of Technology

PHYSICAL EXAMINATION: SENIOR

Patient Name : ______________________________ **File no :** __________ **Date :** __________

Student : **Signature :**

VITALS:

Pulse rate:			Respiratory rate:		
Blood pressure:	R	L	Medication if hypertensive:		
Temperature:			Height:		
Weight:	Any recent change? Y / N		If Yes: How much gain/loss	Over what period	

GENERAL EXAMINATION:

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

SYSTEM SPECIFIC EXAMINATION:

CARDIOVASCULAR EXAMINATION

RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION

NEUROLOGICAL EXAMINATION

COMMENTS

NEUROLOGICAL EXAMINATION: See Regionals

Clinician: **Signature :**

APPENDIX C

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: *L→A 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			Toe extension (dorsiflexion)		
Dorsiflexion			Toe flexion (plantar flexion)		
Supination (inversion)					

Neurological

	R	L
Dermatomes		
Myotomes		
Reflexes		
Balance/proprioception		

Special tests

	R	L
Anterior drawer 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

	R	L
Calcaneus, Achilles tendon, Musculotendinous junction		

Plantarily

	R	L
Plantar muscles and fascia		
Sesamoids		

APPENDIX D

Manipulation

Group 1 will receive a manipulation in the form of a mortise separation as described by Kirk et al. (1994) which is indicated to mobilize the tibiotalar joint.

1. Manipulation is performed with the patient lying in the supine position
2. Doctor kneels at the foot of the table; he/she grasps the medial or lateral border of the foot with either hand so that the thumb is positioned on the sole of the foot and the fingers on the dorsum.
3. The other hand then grasps the opposite border of the foot in the same manner.
4. The ankle is then dorsiflexed, the entire leg is internally rotated and the foot is everted before thrusting straight towards the doctor, with a line of drive parallel to the floor.
5. Eversion of the foot is to ensure protection of the lateral ligaments.

APPENDIX E

Muscle Energy Technique

(Greenman, 1989:329-330)

1. Patient sitting on the table with both legs dangling freely.
2. Operator sits in front of the dysfunctional talus.
3. Operator puts lateral hand under the plantar surface of the forefoot.
4. Operator crosses lower legs underneath patient's forefoot.
5. The web of the operator's medial hand is placed overlying the neck of the talus.
6. Dorsiflexion to the barrier is taken, with combined action of a caudad posterior force on the talar neck and a dorsiflexion movement of the sole of the foot.
7. Patient is instructed to plantarflex the forefoot against equal and opposite resistance.
8. 5 repititions are accomplished against progressive dorsiflexion barrier and held for 7-10 seconds.

Ottawa ankle and foot rules

for Ankle Injury Radiography

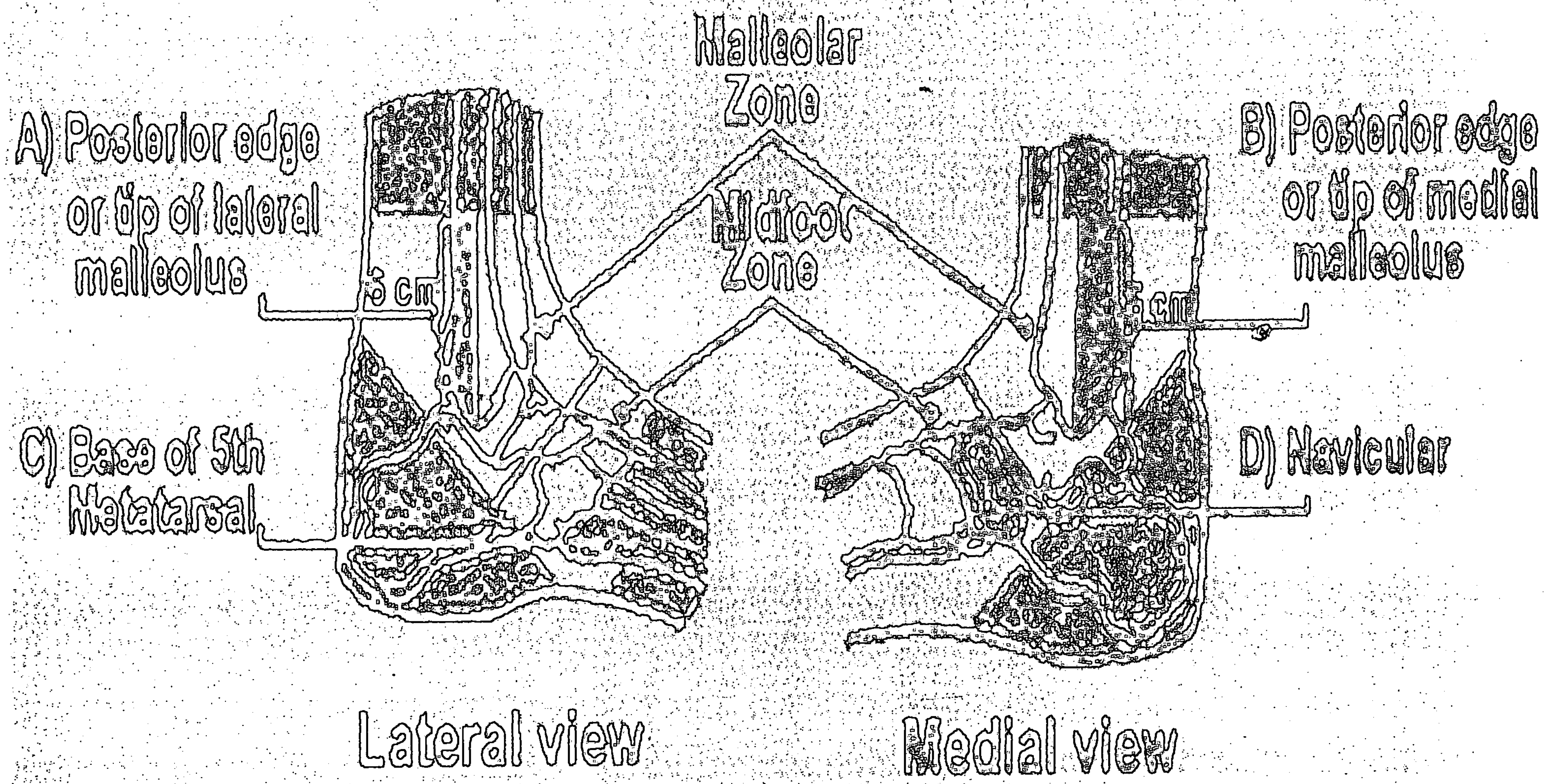
1. An ankle x-ray series is only required if there is any pain in malleolar zone and any of these findings:

   A) Bone tenderness at the posterior edge or tip of lateral malleolus
   or
   B) Bone tenderness at posterior edge or tip of medial malleolus
   or
   C) Inability to bear weight both immediately and in the emergency department

2. A foot x-ray series is only required if there is any pain in midfoot zone and any of these findings:

   A) Bone tenderness at the base of the 5th metatarsal
   or
   B) Bone tenderness at the navicular
   or
   C) Inability to bear weight both immediately and in the emergency department

Stiell IG, McKnight RD, Greenberg GH, et al. Implementation of the Ottawa Ankle Rules. *JAMA* 1994;271:827-32.


Malleolar Zone
Midfoot Zone
A) Posterior edge or tip of lateral malleolus
B) Posterior edge or tip of medial malleolus
6 cm
6 cm
C) Base of 5th Metatarsal
D) Navicular
Lateral view
Medial view

APPENDIX G

DURBAN
INSTITUTE of
TECHNOLOGY

Patient Information Sheet

Dear Patient

Welcome to my study at the Chiropractic Day Clinic at the Durban Institute of Technology.

Supervisor: Dr. N. de Busser (031) 2042244
Research Student: Lynette Joseph (031) 4094938 / 0827538365

Title of my research
The relative effectiveness of Muscle Energy Technique compared to Manipulation in the treatment of chronic stable ankle inversion sprains.

Procedure:
The research will require sixty patients provided that they fall within the prescribed inclusion criteria. This means that you would have attend a screening visit in which you would be assessed for your suitability for participation in the research (a full case history will be taken followed by a physical examination and foot and ankle regional will be performed). If you are found to fit the criteria, you will be randomly allocated into one of two groups by drawing a number from a hat. This means that you will have an equal chance of being either in the control group or in the experimental group. Thirty participants will receive manipulation of the ankle while the other thirty will receive Muscle Energy Technique (active mobilisation).

You will need to return for a maximum of 6 treatments over a three week period. You will be asked to fill a questionnaire regarding your complaint and specific measurements will be taken regarding pain and ankle movement at the first (screening visit), fourth and final visit.

Exclusion or withdrawal from the study without your consent will occur if you:
- Take any anti-inflammatory or anti-coagulant medication.
- Receive any other treatment to the ankle.
- If you sprain your ankle during the study.
- If you do not agree to sign the informed consent form.

Benefits:
All the treatments will be performed under the supervision of a qualified chiropractor and will be free of charge. All your details and results will be dealt with strict confidentiality. Your participation in this study is voluntary and you may withdraw at any time.

Risks:
The use of Muscle Energy Technique and Manipulation may produce some discomfort, but does not cause any harm. In the case of MET, the applied pressure can be modified to patient tolerance, but some discomfort may be necessary to release tough scar tissue and restrictions.

Contact Details:
If you wish to discuss any problems or questions related to the research, please be free to contact me (Lynette Joseph) on (031) 2042205 / 2042512 at the Chiropractic Day Clinic.

Thank you for participating in the study.

Yours faithfully

________________________ ____________________

Lynette Joseph (Chiropractic Intern / Researcher)	Dr. N de Busser (Supervisor)

APPENDIX H

INFORMED CONSENT FORM

Date: ____________

To be completed in duplicate by patient

TITLE OF RESEARCH
The effectiveness of Muscle Energy Technique compared to Manipulation in the treatment of chronic stable ankle inversion sprains.

NAME OF RESEARCH STUDENT
Lynette Joseph

NAME OF SUPERVISOR
Dr. Nicky de Busser

PLEASE CIRCLE THE APPROPRIATE ANSWER

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

Please do not sign unless all your questions have been adequately answered by the researcher.

Fill in below in block letters

PATIENT/SUBJECT Name: ________________ Signature: ____________

WITNESS Name: ________________ Signature: ____________

RESEARCH STUDENT Name: ________________ Signature: ____________

APPENDIX I

Numerical Rating Scale - 101 Questionnaire

Date:____________ **File no:**____________ **Visit no:**_________

Patient name: ____

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

Please write only **one** number.

0 ____ 100

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

Please write only **one** number.

0 ____ 100

APPENDIX J

Short-form McGill Pain Questionnaire (SF-MPQ)

Ronald Melzack (1984)

Date:______________ File no.:________________ Visit no:____

Patient name:____

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

APPENDIX K

SCORING SCALE FOR SUBJECTIVE AND OBJECTIVE FUNCTIONAL FOLLOW-UP EVALUATION AFTER ANKLE INJURY

I	Subjective assessment of the injured ankle*		VI	Rising on toes with injured leg	
	No symptoms of any kind	15		More than 40 times	10
	Mild symptoms	10		30-39 times	5
	Moderate symptoms	5		Fewer than 30 times	0
	Severe Symptoms	0			
II	Can you walk normally?		VII	Single limb stance with injured leg***	
	Yes	15		Longer than 55 seconds	10
	No	0		50-55 seconds	5
				Less than 5 seconds	0
III	Can you walk normally?		VIII	Laxity of the ankle joint (ADS)	
	Yes	10		Stable (<5mm)	10
	No	0		Moderate (6-10mm)	5
				Severe instability (>10mm)	0
IV	Climbing Down Stairs**				
	Less than 18 seconds	10			
	18-20 seconds	5			
	Longer than 20 seconds	0		Dorsiflexion range of motion of injured leg	
				≥10	10
V	Rising on heel with injured leg			5-9	5
	More than 40 times	10		<5	0
	30-39 times	5			
	Fewer than 30 times	0			

Total: Excellent, 85-100; good, 70-80; fair, 55-65; poor, <50

*Pain, swelling, tenderness, or giving away during activity (mild, only if one of these symptoms are present; moderate, 2-3 of these symptoms are present; severe, 4 or more of these symptoms are present).

**Two levels of a staircase with 44 steps

***square beam (10cm x 10cm x 30cm)

ADS = Anterior drawer sign

Adapted from:

Kaikkonen, A., Kannus, P. and Jarvinen, M. 1994. A performance test protocol and scoring scale for the evaluation of ankle injuries. American Journal of Sports Medicine. 22(4): 462-469.

DATA SHEET

Patient Name: ________________ Date: __________

File No.: __________ Group: _________

Consult No.: _________

Inclinometer Readings

	Plantarflexion	Dorsiflexion
Max. ROM before pain		

Proprioception Test (Modified Rhombergs Test)

Stork-standing on floor	Time in Seconds (Sprained ankle)
Eyes Open	
Eyes Closed	

APPENDIX M

Are you between the ages of
18 and 50 years
Do you suffer from

CHRONIC ANKLE PAIN

Research is currently being
conducted at the
Durban Institute of Technology
Chiropractic Day Clinic

FREE TREATMENT

Is available to those who
qualify to take part in this
study

For more information contact

LYNETTE

on (031)204 2205 / 2512