THE RELATIVE EFFECTIVENESS OF DRY NEEDLING THE EXTENSOR MUSCLES OF THE FOREARM AS AN ADJUNCT TO CROSS FRICTION MASSAGE IN THE TREATMENT OF LATERAL EPICONDYLITIS

By

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

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ABSTRACT

Lateral epicondylitis is the most common cause of chronic lateral elbow pain in adults (Bowen et al. 2001:642). No uniform treatment regime is available for lateral epicondylitis, although most authors do agree that treatment should begin with a conservative approach before progressing to more complex and invasive therapies (Kamien 1990:174).

The purpose of this study was to investigate the relative effectiveness of dry needling myofascial trigger points of the forearm extensor muscles as an adjunct to cross friction massage, in the treatment of lateral epicondylitis.

The study was a prospective, randomized controlled study. Forty patients from the Durban Metropolitan area participated in the study. They underwent a case history, a brief physical examination and an elbow regional examination and were then randomly allocated into one of two groups. Those in Group “A” received cross friction massage and dry needling, while those in Group “B” received cross friction massage only.

Each patient received five treatments over two weeks and a sixth treatment at a one-week follow-up. Subjective and objective measurements were taken before the 1^{st}, 3^{rd} and 5^{th} treatments and at the one-week follow-up.

Subjective data was obtained from the short-form McGill Pain Questionnaire and the Numerical Rating Scale (NRS-101). Objective data was obtained from the use of a hand held Dynamometer, the Algometer and the Myofascial Diagnostic Scale.

Examination of the statistical data revealed that both dry needling and cross friction massage versus cross friction massage alone are equally effective in treating lateral epicondylitis. Inter-Group comparisons revealed that both treatments improved the patient's quality and intensity of pain as well as decreasing local tenderness, increasing grip strength and deactivating trigger points. Intra-Group analysis showed that both treatment protocols showed significant improvements between visits, with the exception of the Dynamometer Readings as well as the Myofascial Diagnostic Scale Readings in Group B.

The results of the study seem to suggest that dry needling as an adjunct to cross friction massage was more effective in increasing grip strength and deactivating trigger points than cross friction massage alone. Due to the small sample size, further investigation using a larger sample size is suggested to verify the results obtained in this study.

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COMPARISONS USING BAR CHARTS:

DEFINITION OF TERMS

Myofascial Trigger Point (MFTP):

“A hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction, and autonomic phenomena.” (Travell et al. 1999:5)

Active Myofascial Trigger Point (AMFTP):

“A MFTP that causes a clinical pain complaint. It is always tender, prevents full lengthening of the muscle, weakens the muscles, refers a patient-recognized pain on direct compression, mediates a local twitch response of muscle fibers when adequately stimulated, and, when compressed within the patients pain, produces referred motor phenomena and often autonomic phenomena, generally in its pain reference zone, and causes tenderness in the pain reference zone.” (Travell et al. 1999:1)

Latent Myofascial Trigger Point (LMFTP):

“A MFTP that is clinically quiescent with respect to spontaneous pain; it is painful only when palpated. A LMFTP may have all the other clinical characteristics of an AMFTP and always has a taut band that increases muscle tension and restricts range of motion.” (Travell et al. 1999:4)

Referred Pain:

“Pain that arises in a MFTP, but is felt at a distance, often entirely remote from its source. The pattern of referred pain is reproducibly related to its site of origin.” (Travell et al. 1999:6)

Taut Band:

“The group of tense muscle fibers extending from a trigger point to the muscle attachments. The tension of the fibers is caused by contraction knots that are located in the region of the trigger point. Reflex contraction of the fibers in this band produces the local twitch response.” (Travell et al. 1999:7)

CHAPTER 1

1.1 INTRODUCTION

Lateral epicondylitis is the most common cause of chronic lateral elbow pain in adults (Bowen et al. 2001:642). It was first described in the literature more than 100 years ago (Ernst 1992:55) as “Tennis elbow”. “Tennis elbow” is considered a misnomer in that probably only 10-50% of regular tennis players experience the symptoms of lateral epicondylitis (Sharat and Maffulli 1997:102). According to Viola (1998:53) more than 40 million people currently play tennis in the USA, half of who are likely to suffer from lateral epicondylitis. However that does not mean that racquet sports are the only aetiological factor. Activities related to occupations such as carpentry; bricklaying; gardening and dentistry have been commonly associated with the development of lateral epicondylitis and have resulted in the condition being considered a primarily work related syndrome (Viola 1998:53).

The incidence of lateral epicondylitis is 1-3% of the general adult population (Sharat and Maffulli 1997:102) with its peak incidence occurring between the ages of 30 and 55 (Jackson 1997:104). The syndrome is rarely seen in individuals under the age of 30 (Ernst 1992:55). According to Thomson et al. (1991:60) lateral epicondylitis has an equal gender distribution according to activities.

Ernst (1992:55) states that lateral epicondylitis is a common overuse syndrome resulting in degenerative changes occurring in the common extensor tendon and more specifically the extensor carpi radialis brevis tendon. This suggests that the predominant factor involved in this process is a degenerative rather than a reparative process (Ollivierre and Nirschl 1996:134) resulting in a tendonosis rather than a tendonitis occurring (Kannus 1997:62). Hertling and Kessler (1996:216) have further suggested that lateral epicondylitis is a degenerative disorder that represents “tissue response to repetitive fatigue stresses”.

No uniform treatment regime is available for lateral epicondylitis, although most authors do agree that treatment should begin with a conservative approach before progressing to more complex and invasive therapies (Kamien 1990:174). Cross friction massage has been used as an effective treatment for tendonopathies such as lateral epicondylitis by Cyriax and Cyriax (1993:21); Sevier and Wilson (1999:378) and Hammer (2001). The main theory as to why cross friction massage works on tendons is based on Cyriax’s concept of friction massage and its effects on scar tissue (Hammer 2001 10/25/27). The proposed mechanism of action is to induce traumatic hyperemia, free adhesions in the tendon, increase tissue perfusion and mechanoreceptor stimulation (Hammer 2001 17/10/23).

Travell et al. (1999:734-735) suggests that the literature on lateral epicondylitis fails to supply a convincing explanation for the symptoms associated with lateral epicondylitis, which implies that a major cause may have been overlooked.

Recognition of the role played by myofascial trigger points and their increased tension on the common extensor tendon may assist in providing the missing explanation. Taut bands caused by trigger points in the forearm extensor muscles place a chronic strain on the tendinous attachment to the lateral epicondyle, thereby further exacerbating the symptoms of lateral epicondylitis (Travell et al. 1999:739). It was proposed that the role that forearm trigger points play in pain referral to the lateral epicondyle and strain on the common extensor tendon has largely been overlooked. It was hypothesized that by effectively treating the trigger points in the forearm extensor muscles with dry needling, the strain on the extensor tendon may be lessened and a resolution of symptoms may be seen.

1.2 STATEMENT OF THE PROBLEM

The aim of this study is to investigate the relative effectiveness of dry needling myofascial trigger points of the forearm extensor muscles as an adjunct to cross friction massage, in terms of subjective and objective clinical findings, in the treatment of lateral epicondylitis.

1.3 OBJECTIVES OF THE STUDY

1.3.1 The first objective was to determine the relative effectiveness of dry needling myofascial trigger points in the forearm extensor muscles as an adjunct to cross friction massage in the treatment of lateral epicondylitis, in terms of subjective clinical findings.

1.3.2 The second objective was to determine the relative effectiveness of dry needling myofascial trigger points in the forearm extensor muscles as an adjunct to cross friction massage in the treatment of lateral epicondylitis, in terms of objective clinical findings.

1.4 HYPOTHESES

1.4.1 HYPOTHESIS ONE

It was hypothesised that cross friction massage of the common extensor tendon would be effective in reducing pain and disability, in patients with lateral epicondylitis.

1.4.2 HYPOTHESIS TWO

It was hypothesised that cross friction massage with dry needling of the extensor muscles of the forearm as an adjunct, would be more effective than cross friction massage alone in reducing pain and disability in patients with lateral epicondylitis.

1.5 BENEFITS OF THE STUDY

Lateral epicondylitis can produce a long-lasting and severe condition that may lead to economic consequences such as sick leave, workers compensation claims and even early retirement (Viola 1998:54). In cases such as these it is necessary to find a treatment that is both cost effective and financially viable. Cross friction massage combined with dry needling of the forearm extensors may provide a solution to this dilemma. The treatment methods are relatively inexpensive and allow the patient to continue with work while on the treatment programme. More invasive therapies such as surgery require the patient to take leave from work in addition to incurring the costs of the procedure itself. Although the conservative treatment of this disabling condition has been the subject of a number of clinical studies, there is no unanimous agreement as to the most effective therapy in the management of lateral epicondylitis. It is, therefore, important to substantiate an effective, conservative therapy for this condition.

Labelle et al. (1992:646) reviewed 185 articles pertaining to the treatment of lateral epicondylitis and concluded that there was insufficient scientific evidence to support any of the current methods of treatment. They also expressed the need for properly designed controlled studies to be executed in order to validate or disprove the contradictory results of the randomised, controlled trials reported so far.

It is accepted that lateral epicondylitis is an overuse syndrome resulting in degenerative changes to the common extensor tendon origin (Ernst 1992:55). It is also known that trigger points are directly activated by acute overload and overwork fatigue leading to the development of taut bands and active trigger points that refer pain to the lateral epicondyle, thereby exacerbating the symptoms of lateral epicondylitis (Travell et al. 1999:739). It is hypothesised that by effectively treating the trigger points in the forearm extensor muscles with dry needling, the strain on the extensor tendon may be lessened and a resolution of symptoms may be seen. This study will help to determine the potential value of trigger point therapy on lateral epicondylitis and establish its level of effectiveness when used as an adjunct to cross friction massage.

CHAPTER 2

2.1. INTRODUCTION

Lateral epicondylitis is the most common cause of chronic lateral elbow pain in adults (Bowen et al. 2001:642). It was first described in the literature more than 100 years ago (Ernst 1992:55) as “Tennis elbow” after it was found to affect lawn tennis players (Sharat and Maffulli 1997:102). “Tennis elbow” is considered a misnomer in that probably only 10-50% of regular tennis players experience the symptoms of lateral epicondylitis (Sharat and Maffulli 1997:102). For the purposes of this study the condition shall be referred to as lateral epicondylitis.

Ernst (1992:55) states that lateral epicondylitis is a common overuse syndrome resulting in degenerative changes occurring in the common extensor tendon and more specifically the extensor carpi radialis brevis tendon. According to Ollivierre and Nirschl (1996:134) repetitive muscle contraction produces tensile forces within the tendon of the involved muscle, resulting in microtrauma. When the natural healing process fails, pathological alteration of tissue resulting in “angiofibroblastic degeneration” occurs (Ollivierre and Nirschl 1996:134). This suggests that the predominant factor involved in this process is a degenerative rather than a reparative process (Ollivierre and Nirschl 1996:134) resulting in a tendonosis rather than a tendonitis occurring (Kannus 1997:62).

2.2 EPIDEMIOLOGY

The incidence of lateral epicondylitis is 1-3% of the general adult population (Sharat and Maffulli 1997:102) with its peak incidence occurring between the ages of 30 and 55 (Jackson 1997:104). According to Delee and Drez (1994:860) lateral epicondylitis occurs four times more commonly in the fourth decade, with a peak occurrence at 42 years of age. The syndrome is rarely seen in individuals under the age of 30 (Ernst 1992:55) and is said to involve the lateral epicondyle seven times more frequently than the medial epicondyle (Delee and Drez 1994:860). According to Thomson et al. (1991:60) lateral epicondylitis has an equal gender distribution according to activities.

No reliable statistics could be found concerning the incidence of this condition in Southern Africa. According to Delee and Drez (1994:860) in a study of 1000 patients in the USA, in an area of equal racial distribution, lateral epicondylitis was found to be rare in blacks and occured more frequently in Caucasians. These findings seem to support the current research trends in Southern Africa as Shaik (2000), Roodt (2001), Haswell (2002) and Oehley (2002) found lateral epicondylitis to be far more prevalent in white South Africans. In the above-mentioned studies with the exception of Haswell (2002), there were no black participants, (this was also true of my study). However, one should not automatically conclude that lateral epicondylitis does not affect the black population of Southern Africa. Instead factors such as advertisement methods, location of the chiropractic day clinic and the general lack of awareness concerning chiropractic could account for biased racial demographics occurring as was mentioned by Shaik (2000).

2.3 AETIOLOGY

According to Viola (1998:53) more than 40 million people currently play tennis in the USA, half of whom are likely to suffer from lateral epicondylitis. The generic term of "Tennis elbow" is a misnomer in that most patients suffer from lateral epicondylitis due to occupational disorders as a result of cumulative trauma (Warhold et al.1993: 55). According to Warhold et al. (1993:55) lateral epicondylitis sometimes occurs in response to job-related activities of unaccustomed intensity and duration and is usually seen in manual laborers such as auto mechanics, painters, carpenters and gardeners. Ollivierre and Nirschl (1996:133) further state that "hand-shaking politicians, fishermen, golfers, baseball players, operating room personnel, violinists and homemakers" are also at risk of developing lateral epicondylitis.

Warhold et al. (1993:55) goes on to divide the aetiological factors into two distinct groups. The first group is comprised of young athletes, whose symptoms appear suddenly and with great intensity. While the second group is comprised of older patients between 35 and 50 years, whose onset of symptoms is insidious and usually follows an overuse injury pattern. In fact, according to Sharat and Maffulli (1997:102), any occupation or sports activity that requires forceful and repetitive forearm dorsiflexion, radial deviation and supination has been implicated in the development of lateral epicondylitis.

Sharat and Maffulli (1997:102) describe lateral epicondylitis as arising from several primary mechanisms: use of power grips, impact forces, and more commonly eccentric loading of the forearm extensor muscles. They further explain that impact forces are transmitted via the grip of the racquet, which leads to repetitive microtrauma occurring. The musculotendinous unit is particularly susceptible to overuse injuries resulting from participation in racquet sports (Nicholas et al. 1995:317). Lateral epicondylitis is directly related to activities that increase the tension and hence the stress of the wrist extensor and supinator muscles resulting in muscular contractile overloads that may occur concentrically or eccentrically (Nicholas et al. 1995:317). This clearly describes an overuse syndrome that is characterized by excessive forearm use with respect to intensity and duration (Nicholas et al. 1995:317).

2.4 PATHOLOGY

It has been established that lateral epicondylitis is an overuse syndrome that results in degenerative changes occuring in the common extensor tendon (Ernst 1992:55). The initial injury usually concerns a tear at the tendo-musculo junction, in the tendon or at the tendo-periosteal junction (Thomson et al. 1991:61). The resulting inflammation produces exudate in which fibrin forms to heal the torn tissue (Thomson et al. 1991:61). If excessive fibrin is formed fibrous tissue will result in adhesions between the tendon and surrounding tissues resulting in pain on use (Thomson et al. 1991:61). This initial inflammatory response is the earliest clinically recognizable manifestation of overuse tendon injury (Kannus 1997:62). According to Kesson and Atkins (1998:171) the initial inflammatory changes may produce a characteristic tendonitis, but as the chronic condition develops, the degenerative features of tendonosis become apparent.

2.4.1 Tendonopathies

According to Kannus (1997:62) an overuse injury is defined as "a long- standing or recurring orthopaedic problem and pain in the musculoskeletal system, which starts during exertion and is due to repetitive tissue microtrauma". He further states that in tendinous injuries, 'overuse' implies that the tendon has been strained repeatedly until unable to endure further tension, whereupon injury occurs. The structure of the tendon is disrupted micro- or macroscopically by this repetitive strain and inflammation, resulting in oedema and pain (Kannus 1997:62). Thus tendonitis is the earliest clinically recognizable manifestation of overuse tendon injury (Kannus 1997:62). Hertling and Kessler (1996:216) have further suggested that lateral epicondylitis is a degenerative disorder that represents "tissue response to repetitive fatigue stresses". Kannus (1997:62) explains that according to current concepts, where the basal ability of the tissue to repair itself is out-paced by the repetition of the insult, that this may result in a tendonosis occurring. A 'Tendonosis' can be defined as, "a focal area of intratendinous degeneration that is initially asymptomatic" (Kannus 1997:62).

Khan et al. (1999:398) define a 'Tendonosis' as "tendon degeneration without clinical or histological signs of an inflammatory response."

2.4.2 Histopathology

The extensor carpi radialis brevis tendon has been implicated as the most commonly affected tendon of the extensor muscle group (Sharat and Maffulli 1997:102). According to Khan et al. (1999:398) at surgery Nirschl found the extensor carpi radialis brevis tendon to contain disrupted collagen fibres, increased cellularity and neovascularisation in over 600 patients with lateral epicondylitis. He further found that acute inflammatory cells were almost always absent from the tendon but chronic inflammatory cells were occasionally present in small numbers in supportive or adjacent tissues. Although Nirschl coined the term "angiofibroblastic hyperplasia" from the histology seen in lateral epicondylitis these features are typical of the documented pathological entity of a tendonosis (Khan et al. 1999:398). Khan et al. (1998:398) explains that a recent study of 20 patients with chronic (6 to 48 months) lateral epicondylitis, confirmed that areas of abnormal tissue revealed by MRI corresponded with areas of neovascularisation, disruption of collagen and mucoid degeneration on histopathological examination.

It is as a result of these histological findings that cross friction massage and its effects on scar tissue, would make it particularly suited as an effective treatment of a tendonosis (Hammer 2001 10/25/27). Hertling and Kessler (1996:220) further explain that cross friction massage may also assist in allowing tissue maturation and promote the orientation of immature collagen along lines of stress. This allows the lesion to heal with a maximum degree of tissue extensibility and is less likely to be overstressed as use of the tendon is resumed (Hertling and Kessler 1996:220). According to Kesson and Atkins (1998:171) the normal ageing process causes degenerative changes in collagen fibres and ground substance similar to the changes seen when tissue is immobilized. Hertling and Kessler (1996:216) explain that in aging there is a loss of the mucopolsaccharide chondroitin sulfate which makes the tendon less extensible resulting in more of the energy of tensile loading being absorbed as internal strain to collagen fibres rather than by deformation of the tissue. Degeneration and the relative avascularity of the tendon seem to predispose them to microtrauma through overuse activity (Kesson and Atkins 1998:171). Cross friction massage would thus also aid in preventing any future injury to the tendon, by increasing its extensibility, when full use is resumed.

In a similar pattern an overuse syndrome will activate trigger points in the forearm muscles via acute overload, overwork fatigue, direct impact trauma and radiculopathy leading to the development of active and latent trigger points (Travell et al. 1999:20). These trigger points can result in referred pain, restricted movement and weakness of the affected muscle and their corresponding tendons (Travell et al. 1999:109-119). It would therefore be necessary to inactivate the trigger points in order to allow the muscle to return to normal to prevent an overuse injury occurring.

2.5 CLINICAL PRESENTATION AND DIAGNOSIS

Lateral epicondylitis may be diagnosed by taking a thorough history and clinical examination. Lateral epicondylar pain and tenderness with disability characterize lateral epicondylitis (Sharat and Maffulli 1997:103). The onset of pain may be sudden or gradual and usually occurs within 24 to 72 hours after the provocative activity (Jackson 1997:104). In the acute type, the patient can usually describe the exact time and condition at which the pain occurred (Viola 1998:55).

Typically most patients report pain after repetitive actions that involve flexion and extension, pronation and supination of the elbow (Sharat and Maffulli 1997:103). In recent studies Shaik (2000) and Haswell (2002), found sporting activities to be the most common cause of injury, with racquet sports being the dominant factor. This could possibly be as a result of the chronic repetitive overuse of the forearm extensor muscles, which is commonly associated with racquet sports.

The patient usually reports pain that is exacerbated with activity, in some cases it is so severe as to cause difficulty with routine activities such as lifting a glass, turning a doorknob, brushing the teeth or even shaking hands (Warhold et al. 1993:55). The pain is described as a constant ache over the lateral aspect of the elbow that may become sharp on movements such as repeated gripping or lifting (Kesson and Atkins 1998:170). It usually decreases with rest and can occasionally be referred down the wrist extensors from the elbow to the wrist (Thompson et al. 1991:61). In severe cases pain may occur at rest and is associated with reduced movement at the extremes of flexion and extension (Viola 1998:55).

On palpation point tenderness is present usually over the lateral epicondyle or less commonly the epicondylar ridge (Sharat and Maffulli 1997:103). According to Viola (1998:55) increased tenderness may be the result of repeated micro-trauma causing an inflammatory condition of the periosteum with granulation of tissue that contains large numbers of free nerve endings. This may account for patients reporting excruciating pain when the elbow is knocked accidentally (Kesson and Atkins 1998:170).

On examination pain can be induced by the following tests:

1. **Palpation** of the lateral epicondyle, which induces point tenderness. (Sharat and Maffulli 1997:103)
2. **Cozen's Test**: "The patient's elbow is stabilised by the examiners thumb, which rests on the patient's lateral epicondyle. The patient is then asked to make a fist, pronate the forearm, and radially deviate and extend the wrist while the examiner resists the motion." A positive test is indicated by pain over the lateral epicondlye. (Magee 1997:258)
3. **Lateral Epicondylitis Test**: "The examiner resists extension of the third digit of the hand (distal to the proximal interphalangeal joint), stressing the extensor digitorum muscle and tendon." A positive test is indicated by pain over the lateral epicondyle. (Magee 1997:258)

4. **Mill's Test**: "While palpating the lateral epicondyle, the examiner pronates the patients' s forearm, flexes the wrist fully, and extends the elbow." A positive test is indicated by pain over the lateral epicondyle.
   (Magee 1997:258)

Usually flexion and extension of the elbow are complete, but in some cases of chronic lateral epicondylitis, elbow extension may be limited (Viola 1998:55). According to (Warhold et al. 1993:58) grip strength is usually diminished and should be quantitated using a dynamometer. In severe cases, the grip will be significantly diminished in extension because of the stretching of the tendon in this position (Rettig 1998:119).

Radiographic studies are of little assistance in making a diagnosis of lateral epicondylitis, instead they help to rule out other causes (Viola 1998:56). However, infrared thermography of the affected elbow reveals a discrete localised area of increased heat near the lateral epicondyle in 98% of cases thereby signifying the area of damaged tissue (Viola 1998:56). The area of increased heat could perhaps signify a trigger point in the forearm musculature as Travell et al. (1999:29) found that trigger points display increased temperatures, which are usually due to sympathetic nervous system activity. It would be of interest to note if future studies find a link between trigger point location in the forearm extensor muscles and areas of increased heat near the lateral epicondyle, as indicated via infrared thermography.

2.6 DIFFERENTIAL DIAGNOSIS

Several other conditions need to be considered as the cause of lateral epicondylitis or lateral elbow pain. These include osteocondritis dessicans, radial tunnel syndrome and posterolateral plicas (Field and Savoie 1998:195). According to Viola (1998:56) conditions such as degenerative arthritis and cervical nerve root compression also need to be considered. Travell et al. (1999:728) suggest that myofascial trigger points of the forearm extensor muscles may also play a role in the development of lateral epicondylitis.

Degenerative arthritis of the radio-humeral and radio-ulnar joints usually results in diffuse pain that is not localised to the lateral aspect of the elbow. Loss of extension is usually the most common complaint and stiffness may be the dominant feature in this condition (Viola 1998:56).

Osteocondritis dessicans usually occurs in younger patients presenting with diffuse elbow pain of insidious onset. On examination there is a loss of full elbow extension and there may be crepitation with a resisted range of motion. Patients sometimes complain of intermittent locking of the elbow (Field and Savoie 1998:195).

Radial tunnel syndrome differs from lateral epicondylitis with the area of maximum tenderness usually being more distal in the proximal forearm over the edge of the supinator muscle. The pain is often more vague, diffuse and aching in nature (Field and Savoie 1998:195). According to Warhold et al. (1993:60) there is also pain at rest and paresthesias in the first dorsal web space of the hand in 5-10% of patients.

Posterolateral plicas generally produce symptoms along the posterolateral aspect of the elbow and are associated with complaints of popping, snatching or catching. The lesion can be easily palpated in the posterolateral gutter of the elbow (Field and Savoie 1998:195).

Cervical nerve root compression may produce lateral elbow pain that mimics lateral epicondylitis. This condition usually presents with painful restriction of neck motion and absence of point tenderness (Viola 1998:56). According to Thomson et al. (1991:62) palpation over C4, C5 and C6 on the side of the painful elbow may reproduce the pain.

Lateral ligamentous strain can be confirmed by performing the ligamentous instability test, which will result in instability and pain over the lateral epicondyle (Thomson et al. 1991:62).

Myofascial trigger points in the forearm extensor muscles create taut bands that place a chronic strain on the tendinous attachment to the lateral epicondyle, thereby further exacerbating the symptoms of lateral epicondylitis (Travell et al. 1999:739). Myofascial trigger points usually present as pain over the lateral epicondylitis and may refer down to the wrist and hand. It was proposed that the role that forearm trigger points play in pain referral to the lateral epicondyle and strain on the common extensor tendon has largely been overlooked by most researchers. According to Travell et al. (1999:728) “Tennis Elbow” or “Epicondylitis”, is frequently of myofascial origin, usually due to trigger points in the supinator and extensor muscles in the forearm. Travell et al. (1999:728) further states that “pain from myofascial trigger points in muscles that refer to the elbow region may readily account for the pain of tennis elbow.”

2.7 TREATMENT

The ideal treatment approach for lateral epicondylitis has yet to be found, as according to Ernst (1992:55) more than 40 different treatments have been suggested for this condition. There does however, seem to be a general consensus amongst the medical profession that treatment should begin with a conservative approach before resorting to more complex and invasive techniques such as surgery (Ernst 1992:55). Sevier and Wilson (1999:375) have reported that scientific research has found these treatment protocols to be inconsistently effective in treating lateral epicondylitis, thereby warranting the need for properly designed controlled studies to be executed in order to validate or disprove the contradictory results of the randomised, controlled trials reported so far. As no controlled studies on cross friction massage and dry needling could be found it was necessary to conduct this study to evaluate the treatments effectiveness and the role that it may play in the management of lateral epicondylitis.

2.7.1 Rest

Management of lateral epicondylitis begins with rest and avoidance of any activities that lead to pain (Jackson 1997:104j). Jackson (1997:104j) further suggests that activities should be avoided for as long as acute pain persists or until provocative activities become tolerable. Khan et al. (1999:401) explain that in a tendonosis there is structural damage to the tendon that may include partial tearing of the collagen which may require a longer healing period than that has traditionally been suggested to the patient with a tendonopathy. It is further postulated that tissue repair in tendonosis may take months rather than weeks to completely heal (Khan et al. 1999:401). However, according to society's stressful lifestyle and the emphasis on time management, rest may not always be possible or financially viable for a patient. This applies especially to patients who have acquired lateral epicondylitis as a result of occupational related activities. Viola (1998:53) enforces this by stating " The condition is believed to be primarily a work related syndrome". In cases such as this, it is necessary to find a treatment that is both cost effective and financially viable.

2.7.2 Cryotherapy

Regular ice application in the form of crushed ice or frozen blue gel packs should be applied 4-8 times daily for 10-15 minutes, in the acute phase of lateral epicondylitis, as recommended by (Sharat and Maffulli 1997:104). The cryotherapy affects the soft tissues directly by minimizing oedema and haemorrhaging and helps in the control of the initial inflammation (Sharat and

Maffulli 1997:104). Regular icing may prove to be a problem time wise and will also depend largely on the availability of a freezer.

2.7.3 Laser

A double-blind, randomised, controlled study done by Vasseljien et al. (1992) compared low level laser to placebo. 30 patients participated receiving a total of 8 treatments over 4 weeks. Low level laser in the form of a pulsed Gallium-arsenide (GaAs) laser with infrared light, was shown to have an effect over placebo, however the authors suggest that laser as a sole treatment for lateral epicondylitis is of limited value. They also concluded that further studies were needed to validate the reliability of their findings. In contrast Krasheninnikoff et al. (1994) reported that laser was not significantly better than placebo in the treatment of lateral epicondylitis. This study consisted of 36 patients receiving 2 treatments per week, totaling 8 treatments overall.

2.7.4 Ultrasound

Lundeberg et al. (1988) in a randomised, controlled study, compared the effect of continuous ultrasound at a frequency of 1.0 MHz and intensity of 1.0 W/cm^{-2}, applied for 10 minutes versus placebo ultrasound versus rest. 99 patients participated of which 33 were randomly allocated to continuous ultrasound, 33 to placebo ultrasound and the remaining 33 received only rest. The results found that when continuous ultrasound was compared with rest there was a significant improvement ($p<0.01$), but when compared with placebo ultrasound there was no significant improvement. Haker and Lundeberg (1991) investigated the effects of pulsed ultrasound versus placebo in the treatment of lateral epicondylitis. 45 patients underwent 10 treatments of 10 minutes 2-3 times weekly at settings of 1 MHz, 1:4 and 1 W/cm^2. Follow-ups were conducted at 3 and 12 months. They found no statistical differences in the subjective or objective outcomes between the two groups. They concluded that pulsed ultrasound was considered ineffective in the treatment of lateral epicondylitis.

2.7.5 Steroid Injection

Price et al. (1991) conducted a double blind, comparative study involving hydrocortisone, triamcinolone and lignocaine. 2 ml 1% preparations of lignocaine were compared with either 25 mg hydrocortisone or 10 mg triamcinolone made up to 2 ml with 1% lignocaine. Initial pain relief did occur but at 24 weeks the degree of improvement was similar in both groups. Side effects experienced included post-injection worsening of pain, skin atrophy and relapses. In conclusion, steroid preparations proved to be a less than effective method for the control of pain in lateral epicondylitis.

A pragmatic, randomised controlled trial conducted by Hay et al. (1999) compared local corticosteroid injections to naproxen and placebo. 164 patients aged 18-70 years participated in the study over a 12 month period. Local injections of 20mg methylprednisolone plus lignocaine versus 500 mg of naproxen or placebo tablets given twice daily for 2 weeks, were compaired. Pain and functional assessments were taken at 4 weeks, 6 months and 12 months. At 4 weeks, corticosteroid injection showed a clear advantage over naproxen and placebo. There were some small but significant differences in favor of naproxen or placebo at 6 and 12 months. They concluded that their results showed two important implications for the management of new episodes of lateral epicondylitis. The first one being that early corticosteroid injection is effective for lateral epicondylitis and should be the initial treatment of choice for optimal pain relief. Secondly, by 12 months outcome was good in all groups, and effective early treatment did not seem to influence this at all.

Some of the disadvantages of using corticosteroid injections and oral non-steroidal anti-inflammatory drugs are the side effects that they produce. The study by Hay et al. (1999) reported the development of local skin atrophy in patients receiving the corticosteroid injections, while gastro-intestinal side effects occurred in patients given the oral naproxen.

According to Sevier and Wilson (1999:376) corticosteroid injections are reported to help up to 90% of patients within one year, even though the process is invasive and potentially detrimental (skin atrophy etc.). They further say that the recurrence rate of lateral epicondylitis after injection is up to 50% after 6 months suggesting that corticosteroids are an effective early treatment but that other treatments should be used for long term success.

2.7.6 Manipulation of the Elbow

Traditionally Mill's manipulation was the most popular manipulative procedure used in the treatment of lateral epicondylitis. According to Viola (1998:62)

Wadsworth reported that in 100 resistant cases there was a 99% success rate when using this technique. The findings were over a twenty-year period and only 6 patients required more than one manipulation (Viola 1998:62). However, the manipulation as performed by Wadsworth required the patient to be fully relaxed and under general anaesthesia. The patient was also instructed to avoid strain on the elbow for at least 3 months after the procedure. According to Viola (1998:62) Mill's Manipulation has been suggested as an alternative form of treatment before surgery is considered.

Shaik (2000) conducted a prospective, controlled study in order to determine the relative effectiveness of cross friction with Mill's manipulation compared to cross friction alone in the treatment of lateral epicondylitis. In Shaik's study (2000) all of the patients were conscious and were given the Mill's manipulation without the use of a general anesthetic. Intra-group analysis revealed both groups' experienced subjective and objective improvements over the 6 treatments but not between the 6th treatment and the one-month follow-up. Inter-group analysis revealed that there were no significant differences in improvement between the groups suggesting that either treatment may be used in the treatment of lateral epicondylitis. Roodt (2001) conducted a placebo-controlled, randomised clinical study to determine the efficacy of manipulative treatment of the elbow, based on motion palpation findings, in the treatment of lateral epicondylitis. Statistical analysis revealed no significant differences between the two treatment groups suggesting that manipulation has no advantage over placebo in the treatment of lateral epicondylitis.

2.7.7 Bracing

Braces and supports are used as an adjunct to the treatment of lateral epicondylitis. Splints and braces are used to either rest the wrist extensors to decrease inflammation or to reduce the force overload of the musculature (Warhold et al. 1993:64). Counterforce bracing is used as a mechanism to diminish the overload forces that have been suggested to precipitate and prolong the incidence of lateral epicondylitis. According to Viola (1998:64) the brace should be applied firmly around the forearm over the wrist extensor muscle mass at the elbow to prevent a full contraction of the muscle when the patient contracts the wrist extensors. This placement relieves tension to the attachment of the extensor tendon and prevents any further damage to this tendon (Viola 1998:64). The patient is advised to only wear the brace during actual play, to avoid excessive tightness, and to remove it during periods of inactivity to avoid venous congestion and oedema (Sharat and Maffulli 1997:105). Bracing should be used only as an adjunct to treatment and not as a sole treatment in the management of lateral epicondylitis.

2.7.8 Acupuncture

A study by Brattberg (1983) showed acupuncture to be completely effective in 62% of resistant lateral epicondylitis cases, compaired to improvement in only 31% of control patients who received injections of cortisone. A sample size of 63 patients was used with 37 patients receiving traditional Chinese Acupuncture, using the points LI 5, LI 10, LI 11, LI 12 and T 11. None of the patients reported that acupuncture made them worse or caused any adverse affects. However, according to Viola (1998:59) the study was considered of poor methodological design, due to possible selection bias and type 1 error, and consequently was of poor quality. A placebo-controlled, single blind study, by Molsberger and Hille (1994) has demonstrated the intrinsic analgesic effect of acupuncture in the clinical treatment of lateral epicondylitis pain which exceeds that of placebo. A sample size of 48 patients was used, with 24 patients being treated at non-segmental distal points in the homolateral leg. Whereas patients in the placebo group were treated with placebo acupuncture avoiding penetration of the skin. Active acupuncture was found to be significantly more effective than placebo acupuncture in the treatment of lateral epicondylitis (Molsberger and Hille 1994). These results suggest that needling and its effects need to be further investigated in controlled studies.

2.7.9 Surgery

According to Viola (1998:62) conservative therapy is effective in 90% of patients with lateral epicondylitis and only 10% of cases of severe and resistant lateral epicondylitis are unresponsive to conservative treatment. Warhold et al. (1993:71) suggests a 6 -12 month trial period of conservative treatment before surgery is even considered. In a study by Bowen et al. (2001) the efficacy of nonoperative treatment for lateral epicondylitis was evaluated. 97 patients participated over a two-year period. All patients were initially treated with a structured nonoperative regimen consisting of activity modification, icing, counterforce bracing, and physical therapy such as ultrasound, phonophoresis, and Cyriax-type friction massage. Patients with no medical contraindications were prescribed daily oral NSAIDS. Cortisone injections consisting of 1 ml 2% lidocaine, 1 ml 0.5% xylocaine and 40 mg triamcinolone were given to help resolve acute pain. They found that surgery was averted in 75% of cases on the treatment regime. Patients that achieved pain control after only one cortisone injection successfully avoided surgery 88% of the time, whereas those requiring multiple injections only avoided surgery 44% of the time.

Several different surgical techniques for lateral epicondylitis have been prescribed (Sevier and Wilson 1999:380). Two of the most common procedures described according to Sevier and Wilson (1999:380) include the debridement of chronic inflammatory tissue from the lateral epicondyle and common extensor tenotomy. Viola (1998:62) further expands on this by describing 4 common surgical techniques:

1) Excision of part of the extensor origin together with excision of the orbicular ligament.
2) Distal tendon lengthening of the affected muscle
3) Denervation
4) Total release of the extensor musculature from the lateral epicondyle.

According to Viola (1998:63) 9-43% of surgical patients will continue to experience occasional pain, up to 35% have moderate pain and 10% may experience no benefit at all. This suggests that surgical intervention should be left as the last resort if conservative therapy fails and that there is no guarantee of success.

2.7.9.i Cross Friction Massage

Cross friction massage has been used as an effective treatment for lateral epicondylitis by Cyriax and Cyriax (1993:21); Sevier and Wilson (1999); and Hammer (2001 17/10/23). Hammer (2001 10/25/27) stated that lateral epicondylitis is a tendinosis which results in non-inflammatory intratendinous collagen degeneration occuring at the bone-tendon or muscle-tendon location. These changes have collectively been termed “Angiofibroblastic Tendonosis” by Nirschl (Hammer 2001 10/25/27). According to Hammer (2001 10/25/27) Nirschl states “that in advanced lesions, chronic inflammatory cells may appear in supporting fibroadipose, connective, and even skeletal muscle tissues and tendons which represent new or organizing granulation tissue and fibrous scar tissue”.

The main theory as to why cross friction massage works on tendons is based on Cyriax’s concept of friction massage and its effects on scar tissue (Hammer 2001 10/25/27). The proposed mechanism of action is to induce traumatic hyperaemia, free adhesions in the tendon, increase tissue perfusion and mechanoreceptor stimulation. Hertling and Kessler (1996:220) state that cross friction massage may also assist in allowing tissue maturation and promote the orientation of immature collagen along lines of stress. This allows the lesion to heal with a maximum degree of tissue extensibility and is less likely to be overstressed as use of the tendon is resumed (Hertling and Kessler 1996:220). According to Hammer (2001 17/10/23) a group called Performance Dynamics, a subsidiary of Ball Memorial Hospital in Indiana, USA, have been involved in researching the effects of friction massage. They believe that friction massage causes a microtrauma to the area of excessive soft tissue fibrosis or scar. They state, “The micro-injury causes microvascular trauma and capillary haemorrhage, resulting in a localised inflammatory response which serves as the stimulus for the body’s healing cascade and immune/reparative system”. They have shown that after cross friction massage there is fibroblastic proliferation and normal realignment of collagen fibers. Cross friction massage would thus also aid in preventing any future injury to the tendon when full use is resumed.

2.7.9.ii Dry Needling of Myofascial Trigger Points

In a critical review of the current conservative therapies for lateral epicondylitis done by Viola (1998:62) trigger point therapy was mentioned, however, no clinical research into this field has been conducted. Viola (1998:62) stated, "In the absence of any scientific literature further clinical research would be required to validate the use of this modality in the treatment of lateral epicondylitis.”

Travell et al. (1999:734-735) suggests that the literature on lateral epicondylitis fails to supply a convincing explanation for the symptoms associated with lateral epicondylitis, which implies that a major cause may have been overlooked. Recognition of the role played by myofascial trigger points and their increased tension on the common extensor tendon may assist in providing the missing explanation. Taut bands caused by trigger points in the forearm extensor muscles place a chronic strain on the tendinous attachment to the lateral epicondyle, thereby further exacerbating the symptoms of lateral epicondylitis

(Travell et al. 1999:739). It was proposed by the researcher that, the role that forearm trigger points play in pain referral to the lateral epicondyle and strain on the common extensor tendon needs to be investigated further with controlled studies.

According to Travell et al. (1999:728) tennis elbow or lateral epicondylitis, is frequently of myofascial origin, usually due to trigger points in the supinator and extensor muscles in the forearm. Rachlin (1994:344) further suggests that trigger points in the forearm extensor muscles and brachioradialis may be responsible for the symptoms of lateral epicondylitis. Muscles associated with pain referral to the lateral epicondlyle include the Supinator; Brachioradialis; Extensor Carpi Radialis Longus and Brevis; 4th and 5th Finger Extensors, Triceps Brachii and the Anconeus muscle (Travell et al. 1999:736). It was hypothesised by the researcher that, by effectively treating the associated myofascial trigger points in the extensor muscles of the forearm, the strain on the common extensor tendon will be lessened and a decrease in pain referral to the lateral epicondlye could be felt.

In a study by Haswell (2002) the efficacy of dry needling myofascial trigger points in the forearm extensor muscles in lateral epicondylitis was tested. Haswell (2002) made use of placebo acupuncture needles that operated on a spring mechanism simulating a “sham” needling treatment. The placebo used was appropriate in that patients believed that they were in fact receiving dry needling treatment. Haswell (2002) found that dry needling was effective against placebo in improving the patient's perception of the quality and quantity of pain in lateral epicondylitis. Haswell (2002) states that that there was a significant improvement in the algometer readings over the lateral epicondyle, but that no such difference was demonstrated with regards to the dynamometer readings. His suggestions for future studies include the benefit of dry needling when used in conjunction with other treatment modalities.

According to Rachlin (1994:154) several mechanisms are responsible for the relief of pain in dry needling

1. Mechanical disruption of the trigger point by disruption of muscle elements or nerve endings.
2. Mechanical disruption of the muscle fibers may lead to depolarization of nerve fibers as a result of the release of intracellular potassium.

Lateral epicondylitis is an overuse syndrome resulting in damage to the wrist extensor muscles and their accompanying tendons; it is therefore possible that treatment to these muscles via dry needling may play a role in lessening the symptoms of lateral epicondylitis. It is thus the aim of this study to establish the effectiveness of dry needling the forearm extensor muscles as an adjunct to cross friction massage in the treatment of lateral epicondylitis.

2.8 Summary

According to Ernst (1992:55) more than 40 different treatments have been suggested for lateral epicondylitis, indicating that the ideal treatment approach has yet to be found. He suggests that physical methods should always be selected as the initial treatment, which is in agreement with Kamien's statement that "Treatment should begin with a conservative approach before progressing to more complex and invasive therapies" (Kamien 1990:174). Labelle et al. (1992:646) reviewed 185 articles pertaining to the treatment of lateral epicondylitis and concluded that there was insufficient scientific evidence to support any of the current methods of treatment. Labelle et al. (1992:650) expressed the importance of the placebo effect and the natural evolution of the syndrome emphasizing the need to evaluate all types of therapy with properly controlled, randomized trials. It has been proposed that dry needling as an adjunct to cross friction massage would be effective as a treatment for lateral epicondylitis that would be both cost effective and have long-term results.

APPENDIX J: <u>Muscles Involved in this Study</u>

Origin, Insertion and Action

Muscle Name	Origin	Insertion	Action
1. Extensor digitorum	Lateral epicondyle of the humerus.	Middle base of the 2nd & 3rd phalanges of the index, middle, ring and 5th fingers.	Extension of fingers and wrist (Rachlin 1994:352)
2. Extensor carpi radialis brevis	The common extensor origin.	The styloid process of the base of the third metacarpal.	Extension and fixation of the wrist (Rachlin 1994: 349)
3. 4th & 5th finger extensors	The common extensor tendon origin.	The base of the 2nd phalanx & onto the dorsal surface of the distal phalanx of each finger.	Extension of the fingers and wrist. Also contribute to forceful finger flexion. (Travell et al. 1999:497)
4. Extensor carpi radialis longus	The lower third of the lateral supercondylar ridge	Posterior aspect of the 2nd metacarpal.	Extension and fixation of the wrist (Rachlin: 1994:349)

5. Supinator	The deep fibers attach just below the radial notch of the ulnar. The oblique fibers attach more superficially from the posterior lateral epicondyle, the lateral ligament of the elbow and the annular ligament.	The neck and shaft of the radius.	Supination of the radius (Rachlin 1994: 336)
6. Brachioradialis	The upper two thirds of the lateral supracondylar ridge of the humerus.	The outer side of the base of the radial styloid process.	Flexion of the elbow when the forearm is midway between supination and pronation (Rachlin 1994:349)

CHAPTER 3

3.1 OBJECTIVE

This study was a prospective, randomised controlled clinical trial, which investigated the relative effectiveness of dry needling myofascial trigger points of the forearm extensor muscles as an adjunct to cross friction massage, in terms of subjective and objective clinical findings, in the treatment of lateral epicondylitis.

3.2 RESEARCH METHODOLOGY

3.2.1 Subjects

The proposed sample size was sixty patients, divided into two groups of thirty, however due to a poor patient response and unsuccessful advertising, this was later reduced to forty patients. The study was limited to patients, age twenty-one to sixty, of any sex, race, or occupation and who resided in the greater Durban metropolitan area. Shaik (2000) and Roodt (2001) both included patients between the ages of ten and seventy, but as lateral epicondylitis is rarely seen in children and its peak incidence is between thirty and fifty-five years of age, (Jackson 1997), the suggested age group of twenty-one to sixty would be more acceptable. Advertisements requesting participation in the clinical trial involving chiropractic treatment of “Elbow Pain/Tennis Elbow” were placed on notice boards at Technikon Natal, local universities, library notice boards, local sports clubs as well as pamphlet distribution to specific residential areas. The individuals who responded to these advertisements were assessed and if they complied with the inclusion criteria for the study, they were accepted into the research program. Patients presenting to the Chiropractic Day Clinic with lateral epicondylitis were examined and if they complied with the inclusion criteria they were also included into the study. Patients with any of the exclusion criteria were not accepted into the research program.

The **inclusion criteria** for the study were as follows:

A diagnosis of lateral epicondylitis based on:

a) Pain around the lateral epicondyle that is aggravated by active wrist extension. (Magee 1997:258).

b) A positive finding of a least one of the following tests, performed according to the procedure set out by Magee (1997:258)

1. **Cozen's Test:** A positive test is indicated by pain over the lateral epicondlye on resisted wrist extension and radial deviation with forearm pronation. (Magee 1997:258)
2. **Lateral Epicondylitis Test:** A positive test is indicated by pain over the lateral epicondyle on resisted extension of the third digit of the hand (distal to the proximal interphalangeal joint), thereby stressing the extensor digitorum muscle and tendon (Magee 1997:258).
3. **Mills Test:** A positive test is indicated by pain over the lateral epicondyle on forearm pronation with wrist flexion and active extension of the elbow. (Magee 1997:258)

c) Patients with a minimum of one active myofascial trigger point in the Brachioradialis; 4th and 5th Finger Extensors; Extensor Carpi Radialis Longus and Brevis; or the Supinator muscle were accepted into the research program.

d) If required, patients on oral non-steroidal or anti-inflammatory drugs were given a 4-day wash-out period before treatment was started, in order to cancel out any effects of the medication, that would adversely affect the results of this study.

The **exclusion criteria** for the study were as follows:

Any condition to which cross friction massage was contraindicated resulted in the patient's exclusion. (Hertling and Kessler 1996:143 and Cyriax and Cyriax 1993)

1. Inflammation due to bacterial infection
2. Traumatic arthritis of the elbow joint
3. Ossification or Calcification of Soft Tissue structures
4. Bursitis
5. Rheumatoid types of arthritis
6. In cases of impaired vascular response such as: patients on long-term, high-dose steroid drug therapy and patients with known peripheral vascular disease.

Patients who had any condition that contraindicated dry needling of trigger points were excluded from the study. (Rachlin 1994:175-176):

1. A systemic or local infection

2. Bleeding disorders e.g. Haemophilia or patients on Anticoagulent drugs such as Warfarin
3. Patients who were pregnant

If radiographs were deemed necessary to aid in diagnosis, the patient was excluded from the study. Patients without any active or latent myofascial trigger points in the extensor muscles of the forearm were also excluded from the study.

Each patient underwent an initial consultation, consisting of a detailed case history (Appendix A), a brief physical examination (Appendix B) and an elbow regional examination (Appendix C). At this point a diagnosis of lateral epicondylitis was confirmed followed by five treatments over two weeks and a one-week follow-up. Patients were informed that for the duration of the study they would not be permitted to receive any other treatments for lateral epicondylitis, such as drugs or manual intervention, nor would they be permitted to alter their current lifestyle. All patients signed an informed consent form (Appendix I) before treatment commenced.

3.2.2 Subject Allocation

Convenience sampling was used to select a sample of forty patients, who were randomly assigned equally to each of the two treatment and control groups. Random allocation of patients was carried out using forty pieces of paper, twenty of which contained the letter “A” and twenty of which contained the letter “B”. The marked papers were placed into a box and the patients were requested to draw one piece of paper. The patients were then grouped according to the piece of paper chosen. Those in group “A” received dry needling and cross frictions, while those in group “B” received cross frictions only.

3.2.3 Study Design

Subjects in group A and B had the treatment procedure explained to them. Cross frictions were applied according to techniques described by Hertling and Kessler (1996:141-143) and Cyriax and Cyriax (1993:21-62.)

1.Cross friction massage must be administered to the precise site of the lesion.

2.The patient should be positioned to render the lesion accessible to the researcher.

3. Patients skin must move along with the therapist’s fingers to prevent a friction burn. No lubrication should be used.

4.The therapist’s thumb should be placed over the lesion, and friction massage applied in a direction perpendicular to the normal orientation of the underlying fibers.

5. Cross friction massage was applied for 5-10 minutes depending on the patient’s tolerance level. (Sevier and Wilson 1999:378)

The movement in friction is usually transverse to the fiber direction and friction is begun using only light pressure. At the beginning of the treatment the patient may feel mild to moderate tenderness, however after 1 to 2 minutes the tenderness should have subsided considerably (Hertling and Kessler 1996:142).

If it has not or tenderness has increased, treatment should be stopped (Hertling and Kessler 1996:142). According to Hertling and Kessler (1996:142) it is not unusual for patients to feel some increased 'soreness' following the first or second treatments, this however should not be confused with an exacerbation of symptoms.

Subjects in group A had the dry needling procedure explained to them. Patients were assessed for any active or latent trigger points in the forearm extensor muscles, excluding the trapezius and anconeus muscles, using methods described by Travell et al. (1999:690-742). The forearm extensor muscles chosen included the: Supinator; Brachioradialis; Extensor Carpi Radialis Longus and Brevis; and the 4th and 5th Finger Extensors due to pain referral to the lateral epicondyle and its surrounding area (Travell et al. 1999:736). In the case where more than one active myofascial trigger point exists in a muscle, only the most symptomatic trigger point was treated (Miller 2000:41).

Trigger points were needled according to a combination of techniques described by Rachlin (1994. 336-337, 348-353, 351-354) and Rowley (2000:2). The trigger point was located by palpation and isolated between the fingers and thumb. The acupuncture needle was then inserted directly into the trigger point using a single entry technique. The needle was then withdrawn (not bringing the needle out of the skin) and probed in a circular fanlike motion covering the trigger point area. Once the local twitch response has occurred the needle was left in place for 5 minutes and then removed (Haswell 2002). A 21G, 2-inch acupuncture needle was used (Rachlin 1994:177). Protective measures were taken to ensure that sterile conditions were maintained at all times with the use of alcohol swabs, gloves and sterile acupuncture needles. Each needle, alcohol swab and glove was used only once and then disposed of in medical waste bins.

Treatment was stopped on any patients who become asymptomatic during the course of the study, however these patients were continually evaluated, and treatment resumed if they became symptomatic again. Any patients, who experienced an exacerbation of pain whilst part of the study, were carefully evaluated and, if necessary, withdrawn from the research.

3.2.4 Ethical Considerations

All patients participated in the study voluntarily. They were informed that they were able to leave the study at any time with no repercussions and that all patient information would be considered confidential. Informed consent (Appendix I) was obtained from all patients prior to commencement of the study and they were supplied with a Patient Information Sheet (Appendix J) outlining what treatment was to be administered.

3.3 MEASUREMENTS AND OBSERVATION

3.3.1 The Data

This study included both primary and secondary data.

3.3.1.1 The Primary Data

- Case History (Appendix A)
- Physical Examination (Appendix B)
- Elbow Regional Examination (Appendix C)
- McGill Pain Questionnaire (Appendix D)
- Numerical Rating Scale (NRS-101) (Appendix E)
- Algometer Reading (Appendix F)
- Dynamometer Reading (Appendix G)
- Myofascial Diagnostic Scale (Appendix H)

3.3.1.2 The Secondary Data

The secondary data was obtained from current journals, textbooks and the Internet at the Technikon Natal Library.

3.3.2 Method of Measurement

All patients were required to complete the short-form McGill Pain Questionnaire (Appendix D) and the NRS101 (Appendix E) Questionnaire before the 1^{st}, 3^{rd} and 5^{th} treatments and at the one-week follow-up. These questionnaires provided information on the patient's subjective responses. Objective data was obtained through the use of a hand held dynamometer to test grip strength at 180 degrees of elbow flexion, the non-electronic algometer and the Myofascial Diagnostic Scale (Chettiar 2001). These readings were taken before the 1^{st}, 3^{rd} and 5^{th} treatment and at a one-week follow-up.

3.3.2.1 Subjective Measurements

I. Short-Form McGill Pain Questionnaire

The Short-Form McGill Pain Questionnaire (Melzak 1987), provided information on the quality of pain experienced by the patient such as the patient's sensory, affective and overall intensity of pain. It was derived from the standard McGill Pain Questionnaire for the use in specific research settings when time, for the capture of patient information was limited.

In a study by Melzak (1987), short form McGill Pain Questionnaire scores obtained from patients in post-surgical, obstetrical wards, physiotherapy and dental departments were compared to scores obtained with the standard McGill Pain Questionnaire. The correlations were consistently high and significant, suggesting that the Short-Form McGill Pain Questionnaire was sufficiently sensitive to demonstrate differences due to treatment at statistical levels comparable to those obtained with the standard form (Melzak 1987).

The Short-Form McGill Pain Questionnaire (Melzak 1987) consists of 15 descriptions of pain. Descriptions 1 to 11 represent the sensory dimension of pain experienced and descriptions 12 to 15 represent the affected dimension. A combination of the sensory and affected dimensions of pain will result in the overall pain score. Each description is ranked on an intensity scale of zero=none, one=mild, two=moderate and three-severe pain.

II. Numerical Rating Scale

The NRS–101 is a questionnaire used to measure the intensity of pain a patient is experiencing (Jenson et al. 1986). The patient was requested to indicate by means of a percentage their intensity of pain on a scale of 0 to 100, where 0 represented 'no pain', and 100 represented 'pain as bad as it could be'. Pain intensity was recorded at its most intense and at it's least. The average between these two figures was then taken as the intensity of pain they were experiencing prior to the treatment sessions.

Jensen et al. (1986) examined the usefulness of six different pain intensity measures in a group of 75 chronic pain patients. The scale was found to be the most practical index when measuring clinical pain intensity compared to the other 5 scales. The NRS-101 can be administered in written or verbal forms and is very simple to score. In addition it has 101 response categories and so is more likely to be accepted by researchers concerned with limited response options of the other measures. The scale does not appear to be associated with incorrect responding more than any other scale and the difficulty of the scale is not age related.

3.3.2.2 Objective Measurements

I. Algometer Readings

According to Fischer (1987) the evaluation of the therapeutic efficacy in myofascial pain syndromes and tender spots is based primarily on subjective assessment of local tenderness. Objective assessment of tender spots was measured by the use of a hand-held algometer, which recorded a pressure threshold measurement (PTM). Pressure threshold is the minimum pressure (force) that induces pain or discomfort (Fischer 1987). The lateral aspect of the elbow was carefully palpated in each patient in order to identify the area of maximum tenderness and an algometer was placed on the tender spot in order to take the pressure threshold measurement. Fischer (1987:207-214) found the algometer a useful method for diagnosis of tender spots and trigger points and it is particularly useful in the assessment of treatment results.

The algometer was fitted with a one-centimeter square rubber disc, as this was considered a more suitable way to assess tenderness in tendons, ligaments and joint capsules (Fischer 1986). The pressure was gradually increased at a rate of 1kg per second (Fischer 1986). The patient was asked to say 'now' at the point when the pressure sensation became a point of pain or discomfort. The reading was recorded at that point. The dial was set to zero before recording each reading, by pressing the reset button.

In 1987 Fischer performed a study on the pressure threshold measurement for diagnosis and evaluation of treatment results of trigger points. 24 male patients and 26 females participated in this study. He concluded that algometry is a useful method for diagnosis of tender spots and trigger points and is especially useful in their clinical management and assessment of treatment results. The algometer used in my study was a force dial manufactured by Wagner Instruments: P.O.

Box1217, Greenwich CT 06836. The pressure range of the algometer was 11 kilograms.

II. Dynamometer Readings

Grip strength was measured using the portable JAMAR dynamometer (suppliers Lasec – 32 Oldmo Road, Cape Town). The dynamometer was found to be a reliable method of testing the maximal muscle strength of the upper extremity muscles by Agre et al. (1987). De Smet and Fabry (1997:229) measured grip force in 55 patients with chronic lateral epicondylitis. Their results showed that grip strength was greatly reduced at the pathologic side compared to the control side ($p<0.001$), and that the relative difference between grip strength in elbow flexion (90°) and extension (180°) was highly significant at the pathological side compared with the normal side ($p<0.0001$), with the pathological side showing a marked grip strength reduction with the elbow held in extension. Consequently grip strength was measured with the elbow in full extension (180°).

III. Myofascial Diagnostic Scale

The Myofascial Diagnostic Scale was developed by Chettiar (2001) and used to assess the extent to which a patient suffered from myofascial pain syndrome, by grading the levels of soft tissue tenderness. The Myofascial Diagnostic Scale is made up of four indicators. The first indicator consists of five grades of soft tissue tenderness. Each grade was scored as follows: grade 0 – no tenderness = 0, grade 1 – tenderness to palpation without grimace or flinch = 1, grade 2 –

tenderness with grimace and/or flinch to palpation = 2, grade 3 – tenderness with withdrawl = 3, grade 4 – withdrawal to non-noxious stimuli = 4.

The second and third indicators represented the presence of the local twitch response and the taut band respectively. Theses indicators were given a value of 4 each. The final indicator was the presence of referred pain. Since this is the strongest indicator of an active trigger point, this indicator was given the value of 5. There have been no reliability studies to date, testing the validity of the Myofascial Diagnostic Scale.

3.4 STATISTICAL ANALYSIS

A random sample of forty patients was used in this study (n_1=20, n_2=20) and non-parametric tests were used to analyse both the subjective and objective data. The Technikon Natal research statistician was consulted with regards to which tests were to be run. All the subjective and objective results were then entered into a spreadsheet and analysed using the SPSS© package version 9 (SPSS Inc. 1999).

The Mann-Whitney U-test was utilised to perform inter-group comparisons of subjective data collected by the McGill pain questionnaire and the NRS101 as well as objective data such as the Algometer, Dynamometer and the Myofascial Diagnostic Scale. Friedman's T test for repeated measurements was used for both the subjective and objective data to look for intra-group changes. All tests were carried out at 5% level of significance (α =0,05) and appropriate p-values were used for decision making. The results were found to be statistically significant and so further testing was carried out. In this study the post test used was a multiple comparison procedure called the Dunn Procedure for use with the Friedman's T test (Daniel 1978: 224).

3.4.1 INTER-GROUP COMPARISON (Dry Needling and Cross Friction Massage versus Cross Friction alone)

The Mann-Whitney U test, a non-parametric test, was used to compare the dry needling and cross friction groups with regard to the short-form McGill Pain Questionnaire, the NRS- 101, the algometer readings, the dynamometer readings and the Myofascial Diagnostic Scale.

The above test was used to determine whether any significant differences existed between the dry needling group and the cross friction massage groups at the 1st, 3rd, 5th and 6th (one-week follow up) visits for each of the variables at the α = 0.05 level of significance.

Hypothesis Testing:

The null hypothesis (H_o) stated that there was no difference in pain levels, with regards to the pain questionnaires, and no difference in the algometer, dynamometer readings and the Myofascial Diagnostic Scale readings between the groups. The alternative hypothesis (H_1) stated that there was a difference in pain levels, and the algometer, dynamometer readings and the Myofascial Diagnostic Scale readings between the groups.

- H_0: There was no difference between the groups.
- H_1: There was a difference between the groups.
- $\alpha = 0.05$ = level of significance of the test.

Decision Rule:

For a two-tailed test:

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

3.4.2 INTRA-GROUP COMPARISON (Dry needling and cross friction massage)

Friedman's T test is a non-parametric test that compares three or more paired groups. If the p value is small, one can conclude that at least one of the treatments differs from the rest, and if so it is therefore necessary to look at post-hoc tests to determine which group differs from which other group (Instat 2001). In this study the post-hoc test used was a multiple comparison procedure called the Dunn Procedure for use with the Friedman's T test (Daniel 1978: 224). The Friedman's T test was used within the dry needling group and the cross friction massage group to determine if there were any significant differences according to the Short-form McGill Pain Questionnaire, the NRS-101, the algometer and dynamometer readings and the Myofascial Diagnostic Scale between the 1st, 3rd, 5th and 6th consultations.

Hypothesis Testing:

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

- H_0: There was no difference (improvement) between consultations
- H_1: At least one consultation is different (improvement) from the rest

α= 0.05 = level of significance of the test.

Decision Rule:

For a one-tailed test:

- p = reported p – value/2 < α: if H1 is of form > and Z is positive
  if H1 is of form < and Z is negative

- p = 1 – (reported p value)/2 < α: if H1 is of form > and Z is negative
  if H1 is of form < and Z is positive
- α = 0.05

- p was the observed significance level of the test.

The Dunn Procedure for the Friedman's T test:

If the null hypothesis was rejected for the Friedman's T test, then this multiple comparison procedure will be applied to determine which of the treatments were significantly different (Daniel 1978:231).

3.5 SUMMARY

Forty patients suffering from lateral epicondylitis were selected to participate in this study. Twenty patients were randomly allocated into the dry needling and cross friction massage group and the other twenty into the cross friction massage group alone. Each patient was assessed in terms of subjective and objective clinical findings and all the necessary data was obtained for statistical analysis in the SPSS package.

CHAPTER 4: THE RESULTS

4.1 INTRODUCTION

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

- The McGill Pain Questionnaire
- The Numerical Rating Scale (NRS-101)
- The Algometer Readings
- The Dynamometer Readings
- The Myofascial Diagnostic Scale

4.2 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 measures such as the algometer, dynamometer readings and the Myofascial Diagnostic Scale that were taken by the researcher were used. All responses to the McGill Pain Questionnaire and the NRS-101 were completed under the researcher's supervision.

Several patients were excluded from the study after failing to meet the inclusion or exclusion criteria. Examples of these patients included: patient's over sixty years of age, previous radius and ulnar fractures and C5/C6 disc lesions.

Key for Abbreviations used in the following tables:

Group A : Dry Needling and Cross Friction Massage Group

Group B : Cross Friction Massage Group

V : Visit

4.3 DEMOGRAPHIC DATA

4.3.1 Age Distribution

Table 1: Age distribution within sample of 40 patients

AGE	GROUP A	GROUP B	TOTAL (N=40)
21 – 29	2	0	2(5%)
30 – 39	0	2	2(5%)
40 – 49	10	8	18(45%)
50 – 59	8	10	18(45%)

90% of my patients fell into the 40 – 49 and 50 – 59 age group. This is consistent with Delee and Drez (1994:860) who said that lateral epicondylitis occurs four times more commonly in the fourth decade, with a peak occurrence at 42 years of age. According to Kesson and Atkins (1998:171) the normal aging process causes degenerative changes in the tendon and that degeneration combined with the relative avascularity of the tendon seem to predispose them to microtrauma through overuse activity. This may account for the increased incidence in the older age groups.

4.3.2 Gender Distribution

Table 2: Gender Distribution within sample of 40 patients

GENDER	GROUP A	GROUP B	TOTAL (N=40)
Male	13	10	23(57%)
Female	7	10	17(42.5%)

According to Thomson et al. (1991:60) lateral epicondylitis has an equal gender distribution. However, in my study I had a slightly higher number of male participants. This could possibly be linked to occupations that involve physical activity such as building, painting and lifting of heavy objects

4.3.3 Race Distribution

Table 3: Race Distribution within sample of 40 patients

ETHNIC GROUP	GROUP A	GROUP B	TOTAL (N=40)
Black	0	0	0(0%)
Coloured	0	1	1(2.5%)
Asian	2	4	6(15%)
White	18	15	33(82.5%)

My study showed a predominance of white participants, which is in keeping with a study of 1000 patients in the USA, in which lateral epicondylitis was found to be rare in blacks and occur more frequently in Caucasians (Delee and Drez

1994:860). However this does not mean that lateral epicondylitis does not affect the black population, instead the methods of advertising seem responsible for the biased racial demographics as previously stated by Shaik (2000).

4.3.4 Lateral Epicondyle Affected

Table 4: Lateral epicondyle affected within sample of 40 patients

SIDE AFFECTED	GROUP A	GROUP B	TOTAL (N=40)
Unilateral Right	14	13	27(67%)
Unilateral Left	6	7	13(32.5%)
Bilateral but only one side treated	2	7	9(22.5%)

In 67% of my patients the right elbow was affected by lateral epicondylitis, this could be a result of this being the dominant arm. According to Viola (1998:53) the syndrome is usually restricted to the dominant arm.

4.3.5 Occupation

Table 5: Occupation within sample of 40 patients

OCCUPATION	GROUP A	GROUP B	TOTAL (N-40)
Administration	2	1	3(7.5%)
Builder	2	3	5(12.5%)
Business Analyst	1	0	1(2.5%)

Cost Accountant	1	0	1(2.5%)
Electroplater	1	0	1(2.5%)
Engineer	0	2	2(5%)
Estate Agent	0	1	1(2.5%)
Faculty Officer	1	0	1(2.5%)
Horticulturist	1	0	1(2.5%)
Housewife	0	5	5(12.5%)
Lecturer	1	0	1(2.5%)
Manager	1	1	2(5%)
Medical technologist	0	1	1(2.5%)
Midwife	1	0	1(2.5%)
Minister	1	0	1(2.5%)
Sales	1	2	3(7.5%)
Secretary	1	1	2(5%)
Self Employed	0	2	2(5%)
Student	2	0	5(5%)
Teacher	2	1	3(7.5%)
Turner & Machinist	1	0	1(2.5%)

The highest incidence of 12.5% was found in builders and housewives, with both occupations involving a high degree of physical activity.

4.3.6 Aggravating Activity

Table 6: Aggravating Activity within sample of 40 patients

AGGRAVATING ACTIVITY	TOTAL NUMBER OF PATIENTS
Racquet Sports: Tennis	3(7.5%)
Squash	2(5%)
Other Sports: Paddling	3(7.5%)
Gym	2(5%)
Darts	1(2.5%)
Swimming	1(2.5%)
Non-Sporting Activities:	
Lifting	10(25%)
Gardening	3(7.5%)
Painting	2(5%)
Cleaning	2(5%)
Home Improvement	2(5%)
Housework	2(5%)
Building	2(5%)
Carrying Suitcase	2(5%)
Mowing Lawn	1(2.5%)
Massage	1(2.5%)
Insidious	1(2.5%)

Sewing	1(2.5%)
Laying Tiles	1(2.5%)
Sanding	1(2.5%)
Typing	1(2.5%)
Knitting	1(2.5%)
Chopping Tree	1(2.5%)

While 12.5% of patients reported racquet sports as the causative factor a far larger number of patient's aetiology were linked to non-sporting activities usually involving their occupation. This is consistent with the literature in which occupation rather than sporting activities are primarily responsible for lateral epicondylitis. Viola (1998:53) supports this finding by stating that the condition is believed to be primarily a work related syndrome.

4.3.7 Positive Orthopaedic Tests

Table 7: Positive Orthopaedic Tests within sample of 40 patients.

ORTHOPAEDIC TEST	TOTAL NUMBER OF PATIENTS
Cozen's	33(82.5%)
Lateral Epicondylitis Test	26(65%)
Mill's	11(27.5%)

Cozen's test was positive in 82.5% of patients indicating that wrist extension against resistance is the primary indicator of lateral epicondylitis. The Lateral

Epicondylitis test was positive in 65% of patients, which corresponds with the findings of the Extensor Digitorum muscle being most commonly affected by trigger points (Table 9) in the forearm extensor muscles.

4.3.8 Duration of Symptoms

Table 8: Duration of Symptoms within sample of 40 patients.

DURATION OF SYMPTOMS	TOTAL NUMBER OF PATIENTS
Less than one month	5(12.5%)
1 – 6 months	18(45%)
6 – 12 months	11(27.5%)
More than 12 months	6(15%)

45% of patients had a duration of symptoms of between 1- 6 months. This could possibly be accounted for by the chronicity of the syndrome with a further 27.5% of patients experiencing symptoms up to 12 months.

4.3.9 Prevalence of Myofascial Trigger Points

Table 9: Prevalence of Myofascial Trigger Points within sample of 40 patients.

AFFECTED MUSCLE	TOTAL NUMBER OF PATIENTS
Extensor Digitorum	23(57.5%)
Extensor Carpi Radialis Brevis	14(35%)

4th and 5th Finger Extensors	6(15%)
Extensor Carpi Radialis Longus	4(10%)
Supinator	4(10%)
Brachioradialis	2(5%)

57.5% of patients were found to have trigger points in the Extensor Digitorum muscle, which is consistent with Haswell's (2002) research, which also found the Extensor Digitorum to be the most commonly affected muscle.

4.4 RESULTS OF DATA ANAYLSIS

4.4.1 INTER-GROUP COMPARISON (Group A versus Group B)

4.4.1.1 Subjective Measures

4.4.1.1.1 McGill Pain Questionnaire

Table 10: Comparison of Group A and Group B using the Mann-Whitney U test, to analyze results obtained from the McGill Pain Questionnaire at visits 1, 3, 5 and 6.

	GROUP A		GROUP B
	MEAN	**p-value**	**MEAN**
V.1	20.70	0.913	20.30
V.3	20.33	0.924	20.67

V.5	17.92	0.146	23.08
V.6	18.70	0.307	22.30

The values that are shown for visit 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly ($p \geq 0.05$)

The null hypothesis is accepted for the Short-Form McGill Pain Questionnaire, indicating that at the $\alpha = 0.05$ level of significance there was **no difference** in the patient's sensory perception of pain between the two groups.

4.4.1.1.2 NRS-101 Questionnaire

Table 11: Comparison of Group A and Group B using the Mann-Whitney U test to analyze results obtained from the NRS-101 Questionnaire at visits 1, 3, 5 and 6.

	GROUP A		**GROUP B**
	MEAN	**p-value**	**MEAN**
V1	20.65	0.935	20.35
V3	18.05	0.183	22.95
V5	17.80	0.142	23.20
V6	18.20	0.212	22.80

The values that are shown for visit 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly ($p \geq 0.05$)

The null hypothesis is accepted for the NRS-101 Pain Questionnaire, indicating that at the $\alpha = 0.05$ level of significance there was **no difference** in the patient's pain intensity between the two groups.

4.4.1.2 Objective Measures

4.4.1.2.1 Algometer Readings

Table 12: Comparison of Group A and Group B using the Mann-Whitney U test to analyze results obtained from the Algometer Readings at visits 1, 3, 5 and 6.

	GROUP A		**GROUP B**
	MEAN	**p-value**	**MEAN**
V1	22.98	0.179	18.02
V3	20.88	0.839	20.13
V5	24.35	0.036	16.65
V6	22.83	0.206	18.17

The null hypothesis is accepted for the Algometer Readings, indicating that at the $\alpha = 0.05$ level of significance there was **no difference** in the patient's pain level of tenderness between the two groups at visits 1,3 and 6. However, at visit 5 the null hypothesis was rejected indicating that there **was a difference** in improvement with regards to the level of tenderness experienced.

4.4.1.2.2 Dynamometer Readings

Table 13: Comparison of Group A and Group B using the Mann-Whitney U test to analyze results obtained from the Dynamometer Readings at visits 1, 3, 5 and 6.

	GROUP A		**GROUP B**
	MEAN	**p-value**	**MEAN**
V1	21.80	0.481	19.20
V3	21.10	0.745	19.90
V5	21.88	0.457	19.13
V6	21.80	0.481	19.20

The values that are shown for visit 1 are the values that were obtained before the first treatment indicating that both Group A and Group B started off similarly ($p \geq 0.05$)

The null hypothesis is accepted for the Dynamometer Readings, indicating that at the α = 0.05 level of significance there was **no difference** in the grip strength readings between the two groups.

4.4.1.2.3 Myofascial Diagnostic Scale

Table 14: Comparison of Group A and Group B using the Mann-Whitney U test to analyze results obtained from the Myofascial Diagnostic Scale at visits 1, 3, 5 and 6.

	GROUP A		**GROUP B**
	MEAN	**p-value**	**MEAN**
V1	27.70	0.000(<0.001)	13.30
V3	23.52	0.093	17.48
V5	22.17	0.349	18.83
V6	19.85	0.738	21.15

The null hypothesis is accepted for the Myofascial Diagnostic Scale, indicating that at the α = 0.05 level of significance there was **no difference** in the levels of trigger point tenderness between the two groups for visits 3,5 and 6. At visit 1 the null hypothesis is rejected indicating that the two groups did not start off equally.

4.4.2. INTRA-GROUP COMPARISON

4.4.2.1 <u>Subjective Measures</u>

4.4.2.1.1 McGill Pain Questionnaire

Table 15: Comparisons of Group A and B using the Friedman's T test to analyze results obtained within the groups from the McGill Pain Questionnaire at visits 1, 3, 5 and 6.

MCGILL PAIN QUESTIONNAIRE								
	GROUP A				GROUP B			
	V1	V3	V5	V6	V1	V3	V5	V6
MEAN	4.00	2.75	1.77	1.48	3.72	2.60	2.13	1.55
p-value	**0.000 (<0.001)**				**0.000 (<0.001)**			

For both groups the null hypothesis is rejected for the McGill Pain Questionnaire, 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.

4.4.2.1.2 NRS-101 Questionnaire

Table 16: Comparisons of Group A and B using the Friedman's T test to analyze results obtained within the groups from the NRS-101 Questionnaire at visits 1, 3, 5 and 6.

NRS-101 QUESTIONNAIRE								
	GROUP A				GROUP B			
	V1	V3	V5	V6	V1	V3	V5	V6
MEAN	3.88	2.70	1.98	1.45	3.63	2.83	2.08	1.48
p-value	**0.000 (<0.001)**				**0.000 (<0.001)**			

For both groups the null hypothesis is rejected for the NRS-101 Questionnaire, 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.

4.4.2.2 Objective Measures

4.4.2.2.1 Algometer Readings

Table 17: Comparisons of Group A and B using the Friedman's T test to analyze results obtained within the groups from the Algometer Readings at visits 1, 3, 5 and 6.

ALGOMETER READINGS								
	GROUP A				GROUP B			
	V1	V3	V5	V6	V1	V3	V5	V6
MEAN	1.70	2.03	3.10	3.17	1.55	2.58	2.60	3.28
p-value	**0.000 (<0.001)**				**0.000 (<0.001)**			

For both groups the null hypothesis is rejected for the NRS-101 Questionnaire, 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.

4.4.2.2.2 Dynamometer Readings

Table 18: Comparisons of Group A and B using the Friedman's T test to analyze results obtained within the groups from the Dynamometer Readings at visits 1, 3, 5 and 6.

DYNAMOMETER READINGS								
	GROUP A				**GROUP B**			
	V1	V3	V5	V6	V1	V3	V5	V6
MEAN	2.20	1.95	2.72	3.13	2.05	2.30	2.58	3.08
p-value	**0.010**				**0.064**			

For Group A the null hypothesis is rejected for the Dynamometer Readings, indicating that at the α = 0.05 level of significance there was a **statistically significant** improvement in grip strength between the four consultations in Group A.

For Group B the null hypothesis is accepted for the Dynamometer Readings, indicating that at the α = 0.05 level of significance there was **no difference** in grip strength between the four consultations in Group B.

4.4.2.2.3 Myofascial Diagnostic Scale

Table 19: Comparisons of Group A and B using the Friedman's T test to analyze results obtained within the groups from the Myofascial Diagnostic Scale at visits 1, 3, 5 and 6.

MYOFASCIAL DIAGNOSTIC SCALE								
	GROUP A				GROUP B			
	V1	V3	V5	V6	V1	V3	V5	V6
MEAN	3.55	2.75	2.22	1.48	2.78	2.8	2.3	2.13
p-value	**0.000(<0.001)**				**0.128**			

For Group A the null hypothesis is rejected for the Myofascial Diagnostic Scale, indicating that at the $\alpha = 0.05$ level of significance there was a **statistically significant** improvement between the four consultations in Group A.

For Group B the null hypothesis is accepted for the Myofascial Diagnostic Scale, indicating that at the $\alpha = 0.05$ level of significance there was **no difference** in improvement between the four consultations in Group B.

4.4.3 DUNN'S PROCEDURE (Multiple Comparison Test)

If the null hypothesis (H_0) is rejected for the Friedman's T test, then this multiple comparison procedure will have to be applied to determine between which treatments a significant improvement occurred (Daniel 1978).

The null hypothesis was rejected for the objective and subjective findings of Group A and B. It was the necessary to apply Dunn's Procedure (as described below) to the pain questionnaires, algometer and dynamometer readings and the Myofascial Diagnostic Scale to determine which of the treatments were significantly different.

Let V_j and V_j^1 be the j^{th} and $j^{1\,th}$ treatment rank totals.

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

If $/ V_j - V_j^1 / \geq z \sqrt{\frac{b\,k(k+1)}{6}}$, then V_j and V_j^1 are declared significant.

In the above formula:

b = the number of blocks

k = the number of readings

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

In this case, b=20, k=4, α=0.10 and z=2.409

i.e. If the difference of rank totals $\geq$ 19.669 then V_j and V_j^1 are declared significant.

For the purpose of this study, V_1 is the 1st visit, V_3 is the 3rd visit, V_5 is the 5th visit and V_6 is the 6th visit.

4.4.3.1 SUBJECTIVE MEASURES

4.4.3.1.1 McGill Pain Questionnaire

Table 20: Dunn's Procedure for the McGill Pain Questionnaire (Group A)

	Rank Total	Difference	Rank Total	
V.1	80	25	55	V.3
V.1	80	44.6	35.4	V.5
V.1	80	50.4	29.6	V.6
V.3	55	19.6	35.4	V.5
V.3	55	25.4	29.6	V.6
V.5	35.4	5.8	29.6	V.6

$V_1 – V_3 = 25 \geq 19.669$, therefore between consultations **1 and 3**, the result is declared **statistically significant.**

$V_1 – V_5 = 44.6 \geq 19.669$, therefore between consultations **1 and 5**, the result is declared **statistically significant.**

$V_1 – V_6 = 50.4 \geq 19.669$, therefore between consultations **1 and 6**, the result is declared **statistically significant.**

$V_3 – V_5 = 19.6 < 19.669$, therefore between consultations **3 and 5**, the result is declared **statistically insignificant.**

$V_3 - V_6 = 25.4 \geq 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically significant.**

$V_5 - V_6 = 5.8 < 19.669$, therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

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

4.4.3.1.2 McGill Pain Questionnaire

Table 21: Dunn's Procedure for the McGill Pain Questionnaire (Group B)

	Rank Total	**Difference**	**Rank Total**	
V.1	74.4	22.4	52	V.3
V.1	74.4	31.8	42.6	V.5
V.1	74.4	43.4	31	V.6
V.3	52	9.4	42.6	V.5
V.3	52	21	31	V.6
V.5	42.6	11.6	31	V.6

$V_1 - V_3 = 22.4 \geq 19.669$, therefore between consultations **1 and 3**, the result is declared **statistically significant.**

$V_1 - V_5 = 31.8 \geq 19.669$, therefore between consultations **1 and 5**, the result is declared **statistically significant.**

$V_1 - V_6 = 43.4 \geq 19.669$, therefore between consultations **1 and 6**, the result is declared **statistically significant.**

$V_3 - V_5 = 9.4 < 19.669$, therefore between consultations **3 and 5**, the result is declared **statistically insignificant.**

$V_3 - V_6 = 21 \geq 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically significant.**

$V_5 - V_6 = 11.6 < 19.669$ therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

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

4.4.3.1.3 NRS-101 Pain Questionnaire

Table 22:Dunn's Procedure for the NRS-101 Pain Questionnaire (Group A)

	Rank Total	Difference	Rank Total	
V.1	77.6	23.6	54	V.3
V.1	77.6	38	39.6	V.5
V.1	77.6	48.6	29	V.6
V.3	54	14.4	39.6	V.5
V.3	54	25	29	V.6
V.5	39.6	10.6	29	V.6

$V_1 - V_3 = 23.6 \geq 19.669$, therefore between consultations **1 and 3**, the result is declared **statistically significant.**

$V_1 - V_5 = 38 \geq 19.669$, therefore between consultations **1 and 5**, the result is declared **statistically significant.**

$V_1 - V_6 = 48.6 \geq 19.669$, therefore between consultations **1 and 6**, the result is declared **statistically significant.**

$V_3 - V_5 = 14.4 < 19.669$, therefore between consultations **3 and 5**, the result is declared **statistically insignificant.**

$V_3 - V_6 = 25 \geq 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically significant.**

V_5 - V_6 = 10.6 <19.669 therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

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

4.4.3.1.4 NRS-101 Pain Questionnaire

Table 23:Dunn's Procedure for the NRS-101 Pain Questionnaire (Group B)

	Rank Total	Difference	Rank Total	
V.1	72.6	16	56.6	V.3
V.1	72.6	31	41.6	V.5
V.1	72.6	43	29.6	V.6
V.3	56.6	15	41.6	V.5
V.3	56.6	27	29.6	V.6
V.5	41.6	12	29.6	V.6

$V_1 – V_3$ = 16 < 19.669, therefore between consultations **1 and 3**, the result is declared **statistically insignificant.**

$V_1 – V_5$ = 31 ≥ 19.669, therefore between consultations **1 and 5**, the result is declared **statistically significant.**

$V_1 – V_6 = 43 \geq 19.669$, therefore between consultations **1 and 6**, the result is declared **statistically significant.**

$V_3 – V_5 = 15 < 19.669$, therefore between consultations **3 and 5**, the result is declared **statistically insignificant.**

$V_3 - V_6 = 27 \geq 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically significant.**

$V_5 - V_6 = 12 < 19.669$ therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

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

4.4.3.2 OBJECTIVE MEASURES

4.4.3.2.1 The Algometer Readings

Table 24:Dunn's Procedure for the Algometer Readings (Group A).

	Rank Total	Difference	Rank Total	
V.1	34	6.6	40.6	V.3

V.1	34	28	62	V.5
V.1	34	29.4	63.4	V.6
V.3	40.6	21.4	62	V.5
V.3	40.6	22.8	63.4	V.6
V.5	62	1.4	63.4	V.6

$V_1 – V_3 = 6.6 < 19.669$, therefore between consultations **1 and 3**, the result is declared **statistically insignificant.**

$V_1 – V_5 = 28 \geq 19.669$, therefore between consultations **1 and 5**, the result is declared **statistically significant.**

$V_1 – V_6 = 29.4 \geq 19.669$, therefore between consultations **1 and 6**, the result is declared **statistically significant.**

$V_3 – V_5 = 21.4 \geq 19.669$, therefore between consultations **3 and 5**, the result is declared **statistically significant.**

$V_3 - V_6 = 22.8 \geq 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically significant.**

$V_5 - V_6 = 1.4 < 19.669$ therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

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

4.4.3.2.2 The Algometer Readings

Table 25: Dunn's Procedure for the Algometer Readings (Group B).

	Rank Total	Difference	Rank Total	
V.1	31	20.6	51.6	V.3
V.1	31	21	52	V.5
V.1	31	34.6	65.6	V.6
V.3	51.6	0.4	52	V.5
V.3	51.6	14	65.6	V.6
V.5	52	13.6	65.6	V.6

$V_1 - V_3 = 20.6 \geq 19.669$, therefore between consultations **1 and 3**, the result is declared **statistically significant.**

$V_1 - V_5 = 21 \geq 19.669$, therefore between consultations **1 and 5**, the result is declared **statistically significant.**

$V_1 - V_6 = 34.6 \geq 19.669$, therefore between consultations **1 and 6**, the result is declared **statistically significant.**

$V_3 - V_5 = 0.4 < 19.669$, therefore between consultations **3 and 5**, the result is declared **statistically insignificant.**

$V_3 - V_6 = 14 < 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically insignificant.**

$V_5 - V_6 = 13.6 < 19.669$ therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

This implies that a significant improvement exists between visits 1 and 3, 1 and 5, 1 and 6, but no improvement can be demonstrated between visits 3 and 5, and 3 and 6, and 5 and 6 with regard to the level of tenderness experienced in Group B.

4.4.3.2.3 The Dynamometer Readings

Table 26: Dunn's Procedure for the Dynamometer Readings (Group A).

	Rank Total	Difference	Rank Total	
V.1	44	5	39	V.3
V.1	44	10.4	54.4	V.5
V.1	44	18.6	62.6	V.6
V.3	39	15.4	54.4	V.5
V.3	39	23.6	62.6	V.6

V.5	54.4	8.2	62.6	V.6

$V_1 – V_3 = 5 < 19.669$, therefore between consultations **1 and 3**, the result is declared **statistically insignificant.**

$V_1 – V_5 =10.4 < 19.669$, therefore between consultations **1 and 5**, the result is declared **statistically insignificant.**

$V_1 – V_6 = 18.6 < 19.669$, therefore between consultations **1 and 6**, the result is declared **statistically insignificant.**

$V_3 – V_5 = 15.4 < 19.669$, therefore between consultations **3 and 5**, the result is declared **statistically insignificant.**

$V_3 - V_6 = 23.6 \geq 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically significant.**

$V_5 - V_6 = 8.2 < 19.669$ therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

This implies that a significant improvement exists between visits 3 and 6, but no improvement can be demonstrated between visits 1 and 3, 1 and 5, 1 and 6, 3 and 5, and 5 and 6 with regard to the grip strength for Group A.

4.4.3.2.4 The Myofascial Diagnostic Scale

Table 27: Dunn's Procedure for the Myofascial Diagnostic Scale (Group A).

	Rank Total	Difference	Rank Total	
V.1	71	16	55	V.3
V.1	71	26.6	44.4	V.5
V.1	71	41.4	29.6	V.6
V.3	55	10.06	44.4	V.5
V.3	55	25.4	29.6	V.6
V.5	44.4	14.8	29.6	V.6

$V_1 – V_3$ = 16 < 19.669, therefore between consultations **1 and 3**, the result is declared **statistically insignificant.**

$V_1 – V_5$ =26.6 ≥ 19.669, therefore between consultations **1 and 5**, the result is declared **statistically significant.**

$V_1 – V_6$ = 41.4 ≥ 19.669, therefore between consultations **1 and 6**, the result is declared **statistically significant.**

$V_3 – V_5$ = 10.6 <19.669, therefore between consultations **3 and 5**, the result is declared **statistically insignificant.**

$V_3 - V_6 = 25.4 \geq 19.669$, therefore between consultations **3 and 6**, the result is declared **statistically significant.**

$V_5 - V_6 = 14.8 < 19.669$ therefore between consultations **5 and 6**, the result is declared **statistically insignificant.**

This implies that a significant improvement exists between visits 1 and 5, 1 and 6, 3 and 6, but no improvement can be demonstrated between visits 1 and 3, 3 and 5, and 5 and 6 with regard myofascial pain in Group A.

4.5 COMPARISON OF TRENDS

The following graphs are a visual representation of the mean value changes of Group A and B found within the 1st, 3rd, 5th and 6th (one-week follow up) consultations. These graphs serve to indicate trends within the two groups.

4.5.1 Mean McGill Values

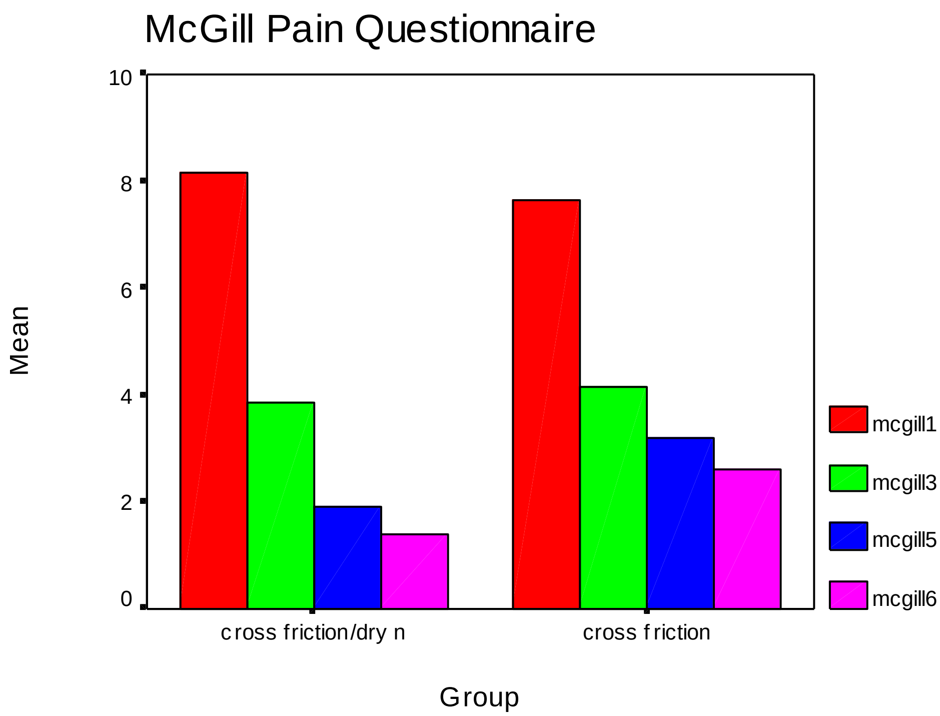

Figure 1: Changes in the mean percentage quality of pain experienced over the period of evaluation.

This graph indicates that both group started out at similar pain scores, but by the final treatment Group A had improved considerably more than Group B and at a faster pace. It is also interesting to note that Group A improved by 50% between visits 1 and 3.

4.5.2 Mean NRS-101 Values

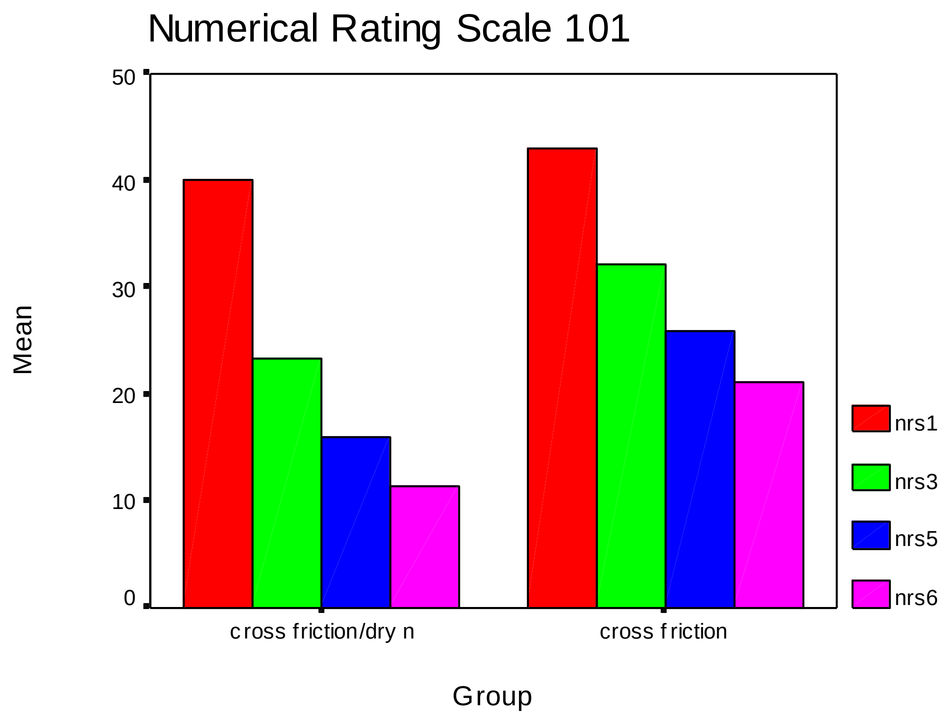

Figure 2: Changes in mean percentage of pain perception over the period of evaluation.

This graph indicates that both groups started out at similar pain scores, but by the final treatment Group A had improved considerably and was half of what Group B was at the one-week follow up. It is also noted that Group A dropped by approximately half between the 1st and 3rd treatments, whereas Group B did not fair nearly as well.

4.2.3 Mean Algometer Values

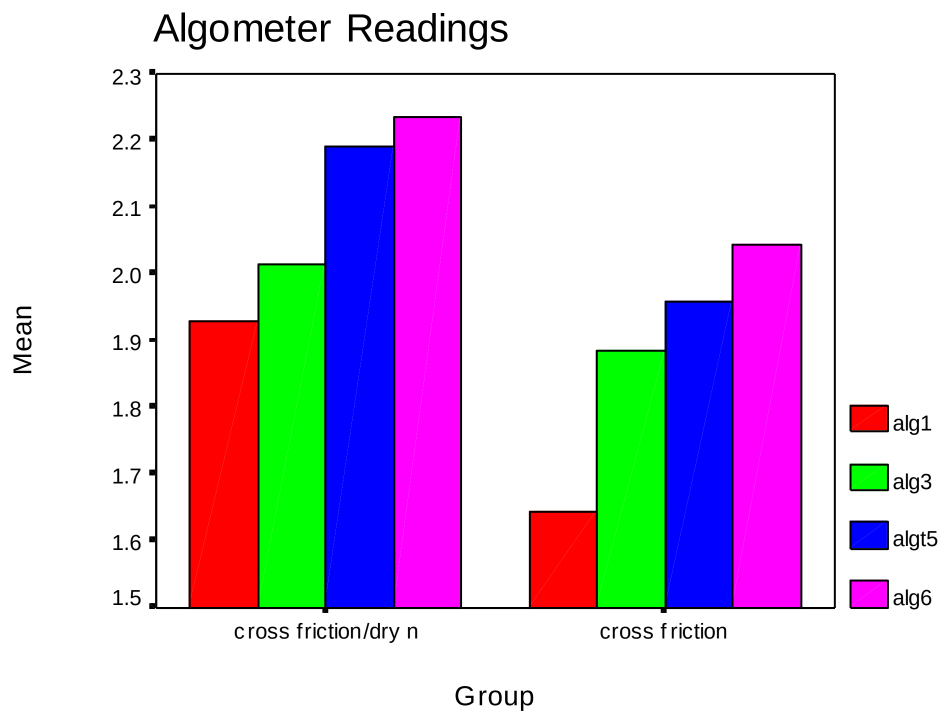

Figure 3: Changes in mean algometer readings indicating the patient's level of tenderness over the period of evaluation.

This Graph indicates that there were marked differences between Groups A and B. On the first consultation Group A was able to withstand more pressure over the common extensor tendon than Group B. By treatment 3 there was only a small improvement in Group A (0.1), whereas Group B showed considerable improvement (0.3). At the one-week follow up both groups had improved with Group B showing a slightly bigger overall improvement than Group A.

4.2.4 Mean Dynamometer Values

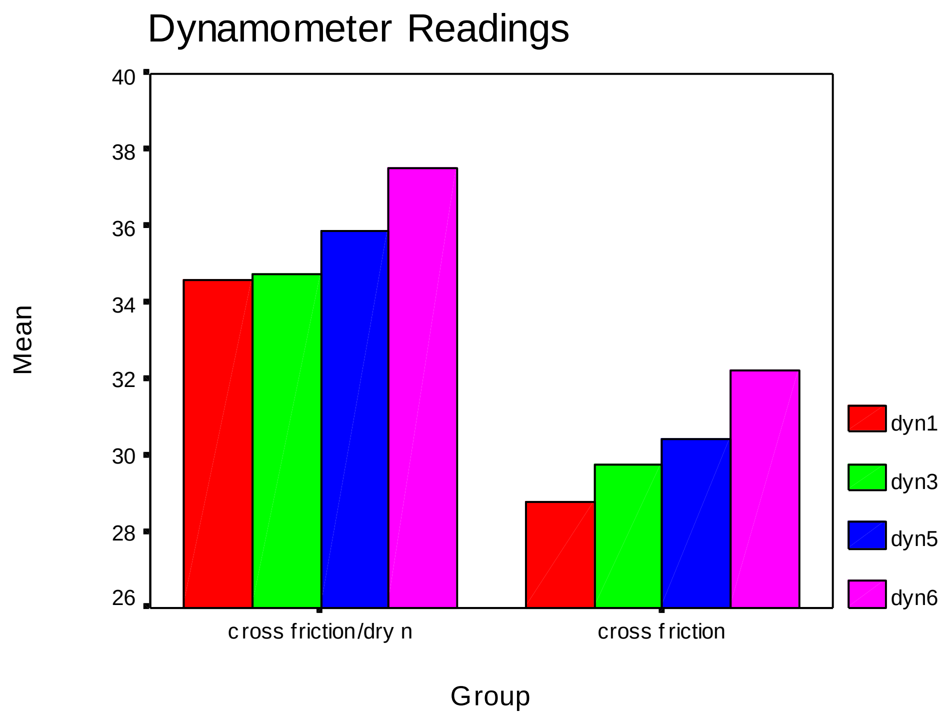

Figure 4: Changes in mean grip strength readings over the period of evaluation.

The graph indicates that overall Group A had a stronger grip strength on visit 1, whereas Group B had a considerably weaker grip strength on visit 1. This could possibly be attributed to the higher number of males in Group A. Overall both groups seemed to improve at a similar pace to the completion of the visits.

4.2.5 Mean Myofascial Diagnostic Scale Values

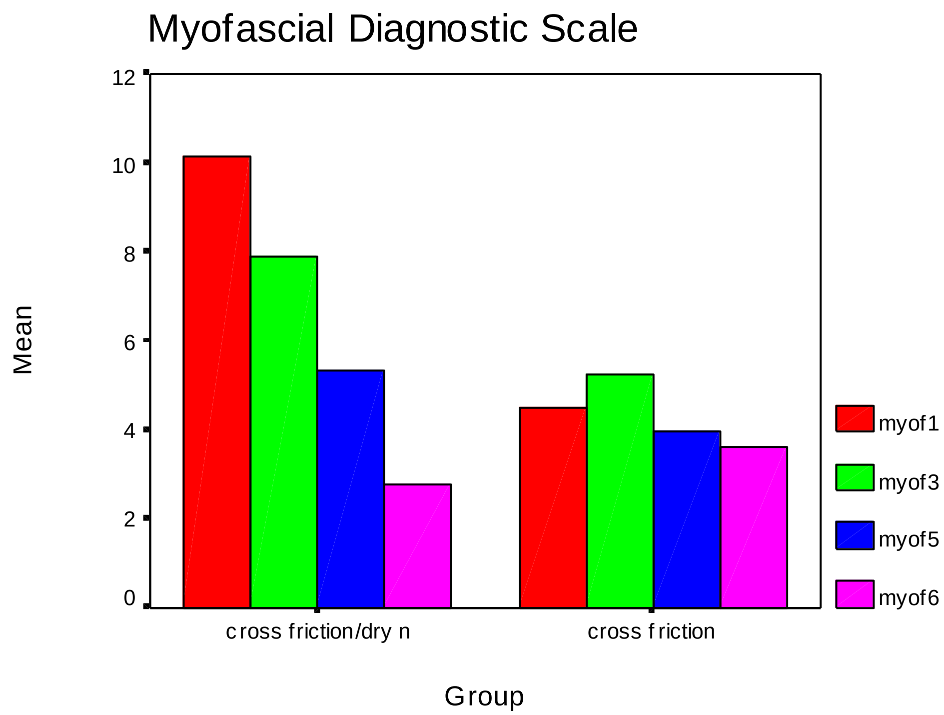

Figure 5: Changes in mean myofascial diagnostic scale readings over the period of evaluation.

This graph shows a consistent improvement in Group A from treatment 1 to the visit 6 (one-week follow up), suggesting that dry needling is effective in reducing the pain of myofascial trigger points. Whereas Group B demonstrated only a small improvement in myofascial pain and even an increase at treatment 3, indicating that trigger points were persisting and contributing to pain levels.

CHAPTER 5: DISCUSSION

5.1 INTRODUCTION

This chapter deals with the discussion of the results gained from the statistical analysis of the data obtained from the McGill Pain Questionnaire, the Numerical Rating Scale (NRS-101), the Algometer and the Dynamometer Readings as well as the Myofascial Diagnostic Scale.

5.2 DEMOGRAPHIC DATA

Table 1 shows the age distribution within the sample of 40 patients. 90% of the patients fell into the 40–49 and 50–59 age group, with the average age being 48 years. Roodt (2001) had a similar finding in that the average age in his study was 47 years whereas Oehley (2002) had an average age of 45 years, with 17% falling into the 41-50 age group. This is consistent with Delee and Drez (1994:860) who said that lateral epicondylitis occurs four times more commonly in the fourth decade, with a peak occurrence at 42 years of age. Shaik (2000) had a slightly younger average age of 40 years, whilst Haswell (2002) had the youngest overall average age of 36 years. Jackson (1997:104) further stated that lateral epicondylitis was more commonly found between the ages of 30 and 55 years. As can be seen from the table only 5% of patients fell in the 21–29 age group, which is qualified by Ernst (1992:55) who stated that the syndrome is rarely seen in individuals under the age of 30. According to Kesson and Atkins (1998:171) the normal aging process causes degenerative changes in the tendon and that degeneration combined with the relative avascularity of the tendon seem to predispose them to microtrauma through overuse activity. This may account for the increased incidence in the older age groups.

Table 2 demonstrates a greater incidence of males (57%) as compared with females (42.5%). Both Oehley (2002) and Roodt (2001) also found a greater incidence of males in their studies. The higher male predominance could be linked to there being a higher male than female population at the sports clubs where most of the advertising took place. According to Thomson et al. (1991:60) lateral epicondylitis has an equal gender distribution according to activity. However, Viola (1998:53) has reported that some studies have shown a slight excess in either males or females. No explanations for the gender variations were given. Shaik (2000) and Haswell (2002) found opposing results to the above-mentioned studies in that both had a higher incidence of female patients in their studies and no explanations for these variances were given.

Table 3 is concerned with the racial distribution of patients and demonstrates a predominance of white participants (82.5%), which is in keeping with a study of 1000 patients in the USA, in which lateral epicondylitis was found to be rare in blacks and occur more frequently in Caucasians (Delee and Drez 1994:860). No reliable statistics could be found concerning the incidence of this condition in Southern Africa. Table 3, may incorrectly allude to the conclusion that lateral epicondylitis does not affect the black population, as there were no black participants in my study. It was previously argued by Shaik (2000) and Haswell (2002) that the methods of advertising employed, the location of the Chiropractic Day Clinic as well as a lack of awareness toward chiropractic were responsible for the biased racial demographics. The fact that the Chiropractic Day Clinic is located close to the Warwick Triangle Bus Terminal suggests that the study should be accessible to a large number of non-whites, however this was clearly not demonstrated by the demographics. This could be explained by a general lack of understanding of what chiropractic is and what it has to offer the patient.

Table 4 showed that in 67% of patients the right elbow was affected by lateral epicondylitis. This could be as result of this being the dominant arm and thereby being exposed to overuse more frequently than the non-dominant arm. According to Viola (1998:53) the syndrome is usually restricted to the dominant arm.

Table 5 demonstrated the incidence of lateral epicondylitis according to occupation and showed that the highest incidence of 12.5% was found in builders and housewives. Both occupations involve a high degree of physical activity and may result in an overuse syndrome developing. Interestingly Shaik (2000) and Oehley (2002) found a high incidence of lateral epicondylitis among managers.

Table 6 is concerned with listing the aggravating activity. While 12.5% of patients reported racquet sports as the causative factor a far larger number of patient’s aetiology were linked to non-sporting activities usually involving their occupation. This is consistent with the literature in which occupation rather than sporting activities are primarily responsible for lateral epicondylitis (Warhold et al. 1993:55). In other studies, sporting activities seem to be the most commonly found cause of injury, with racquet sports being the dominant factor (Shaik, 2000 and Haswell, 2002). This could possibly be as a result of the chronic repetitive overuse of the forearm extensor muscles, which is commonly associated with racquet sports.

Table 7 showed that Cozen's test was positive in 82.5% of patients, indicating that wrist extension against resistance is the primary indicator of lateral epicondylitis. This is consistent with Kessin and Atkins (1998:171) who state that, "Pain on resisted extension of the wrist is pathognomonic of the condition". In contrast Haswell (2002) and Oehley (2002) found Mill's Test to be the primary positive orthopaedic test. The Epicondylitis test was the second most commonly found positive orthopaedic test occurring in 65% of patients, which corresponds with the findings of the Extensor Digitorum muscle being most commonly affected by trigger points (Table 9) in the forearm extensor muscles.

Table 8 demonstrated the duration of symptoms in lateral epicondylitis patients. 45% of patients had a duration of symptoms of between 1- 6 months. This is consistent with Roodt (2001) who found 47% of his patients had a duration of symptoms of between 1-6 months. This could possibly be accounted for by the chronicity of the syndrome with a further 27.5% of patients experiencing symptoms up to 12 months.

Table 9 was used to indicate the prevalence of myofascial trigger points in the forearm extensor muscles. The high incidence of trigger points in the forearm extensor muscles suggests that the role that trigger points play in lateral epicondylitis is important and should not be ignored. This supports Travell et al.'s (1999:728) belief that "Tennis Elbow" or "epicondylitis" is frequently of myofascial origin, usually due to trigger points in the supinator and extensor muscles in the forearm. Rachlin (1994:344) further suggests that trigger points in the forearm extensor muscles may be responsible for the symptoms of lateral epicondylitis. 57.5% of patients were found to have trigger points in the Extensor Digitorum (consisting of the Extensor Indicis, the Middle Finger Extensors and the Ring Finger Extensors) muscle, which is consistent with Haswell's research (2002), which also found the Extensor Digitorum to be the most commonly affected muscle. 35% of patients also had trigger points in the Extensor Carpi Radialis Brevis Muscle (ECRB). Taut bands caused by trigger points in the ECRB muscles place a chronic strain on the tendinous attachment to the lateral epicondyle, thereby further exacerbating the symptoms of lateral epicondylitis. This may explain why the extensor carpi radialis brevis tendon has been implicated as the most commonly affected tendon of the extensor muscle group (Sharat and Maffulli 1997:102). Both the ECRB muscle and the Extensor Digitorum muscle have very similar actions in that the both cause extension of the fingers and wrist, which may account for their predisposition of developing myofascial trigger points.

5.3 INTER-GROUP COMPARISON

5.3.1 SUBJECTIVE DATA

The statistical data is tabulated in Tables 10 and 11. Statistical analysis revealed no statistically significant differences between Group A and B at the 1^{st}, 3^{rd}, 5^{th} and 6^{th} visits with regard to the McGill Pain Questionnaire and the Numerical Rating Scale (NRS-101).

- **The McGill Pain Questionnaire (Table 10)**

A comparison of the 1st consultation of both groups revealed no significant statistical difference (p=0.913), which indicates that both groups started off similarly. A comparison of the 3^{rd}, 5^{th} and 6^{th} visits (p=0.924; p=0.146 and p=0.307 respectively) also revealed no statistical difference between the two groups. The null hypothesis, which states that there is no significant difference between the groups, is therefore accepted. Both treatment protocols were therefore equally effective in reducing the patient's sensory perception of pain. Clinically Group A seemed to improve at a slightly faster rate than Group B which is perhaps as a result of the trigger points being deactivated and a lessoning of the strain on the common extensor tendon occurring. Both groups showed an improvement between visit 1 (V_1) and visit 3 (V_3) but then seemed to improve at a slower and more constant rate thereafter. This could possibly be accounted for by the long period of time that the tendon requires to heal and repair itself fully or perhaps as a result of a marked Hawthorne effect.

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

A comparison of the 1st consultation of both groups showed that there was no significant statistical difference (p=0.935), which means that both groups started off similarly. A comparison of the 3rd, 5th and 6th visits (p=0.183; p=0.142 and p=0.212 respectively) also revealed no statistical difference. The null hypothesis is therefore accepted. This indicates that dry needling and cross friction massage, versus cross friction alone were equally effective in reducing the patients pain intensity. Clinically group A showed a rapid and constant improvement with almost a 75% improvement between V_1 and V_6 (Figure 2). Whereas Group B showed only a 50% improvement between V_1 and V_6 (Figure 2), this suggests that dry needling and the resolution of the trigger points in the forearm extensors seems to speed up the recovery period in lateral epicondylitis.

5.3.2 OBJECTIVE DATA

The statistical data is obtained from Tables 12-14. Statistical analysis revealed no significant differences between Group A and B with regard to the Algometer and Dynamometer readings and the Myofascial Diagnostic Scale. However a significant difference was noted at visit 5 in the Algometer readings.

- **Algometer Readings**

Both groups started off similarly with regards to the level of tenderness as indicated by the Algometer suggesting no statistical differences ($p=0.179$). The null hypothesis is accepted for visits 1, 3 and 6 ($p=0.179$; $p=0.839$ and $p=0.206$) indicating that both treatment protocols were equally effective. A statistically significant improvement occurred at visit 5 ($p=0.036$) resulting in the null hypothesis being rejected. The mean Algometer readings in Group A increased in the 5th visit indicating that cross friction massage and dry needling was more effective in reducing tenderness than cross friction alone. No such difference was demonstrated in V_6, which may be accounted for by the one-week follow-up that patients were required to wait for their final assessment. It was reported to the researcher by the patients that many patients had resumed the aggravating activity that was the initial cause of the condition, after experiencing a decrease in pain as a result of the treatment.

- **Dynamometer Readings**

A comparison of the 1st consultation of both groups showed that there was no significant statistical difference ($p=0.481$), which means that both groups started off similarly. A comparison of the 3rd, 5th and 6th visits ($p=0.745$; $p=0.457$ and $p=0.481$ respectively) also revealed no statistical difference. The null hypothesis is therefore accepted. This indicates that dry needling and cross friction massage, versus cross friction alone were equally effective in improving the grip strength. It is suggested by the researcher that the Dynamometer may in fact be an aggravating factor of the condition. Many patients reported increased pain levels after using the Dynamometer and it is suggested by the researcher that perhaps testing the arm in a 90^o position should be substituted instead of the 180^o position to reduce tension on the common extensor tendon.

- **Myofascial Diagnostic Scale**

There was a statistically significant difference between Group A and B at visit 1 (p=0.000), indicating that the groups did not start off similarly. This could possibly be accounted for by several patients refusal to be needled, which resulted in them being placed in Group B thereby decreasing the possibility of true random selection. The use of dry needling was explained to patients during the initial consultation and during the telephonic interview, however several patients expressed great fear of the needling process and so revision was made with their placement in Group B. With hindsight, perhaps it would have been better to exclude these patients, to allow for true random selection to take place. The null hypothesis is accepted for visits 3, 5 and 6 (p=0.093; p=0.349 and p=0.738) indicating that both treatment protocols were equally effective.

5.4 INTRA-GROUP COMPARISON

5.4.1 SUBJECTIVE DATA

The statistical data is obtained from Tables 15-16. It was hypothesized that there would be a difference between visits with regards to the variable of interest in Group A, showing that dry needling and cross friction massage were more effective than cross friction massage alone in the treatment of lateral epicondylitis.

A significant improvement was noted in Group A and B, with regards to the McGill Pain Questionnaire and the Numerical Pain Rating Scale (NRS-101).

- **The McGill Pain Questionnaire**

Analysis of visits 1,3, 5 and 6 revealed a statistically significant difference between Group A and B (p=0.000 for both groups) indicating a decrease in pain intensity (Table 15). A multiple comparison procedure namely the Dunn's Procedure was used to determine at which point the treatment made a significant improvement.

In Group A, a significant improvement occurred between visits 1 and 3, 1 and 5, 1 and 6, and 3 and 6 but no improvement can be demonstrated between visits 3 and 5 and 5 and 6 with regard to the subjective data on pain perception (Table 20). In Group B, a significant improvement exists between visits 1 and 3, 1 and 5, 1 and 6, and 3 and 6 but no improvement can be demonstrated between visits 3 and 5 and 5 and 6 with regard to the subjective data on pain perception (Table 21).

The significant improvement between V_1 and the remaining treatments indicates that both treatment protocols are effective in reducing the patient's subjective perception of pain over the entire treatment program. The fact that there was no improvement in both groups between V_3 and V_5 and V_5 and V_6 indicates the need for the introduction of a rehabilitation program, which includes daily stretching and strengthening exercises to compliment the existing treatment protocol.

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

Analysis of visits 1,3, 5 and 6 revealed a statistically significant difference between Group A and B (p=0.000 for both groups) indicating a decrease in the level of pain perception (Table 16). A multiple comparison procedure namely the Dunn's Procedure was used to determine at which point the treatment made a significant improvement.

In Group A, a significant improvement was noted 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 the subjective data on pain perception (Table 22). In Group B, a significant improvement was noted between visits 1 and 5, 1 and 6, and 3 and 6 but no improvement can be demonstrated between visits 1 and 3, 3 and 5 and 5 and 6 with regard to the subjective data on pain perception (Table 23).

As stated previously a significant improvement was noted between V_1 and the remaining visits, but that no difference was shown when the comparisons of the final visits were made. It seems that a trend developed in which the improvement of the patients seemed to reach a plateau where after improvement was only gradual. This suggests that the treatment protocols need to be supplemented in some way, such as the introduction of a rehabilitation program that includes daily stretching and strengthening exercises.

5.4.2 OBJECTIVE DATA

- **The Algometer Readings**

Analysis of visits 1, 3, 5 and 6 revealed a statistically significant difference between Group A and B (p=0.000 for both groups) indicating a decrease in the level of tenderness in the common extensor tendon (Table 17). A multiple comparison procedure namely the Dunn's Procedure was used to determine at which point the treatment made a significant improvement.

In Group A, a significant improvement was noted between visits 1 and 5, 1 and 6, 3 and 5, and 3 and 6 but no improvement was demonstrated between visits 1 and 3, and 5 and 6 with regard to the objective data on the level of tenderness experienced (Table 24). In Group A no significant improvement was noted between V_1 and V_3 I believe that this could be explained by active trigger points requiring at least three needling treatments before they are deactivated and only there after will a large improvement be noted.

In Group B, significant improvement was noted between visits 1 and 3, 1 and 5, 1 and 6, but no improvement was demonstrated between visits 3 and 5, and 3 and 6, and 5 and 6 with regard to the objective data on the level of tenderness experienced (Table 25). The lack of significant improvement in the later visits could be linked to the long time period required for full tendon healing and so 3 weeks is in no way long enough to allow for complete resolution of the condition.

- **The Dynamometer Readings**

Analysis of visits 1, 3, 5 and 6 revealed a statistically significant difference in Group A only (p=0.010) indicating an increase in grip strength (Table 18). This suggests that trigger point treatment does play a role in increasing patient's grip strength in lateral epicondylitis as no such increase was demonstrated in Group B. A multiple comparison procedure namely the Dunn's Procedure was used to determine at which point the treatment made a significant difference.

In Group A, a significant improvement was noted between visits 3 and 6, but no improvement can be demonstrated between visits 1 and 3, 1 and 5, 1 and 6, 3 and 5, and 5 and 6 with regard to the grip strength (Table 26). As only V_3 and V_6 showed significant improvement this suggests that the Dynamometer is not a reliable measurement of lateral epicondylitis. It was also mentioned earlier that the Dynamometer may in fact be an aggravating factor of the condition, in that many patients reported increased pain levels after using the Dynamometer and that perhaps testing the arm in a 90^o position should be substituted instead of the 180^o position currently being used.

- **The Myofascial Diagnostic Scale**

Analysis of visits 1, 3, 5 and 6 revealed a statistically significant difference in Group A only (p=0.000) indicating a decrease in the number and intensity of trigger points (Table 19). Dunn's Procedure was used to determine at which point the treatment made a significant difference.

In Group A, a significant improvement was noted between visits 1 and 5, 1 and 6, 3 and 6, but no improvement can be demonstrated between visits 1 and 3, 3 and 5, and 5 and 6 with regard myofascial pain (Table 27). This suggests that myofascial trigger points require at least 2-3 treatments before becoming deactivated and thereby lessoning the tension placed on the common extensor tendon, which is necessary for the healing process to begin.

5.5 CONCLUSIONS OF THE ABOVE DATA

From the above data it can be concluded that statistically speaking both dry needling and cross friction massage versus cross friction massage alone are equally effective in treating lateral epicondylitis. However, clinically speaking Group A seemed to improve at a faster rate and intensity than Group B. Inter-Group comparisons revealed that both treatments improved the patient's quality and intensity of pain as well as decreasing local tenderness, increasing grip strength and deactivating trigger points. Intra-Group analysis showed that both treatment protocols showed significant improvements between visits, with the exception of Group B and the Dynamometer Readings as well as the Myofascial Diagnostic Scale Readings.

5.6 STUDY LIMITATIONS

5.6.1 Problems with the Subjective Data

With regards to the Questionnaires there is the possibility that the questionnaires are not specific to lateral epicondylitis and so perhaps are not sensitive enough to detect any subtle changes in the patient's degree of disability and pain intensity. It was also noted by the researcher that patients had difficulty in defining and quantifying their pain with the current questionnaires. It is therefore recommended by the researcher that questionnaires specific to lateral epicondylitis be used in order to gain a clearer insight to any progress being made by patients. Questionnaires such as the Mayo Elbow Performance Index as used by Bowen et al. (2001:643) are therefore recommended in any future studies of lateral epicondylitis.

5.6.2 Problems with the Objective Data

Placing the Algometer on the exact position as taken previously was almost impossible and human error was likely to occur which resulted in the pain threshold readings being influenced. A possible solution could include recording the exact position of tenderness via the use of a henna marker. It was noted by the researcher that some patients squeezed the Dynamometer initially while trying to find a comfortable grip position, which resulted in an initial reading being taken by the dynamometer. They then proceeded to squeeze as hard as they could to complete the test, without the dynamometer being recalibrated back to zero. This resulted in inaccurate readings as the patient should have squeezed the Dynamometer with gradually increasing pressure until maximal grip strength was reached. Several patients also complained of discomfort in the hand, which would have resulted in their inability to squeeze to their maximum capacity.

The Dynamometer may in fact be an aggravating factor of the condition, in that many patients reported increased pain levels after using the Dynamometer that resulted in an exacerbation of symptoms or a post-test ache. In the discussion of their results De Smet and Fabry (1997:231) suggest that measurement of the grip force should be repeated only after the local tenderness has disappeared and the maximum grip effort by the patient can cause further damage to the wrist extensors. This suggests that careful instruction on the correct use of the Dynamometer should be given to the patient in order to prevent an exacerbation of symptoms in this condition. The use of the Myofascial Diagnostic Scale is also questionable, in that no reliability tests to evaluate the scales validity have been conducted.

CHAPTER 6:CONCLUSIONS

6.1 RECOMMENDATIONS

Should this study be repeated, the researcher recommends the following:

- **Questionnaires**

The use of pain questionnaires specific to lateral epicondylitis, such as the Mayo Elbow Performance Index (Bowen et al. 2001:643). Also the Myofascial Diagnostic Scale should be tested in terms of reliability and validity.

- **Blinding**

The introduction of a second examiner, who would be blinded to the treatment protocol that the patient is receiving. This examiner would be used to collect and collate the data, which would be instrumental in reducing examiner bias.

- **Sample Size**

A larger sample size should be used, namely sixty patients or more. Perhaps two researchers could work together in order to gain a larger and more accurate representation of the population. This would also increase the accuracy of the statistical analysis and perhaps show any differences between the two groups more clearly.

- **Placebo Studies**

Cross friction massage against placebo has yet to be tested, as previous studies have been in conjunction with other treatment protocols. I suggest that cross friction massage against placebo should be evaluated.

- **Rest Period**

In my study I found that a day's rest between treatments helped to reduce post-cross friction soreness. When this was not possible the patient's tolerance of cross friction intensity was greatly reduced.

- **Post Treatment Prevention Care**

I suggest that patients be instructed not to resume the aggravating activity until after treatment has ceased. Many patients resumed the aggravating activity prematurely after experiencing an improvement in symptoms, which lead to a relapse in pain and disability, as the tendon had not fully healed.

- **Telephonic Follow-ups**

A telephonic follow-up at 6 months is recommended to establish the long-term effectiveness of both treatment protocols. This is in keeping with current literature, which suggests that tendons may take several months to completely heal rather than weeks, which is currently being recommended.

- **Further Research**

Lastly, as there is still much controversy over the pathogenesis, pathology, natural course and particularly the treatment of lateral epicondylitis, the researcher recommends studies such as Bowen et al. (2001) in which a combination of several non-operative treatments were given to the patient, rather than individual treatment modalities being assessed.

6.2 CONCLUSIONS

The purpose of this study was to investigate the relative effectiveness of dry needling myofascial trigger points of the forearm extensor muscles as an adjunct to cross friction massage, in the treatment of lateral epicondylitis.

The study was a prospective, randomized controlled study. Forty patients from the Durban Metropolitan area participated in the study. They underwent a case history, a brief physical examination and an elbow regional examination. They were then randomly allocated into one of two groups. Those in Group “A” received cross friction massage and dry needling, while those in Group “B” received cross friction massage only.

Each patient received five treatments over two weeks and a sixth treatment at the one-week follow-up. Subjective and objective measurements were taken before the 1st, 3rd and 5th treatments and at the one-week follow-up. Subjective data was obtained from the short-form McGill Pain Questionnaire and the

Numerical Rating Scale (NRS101). Objective data was obtained from the use of a hand held Dynamometer, the Algometer and the Myofascial Diagnostic Scale.

From the analysis of the data it can be concluded that both dry needling and cross friction massage versus cross friction massage alone are equally effective in treating lateral epicondylitis. Inter-Group comparisons revealed that both treatments improved the patient’s quality and intensity of pain as well as decreasing local tenderness, increasing grip strength and deactivating trigger points. Intra-Group analysis showed that both treatment protocols showed significant improvements between visits, with the exception of Group B and the Dynamometer Readings as well as the Myofascial Diagnostic Scale. The reasons for this are clearly outlined in Chapter 5. The results of the study seem to suggest that dry needling as an adjunct to cross friction massage was more effective in increasing grip strength and deactivating trigger points than cross friction massage alone.

After analysis of the statistical data a clinical trend emerged that showed that there was improvement in the early stages of the treatment but that this improvement seemed to plateau and only a small improvement was seen thereafter. This suggests to the researcher that although the treatment protocols were effective there was a need for the introduction of the next phase in the management protocol. This consists of a comprehensive rehabilitation program, which includes both daily stretching of the forearm extensor muscles and gradual introduction to strengthening exercises. The issue of educating the patient with regards to this condition and the necessary steps that should be taken in order to prevent a relapse are also of utmost importance and should be clearly explained to the patient during the final consultation.

This study indicates that both dry needling and cross friction massage versus cross friction massage alone are effective in the treatment of lateral epicondylitis and as a result of this further research is recommended to validate these results. It is my opinion that patients should be made aware of conservative treatment and the benefits thereof, before resorting to surgery, as this should be considered only as a last resort. Conservative care is cost effective, in that it decreases the need for medication and may reduce the amount of sick leave taken in comparison with surgery especially in a chronic condition such as lateral epicondylitis.

The results of this study suggest that both treatment protocols are effective in the management of lateral epicondylitis and thus should be integrated into the treatment protocol for this condition. As previously mentioned there is a need for the introduction of a comprehensive rehabilitation program to be introduced at the completion of treatment. It was however, unfortunate that the study failed to determine which treatment protocol was more effective in the management of lateral epicondylitis.

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