THE EFFICACY OF MUSCLE ENERGY TECHNIQUE IN THE TREATMENT OF ROTATOR CUFF TENDONITIS IN TERMS OF SUBJECTIVE AND OBJECTIVE CLINICAL FINDINGS

By

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I, Manny Azizi, do declare that this dissertation represents my own work in both conception and execution.

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Dedication

This work is dedicated to my father, mother and sister.

My mom and dad, your love and support are the only reason I am where I am today. Thank you so much for everything.

My sister Mary, you are my best friend and always have been. You have taught me so much and have been there for me without question. Thank you so much. I'll see you soon.

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"Anybody can sympathise with the sufferings of a friend, but it requires a very fine nature to sympathise with a friend's success."

- Oscar Wilde

Abstract

Purpose

Repetitive strain injuries, especially rotator cuff tendonitis, are increasing and reaching epidemic proportions in certain industries and in most industrialized countries (Yassi et al. 1996). Fatigue of the rotator cuff allows the humeral head to translate anteriorly, with resultant mechanical impingement of the supraspinatus tendon. At this point inflammatory changes become evident (Fu et al. 1995).

According to Greenman (1996), muscle energy technique (MET) is a "manual medicine treatment procedure that involves the voluntary contraction of a patients muscle in a precisely controlled direction, at varying levels of intensity, against a distinctively executed counterforce applied by the operator." It has been hypothesized that MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and decrease local edema, and to mobilize a restricted articulation (Greenman 1996). However, these statements have been made in the absence or appropriate research in order to support such statements, therefore. the aim of this study was to assess the efficacy of Muscle Energy Technique in the treatment of rotator cuff tendonitis in terms of subjective and objective clinical findings.

Methods

Objective measures included: Diagnostic ultrasound which was used to evaluate changes in inflammation and thickness of the involved tendon, the algometer was used to assess point tenderness, whilst inclinometer readings were taken to evaluate the associated changes in range of motion that may have taken place.

Subjective measurements included: the Numerical Rating Scale – 101 (NRS-101) and the Pain And Disability Scale.

The study consisted of a total of 30 subjects (randomly split into two equal groups of 15) each diagnosed with rotator cuff tendonitis. Participants were between the ages of 18 and 50.

Group 1 received 4 treatments (with Muscle Energy Technique) over a 3-week period, whereas group 2 received detuned (placebo) ultrasound over 4 consultations within the same 3-week period. Subjects underwent a clinical assessment (objective and subjective findings) at the first (pre-treatment), third and fifth consultation.

Data were entered into a MS Excel spreadsheet and imported into SPSS version 13 (SPSS Inc., Chicago, Illinois, USA), which was used for data analysis.

Demographics were compared between the two treatment groups using Pearson's chi square tests or Fisher's exact tests as appropriate for categorical variables, and independent t-tests for quantitative variables.

In the assessment of a treatment effect, 3 effects were tested:
1) the effect of time
2) the effect of group (MET vs. placebo), and
3) the interaction effect of time and group (treatment effect)

Results

According to the algometer and diagnostic ultrasound readings, there was objective improvement during the treatment programme for both groups. There was, however, more statistically significant improvement in the Muscle Energy Technique group. According to the inclinometer readings and the subjective readings of the Numerical Pain Rating Scale-101 and Pain Disability Scale, there was improvement within both groups. Although statistical testing showed the difference between the groups to be insignificant, the MET effect was at no point worse than the effect of the placebo ultrasound, and even showed a trend towards a beneficial effect of the MET treatment when results were viewed graphically.

This research would indicate that although Muscle Energy Technique may be more effective than placebo ultrasound in the treatment of rotator cuff tendonitis in terms of objective findings, it alone is not clinically effective in the treatment of this condition and should be used more as an adjunct to other primary treatment methods.

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List of Abbreviations

NRS-101: Numerical Rating Scale – 101

MET: Muscle Energy Technique

PIR: Post Isometric Relaxation

VA: Vertical Abduction

Definition of Terms:

Muscle Energy Technique

According to Greenman (1996), muscle energy technique (MET) is a "manual medicine treatment procedure that involves the voluntary contraction of a patients muscle in a precisely controlled direction, at varying levels of intensity, against a distinctively executed counterforce applied by the operator."

Tendinitis

Is defined according to Clancy (1996), as symptomatic degeneration of the tendon with vascular disruption and inflammatory repair response.

Ultrasonography

The imaging of deep structures of the body by recording the echoes of pulses of ultrasonic waves directed into the tissues and reflected by tissue planes where there is a change in density (Dorland's Medical Dictionary, 1995).

Chapter One

1.1 Introduction

The most frequently recorded shoulder disorder in general practice is rotator cuff tendonitis (Van der Windt et al. 1995). Primary impingement of the supraspinatus tendon is responsible in the majority of cases (Fu et al. 1995). The dynamic and static stabilizers of the shoulder are placed under stress with overhead movements. These repetitive stresses result in microtrauma to the glenohumeral ligaments. Eventually fatigue of the rotator cuff allows the humeral head to translate anteriorly, with resultant mechanical impingement of the supraspinatus tendon. At this point inflammatory changes become evident (Fu et al. 1995).

Repetitive strain injuries, especially rotator cuff tendonitis, are increasing and reaching epidemic proportions in certain industries and in most industrialized countries (Yassi et al. 1996). An extensive review of the literature revealed contradictory information pertaining to the treatment of rotator cuff tendonitis (Green et al. 1998). Almkinders and Temple (1998) also believe that further investigation is required regarding the diagnosis and management of shoulder pain.

According to Greenman (1996), muscle energy technique (MET) is a "manual medicine treatment procedure that involves the voluntary contraction of a patients muscle in a precisely controlled direction, at varying levels of intensity, against a distinctively executed counterforce applied by the operator." It has been hypothesized that MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and decrease local edema, and to mobilize a restricted articulation (Greenman 1996).

While MET has become widely used with clinicians, little has been published on this intervention (Gibbons and Tehan, 1998) and very little has been published in the way of randomized control trials involving MET (Schenk 1994).

Due to the wide use of this treatment technique and the lack of published clinical trials, it is imperative that further research be done to determine its efficacy in the treatment of neuromusculoskeletal disorders such as rotator cuff tendonitis.
The aim of this study was to evaluate the efficacy of Muscle Energy Technique (MET) in the treatment of rotator cuff tendonitis.

1.2 Aim of the Study

The aim of this study was to determine the efficacy of Muscle Energy Technique in the treatment of rotator cuff tendonitis in terms of subjective and objective clinical findings

OBJECTIVES

The first objective was to evaluate the effect of Muscle Energy Technique as opposed to de-tuned ultrasound in terms of subjective findings in the treatment of rotator cuff tendonitis.

The second objective was to evaluate the effect of Muscle Energy Technique as opposed to de-tuned ultrasound in terms of objective findings in the treatment of rotator cuff tendonitis.

It was hypothesized that both MET and de-tuned ultrasound would have a beneficial effect in the treatment of rotator cuff tendonitis in terms of both subjective and objective clinical findings. It was further hypothesized that MET would have a greater beneficial effect than de-tuned ultrasound in the treatment of rotator cuff tendonitis in terms of both subjective and objective clinical findings.

1.3 Rationale for the Study

An extensive review of the literature revealed contradictory information pertaining to the treatment of rotator cuff tendonitis (Green et al. 1998). It would, therefore, be beneficial to research the clinical efficacy of treatment techniques, such as Muscle Energy Technique, on this disorder so that a clearer understanding of the treatment options and their efficacy can be obtained.

Muscle Energy Technique has found an increasing audience with clinicians (Gibbons and Tehan, 1998) but very little has been published about this intervention (Wilson et al. 2003).

This study would open the way for future research into both the treatment of supraspinatus tendonitis as well as the clinical use of Muscle Energy Technique.

1.5 Conclusions

The aim of this study therefore, was to assess the efficacy of Muscle Energy Technique in the treatment of rotator cuff tendonitis in terms of subjective and objective clinical findings

Chapter two consists of a brief review of literature, followed by the research methodology and materials used (chapter three), and lastly the results and interpretation thereof in chapters four and five, resepectively.

Chapter Two

REVIEW OF RELATED LITERATURE

2.1 Introduction and overview of the chapter

The following chapter aims to review and describe the relevant anatomy of the shoulder girdle, the most common soft tissue pathology found in the girdle, as well as the some common treatment methods. Thereafter Muscle Energy Technique and its hypothesized benefits will be discussed.

2.2 Anatomy and function of the cuff

The supraspinatus, infraspinatus, teres minor and subscapularis muscles are referred to as the rotator cuff of the shoulder joint (Moore, 1992; Prescher, 2000).

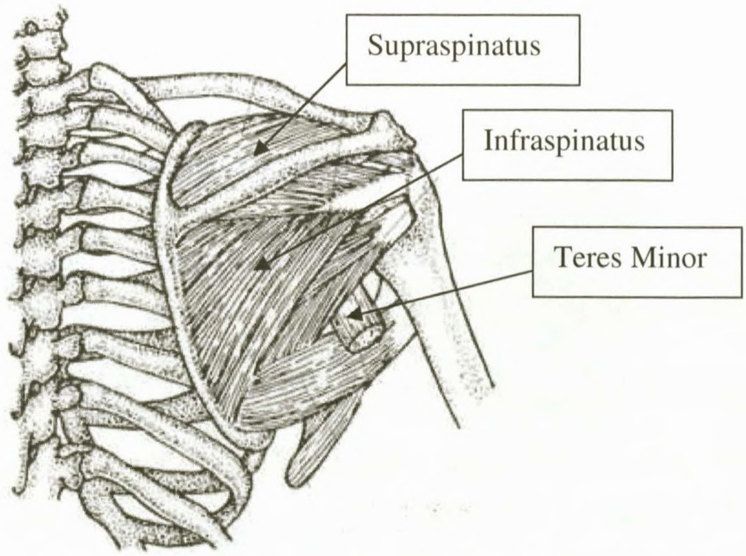

Image 1: Anatomy of the cuff (subscapularis omitted from the picture)
By Kibler, W.B (2005).

Table 1: The following table illustrates the attachments of these rotator cuff muscles:

Muscle	Origin	Insertion
Subscapularis	Arises from the medial and lower two-thirds of the axillary border of the subscapular fossa.	Fibres converge in a tendon, which is inserted into the lesser tubercle of the humerus.
Infraspinatus	Arises from fibers on the medial two-thirds of the infraspinatous fossa.	Fibres converge to a tendon and are inserted into the middle impression on the greater tubercle of the humerus.
Teres Minor	Arises from the dorsal surface of the axillary border of the scapula.	Fibres end in a tendon, which is inserted into the lowest of the three impressions on the greater tubercle of the humerus.
Supraspinatus	Arises from the medial two-thirds of the supraspinatous fossa.	Fibres converge to a tendon, which is inserted into the highest of the three impressions on the greater tubercle of the humerus.

(Table information from Gray, Pickering Pick & Howden, 1974; Moore, 1992 and Kieser & Allen, 1999)

Principally the supraspinatus assists the deltoid to abduct the arm and in conjunction with the other rotator cuff muscles (viz. infraspinatus, teres minor and subscapularis), helps hold the humeral head in the glenoid cavity (Moore, 1992 and Moore and Dalley, 1999).

The suprascapular nerve (SSN) arises from the superior trunk of the brachial plexus mainly at the C5 - C6 level, whereby it passes obliquely outwards beneath the trapezuis muscle in the posterior triangle of the neck (Moore, 1992). The nerve passes through the suprascapular notch, whereby it enters the supraspinous fossa giving off two motor branches to the supraspinatus muscle.

The SSN also gives off a superior articular branch, which innervates the acromioclavicular joint and its associated bursa and the coracoclavicular and coracohumeral ligaments.

The SSN therefore, provides the motor innervation of the supraspinatus and infraspinatus muscles, and the sensory and proprioceptive innervation of the glenohumeral and acromioclavicular joints, subacromial bursa, scapula, and posterior aspect of the shoulder joint (Reeser, 2003).

2.3 Incidence and prevalence

Rotator cuff tendonitis is one of the most common causes of shoulder pain and dysfunction seen in athletes (Brukner, 1996). According to Brukner (1996), and Arroyo et al., (1997), rotator cuff tendonitis is a common cause of pain and dysfunction, and is the most common shoulder problem in sports medicine, particularly in overhead throwing athletes. However, even a non-competitive athlete may find himself suffering from the same underlying pathology following a vigorous weekend game of tennis (Barry and McGuire 1996). It is prevalent in individuals who subject their shoulders to repeated stresses, overhead athletes and middle-aged and elderly persons in whom a cause may not be apparent (Arroyo et al. 1997).

Van der Windt et al. did a survey in 1995, whereby 35150 patients participated in an observational study by eighteen practitioners in a Dutch general practice, to determine the incidence and management of intrinsic shoulder disorders. Seven hundred and fifty four consultations took place over a year period, 472 of those patients presenting with shoulder complaints. Of this number, 392 patients presented with an incident complaint (defined as the number of new cases of a disease that occur in a population each year). Thus, there was an estimated 14.7 per 1000 per annum cumulative incidence of shoulder complaints. Subacromial impingement syndrome was the disorder diagnosed most frequently, in particular rotator cuff tendonitis (29%) (Van der Windt et al. 1995).

Furthermore, rotator cuff tendonitis is also found in labourers involved in repeated overhead activities (i.e. among shipyard welders and steel plate workers), where the prevalences of 18, 3% and 16, 2% exist respectively (Herberts et al., 1984).

2.4 Aetiology

According to Fu et al. (1995), the aetiology of injury to the rotator cuff is still uncertain. Despite the relatively high incidence and prevalence, Dela Rosa et al. (2001), also states that the exact cause and pathogenesis of rotator cuff tendonitis is unclear.

Two main theories do exist however: extrinsic and intrinsic mechanisms of injury. Extrinsic causes are from outside the rotator cuff. Intrinsic causes are a primary breakdown of the cuff. Both extrinsic and intrinsic injuries to the rotator cuff are accelerated by overuse. Both primary (direct trauma) and secondary causes (repetitive microtrauma to surrounding structures) of impingement lead to an indistinguishable pattern of tendonitis (Fu et al. 1995).

2.4.1 Overuse

According to Dela Rosa et al. (2001), chronic overloading of the affected tendon leads to microscopic failure of the fibrils and eventual tendon injury.

2.4.2 Intrinsic causes

The intrinsic mechanism involves injury within the tendon itself from either direct tendon overload and/or breakdown of the cuff (Budoff et al., 1998; Uhthoff et al., 1998).

The main contributing factors to rotator cuff disease include: cuff tendon degeneration, avascularity, direct tendon overload or repetitive trauma (Hertling and Kessler, 1996; Faber, et al., 1998).

Many authors have described a "critical" zone of relative hypovasculartiy within the supraspinatus tendon (Hawkins and Kennedy, 1980; Loehr et al., 1990; Souza, 1994 and Dela Rosa et al. 2001). This area is located near the tendon's insertion onto the greater tuberosity. It is this "critical" zone that gets compressed under the coracoacromial arch when the arm is abducted. Therefore, those participating in repetitive overhead activities, whether it is recreational or work-related, who constantly place the arm in the abducted position, do not allow the critical zone to be able to repair itself properly leading to a process of continuous injury and eventual tendon degeneration (Hertling and Kessler, 1996; Souza 1994).

This injury causes a weakened and dysfunctional rotator cuff. Muscle imbalance of the shoulder between the weakened rotator cuff and a normal deltoid causes the humeral head to migrate upward during elevation of the arm. Repetitive abrasion between the tendon and the coracoacromial arch will result in injury to the rotator cuff (Fulcher *et al.* 1998).

It would appear that chronic irritation of the previously mentioned avascular region of the supraspinatus tendon leads to the initial inflammatory response reflected in rotator cuff tendonitis (Clancy and Hagan, 1996). The resultant tissue may be irritated / overloaded again and a vicious cycle of microtearing – inflammation – scarring – microtearing – inflammation –scarring occurs (Hammer, 1991).

2.4.3 Extrinsic causes

Extrinsic causes are forces that act outside the rotator cuff causing injury to the tendon (Fu et al. 1995). Tendon injury here is mainly through compression of the supraspinatus tendon against a surrounding structure, namely the coracoacromial arch (Neer, 1983; Dela Rosa et al., 2001). The arch is composed of the coracoid process, the coracoacromial ligament and the anterior part of the acromion. Contents of the supraspinatus outlet include: the rotator cuff tendon, the subacromial bursa and the long head of the biceps brachii muscle (Michener et al., 2003; Dela Rosa et al., 2001). Therefore any abnormalities in this outlet can result in an impingement syndrome and rotator cuff tendonitis (Chang, 2004). Alterations on the undersurface of the anterior third of the acromion, the coracoacromial ligaments and sometimes the acromioclavicular joint are some of the changes associated with rotator cuff tendonitis (Klaiman and Gerber 1996).

Another important factor is the interaction of these anatomical structures in terms of movement, especially with repetitive overhead activity. Here the dynamic and static stabilizers of the shoulder joint are placed under great stress, therefore predisposing the shoulder to injury (Chang, 2005; Malanga, 2004). The dynamic stabilizers are consequently fatigued sooner and there is altered movement between the involved humerus and scapula, resulting in a narrowing of the suprapspinatus outlet and hence causing impingement of various structures (Bigliani et al. ,1997; Faber, et al., 1998).

When the arm is internally rotated in the forward flexed position this tends to drive the greater tuberosity farther under the coracoacromial arch so that the impingement area becomes directly under the coracoacromial ligament. The greater tuberosity also impinges against the lateral acromion and against the undersurface of the acromioclavicular joint as abduction progresses (Curtis and Wilson, 1996).

2.5 Pathology

Mechanical impingement, either primary or secondary, results in rotator cuff tendonitis and initiation of inflammatory changes (Fu et al. 1995).

Hypovascularity, age-related degeneration impingement, repetitive microtrauma and macrotrauma result in rotator cuff tendonitis (Blevins, 1997). The supraspinatus tendon passes under the coracoacromial arch through a rigid canal. Repetitive mechanical load results in micro injuries of the tendon tissue. If the injurious effects of repetitive motion continue to exceed the healing capability of the tendon, a symptomatic tendon injury or tendonitis can develop (Almekinders and Temple, 1998).

Neer (1983) classified rotator cuff tendonitis into three stages based on degeneration and pathology:

Stage 1 – "edema and hemorrhage." This stage may result from excessive overhead use in sports or work. This involves usually the supraspinatus or the long head of the biceps (Baquie, 1997).

Stage 2 – "Fibrosis and tendonitis." With repeated episodes of mechanical inflammation, the bursa may become thickened and fibrotic: hence, the problem magnifies (Neer, 1983). The resultant tissue may also be irritated / overloaded again and a vicious cycle of microtearing – inflammation – scarring – microtearing – inflammation –scarring occurs (Hammer, 1991).

Stage 3 – "Tears of the rotator cuff, biceps ruptures, and bone changes." With further impingement wear, incomplete or complete tears of the rotator cuff, biceps lesions, and bone alterations at the acromion and greater tuberosity may occur (Neer, 1983).

2.6 Examination and presentation

Rotator cuff tendonitis can clearly be diagnosed and classified on the basis of the history and physical examination (Faber et al., 1998).

According to Faber et al. (1998), patients often localize the pain in the front and to one side of the shoulder, which often radiates down the upper arm to the elbow, but not past it. Patients may also report pain, particularly at night and when sleeping on the affected side. Pain is usually aggravated by activity where the elbow is level with the shoulder. Symptoms of rotator cuff tendonitis can be reproduced with the supraspinatus impingement tests and pain will also occur with resisted contraction of the supraspinatus muscle (Brukner, 1996). Muscle testing against resistance demonstrates a weakness or insufficiency of the supraspinatus secondary to a tear or pain associated with rotator cuff tendonitis (Rupp et al. 1995). Active movement reveals a painful arc on abduction between approximately 70 degrees and 120 degrees. A recent study by Moosikasuwan et al. 2006, stated that the most sensitive clinical findings are impingement and the "arc of pain" sign.

Chang (2004) states that the MRI is the imaging study of choice for shoulder pathology. The MRI is able to detect intrasubstance tendon degeneration or partial rotator cuff tears. Neer (1983) stated that the most reliable method for detecting full rotator cuff tears is arthrography. More recently, ultrasonography is being widely accepted and used amongst practitioners (Blankstein et al., 2005).

However, these are not always practical in terms of their use especially with respect to accessibility, affordability and thus most diagnoses are based on clinical acumen.

2.6.1 Clinical characteristics of Rotator Cuff Tendonitis

2.6.1.1 Stage 1

Characteristically, tendonitis is initially felt as a toothache like pain after exercise, or frequently the following morning (Brukner, 1996). This pain may progress to discomfort during sport or activity, eventually affecting performance and interfering with sleep (Belzer and Durkin, 1996).

If the supraspinatus tendon is primarily involved, the important positive clinical signs are:

(1) Point tenderness over the greater tuberosity and usually the anterior acromion;
(2) Painful arc of abduction, maximum at 90 degrees; and
(3) A positive shoulder abduction stress test.

(Schafer and Faye, 1990)

2.6.1.2 Stage 2

Chronic inflammation or repetitive episodes of impingement can lead to stage 2. The symptoms still consist of an aching discomfort often worse at night that interferes with sleep, and may progress to interfere with everyday activities (Brukner, 1996).

The clinical picture and physical signs are present as in stage 1. There is often a stiffer shoulder with acromioclavicular joint tenderness. There may also be a painful catching sensation as the arm is lowered from the abducted position (Belzer and Durkin 1996). Repetitive microtrauma leads to eventual scarring in the subacromial space and this is manifested as soft tissue crepitus (Barry and McGuire 1996).

The shoulder functions adequately for light activity but becomes symptomatic after vigorous overhead use (Neer 1983).

2.6.1.3 Stage 3

Characteristic of this stage is a long history of shoulder problems, characterized by a refractory tendonitis, wear and tear of the supraspinatus and frequently biceps tendon, with partial and eventual complete thickness rotator cuff tears (Brukner 1996). All of the previous signs described in stages 1 and 2 are frequently present. By this stage, patients generally have more pain and stiffness, weakness is experienced and is found to be more pain related, and there are frequently bicipital findings as well as tenderness about the acromioclavicular joint (Belzer and Durkin 1996).

In the case of a partial thickness tear, the rotator cuff is vulnerable and any minor insult could result in a full thickness tear (Brukner 1996). This would manifest as sudden weakness and decreased range of motion, seen primarily as inability to elevate the arm (Klaiman and Gerber 1996).

2.7 Treatment

According to Brukner (1996), the majority of patients with rotator cuff tendonitis respond well to conservative treatment. However, Green *et al.* (1998) believe there is no proven best treatment for shoulder pain and that the literature reveals contradictory information pertaining to the treatment of rotator cuff tendonitis. Almekinders and Temple (1998) agree that further research is required regarding the diagnosis and management of rotator cuff tendonitis.

2.7.1 Stage 1

Brukner (1996) and Fu *et al.* (1995) reported that stage 1 generally responds well to conservative treatment and is reversible with appropriate rehabilitation. The main goals in the treatment of stage 1 rotator cuff tendonitis are to promote healing of inflamed tissue and restore joint function. Proprioceptive neuromuscular functions to correct strength deficiencies provide flexibility and coordination (Fu *et al.* 1995).

Brukner (1996) suggests that firstly avoiding the aggravating activity; applying ice and administering anti-inflammatory drugs to reduce inflammation can treat the tendonitis.

Souza (1994) states the use of cold therapy is important for three major reasons:

1) A cold compress is effective in reducing swelling. The inflammatory process is slowed down by the effect of the cold on the local metabolic rate.
2) There is a reduction in pain through a decrease in neural conduction.
3) It is theorized that there is reflex inhibition, whereby cold allows muscles to be stretched further with resetting of the muscle spindle.

Due to the chronicity of most overuse shoulder injuries/disorders, the application of cold therapy is mostly used for pain inhibition rather than its anti – inflammatory properties. Cryotherapy is used as an adjunct to other treatments and can also be done effectively at home by the patient for pain control (Harper, 2006).

A recent study by Giombini *et al.* 2006, concluded that hyperthermia was effective in the management of supraspinatus tendinopathy. The authors studied 37 athletes with supraspinatus tendinopathy who were randomly assigned to three groups. Group A received hyperthermia at 434 MHz. Group B received continuous ultrasound at 1 MHz at an intensity of 2.0 w/cm² three times a week. Group C undertook exercises, consisting of pendular swinging and stretching exercises, for 5 minutes twice a day every day. All interventions were undertaken for 4 weeks. The results showed that patients who received hyperthermia experienced significantly better pain relief than did patients receiving ultrasound or exercises.

This can be combined with ultrasound, laser and interferential stimulation. However recommendations by DeLee and Drez (1994), suggested that electrotherapeutic modalities such as ultrasound, transcutaneous nerve stimulation, muscle stimulation and laser therapy should only be instituted according to a positive patient response to these modalities.

The second part of the treatment consists of correcting associated abnormalities including glenohumeral instability, muscle weakness or incoordination, soft tissue tightness and training errors.

Green *et al.* (1998) designed a study that included all the randomised controlled trials of non-steroidal anti-inflammatory drugs, intra-articular and subacromial glucocorticosteroid injection, oral glucocorticosteroid treatment, physiotherapy, manipulation under anaesthesia, hyrdodilatation, and surgery for shoulder pain that were identified by computerised and hand searches of the literature. They concluded that there is little evidence to support or refute the efficacy of these common interventions for shoulder pain.

2.7.2 Stage 2

Symptoms of the tendonitis become more evident in stage 2 and the same conservative measures as used in stage 1 are necessary to control these symptoms.

Restoration of motion and flexibility become more important in this stage. Active strengthening of the tendon is recommended. Eccentric appear to have specific affect on tendon strength compared to concentric exercises. Recent research by Hömlich *et al.* (1999) shows that there is definite scientific evidence to support the clinical effectiveness of eccentric strengthening programs. Manual loading of soft tissue is said to increase fibroblastic proliferation, which synthesizes and maintains collagen, fibronectin, proteoglycans, and other proteins of connective tissue matrix (Hammer, 1991).

Hammer (1991) suggests that the most valuable modality to treat chronic overuse soft tissue syndromes is friction massage. Cyriax (1984) believed that friction massage induced local hyperemia, causing the release of chemical mediators namely bradykinin and histamine, resulting in vasodilation and reduced edema (Hammer, 1991). There is also believed to be a breakdown of old disorganized scar tissue and adhesions (Cyriax, 1984 and Hertling and Kessler, 1996).

Further use of non-steroidal anti-inflammatory drugs and corticosteroid injections may be used however according to Dela Rosa *et al.*, (2001), the use of steroid injections is a common practice, yet intratendinous injections are thought to have no place in the management of tendon disease, as steroid injections are known to have deleterious effects such as inhibition of collagen synthesis, weakening of the tendon and tissue necrosis, especially when injected directly into the affected tendon.

Surgery is occasionally indicated when conservative management has failed. This may involve stripping of the paratendon, release of adhesions or removal of degenerative tissue (Brukner, 1996).

2.7.3 Stage 3

In Stage 3 a rotator cuff tear is often present. Pain control is still prescribed, as is maintenance of flexibility by mild stretching and strengthening (Fu *et al.* 1995). A full thickness tear would manifest as sudden weakness and decreased range of motion, seen primarily as inability to elevate the arm (Klaiman and Gerber 1996).

Surgery is often indicated and the approach involves arthroscopy to evaluate the tear, treatment of the associated pathology and subacromial decompression (Curtis and Wilson, 1996). MRI is able to detect intrasubstance tendon degeneration or partial rotator cuff tears (Chang, 2004). MRI can therefore be used to assess the tendon tear both before and after surgical repair. Ultrasonography can also be used to assess rotator cuff tears. A recent study by Middleton *et al.* 2004, concluded that the level of interobserver variability in the sonographic detection and characterization of rotator cuff tears was low. The radiologists were in full agreement in the categorization of 92% (56/61) of the patients.

Anterior acromioplasty can be performed and has been successful in selected patients. Subacromial decompression showed excellent relief of pain, however very few athletes could return to the same level of activity (Arryo *et al.* 1997).

2.8 Muscle Energy Technique

According to Greenman (1996), Muscle Energy Technique (MET) is a "manual medicine treatment procedure that involves the voluntary contraction of the patient's muscle in a precisely controlled direction, at varying levels of intensity, against a distinctively executed counterforce applied by the operator."

The main goals of conservative management, for a patient with an impingement syndrome, are to restore pain-free function in the shortest possible time. Pain, inflammation, active range of motion deficits, and neuromuscular control therefore all need to be addressed (Myers 1999). It has been hypothesized that MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and decrease local edema, and to mobilize a restricted articulation (Greenman, 1996).

The term post-isometric relaxation is often used in conjunction with Muscle Energy Technique. Post-isometric relaxation (PIR) refers to the theory that after a muscle is isometrically contracted there is a refractory, or latency, period of approximately 15 seconds during which there can be an easier (due to reduced tone) movement towards the new resistance barrier of a muscle with resultant decrease in tone and increase in length of a muscle. The precise reasons for the effectiveness of MET remain unclear, although in achieving PIR the effect of a sustained contraction on the golgi tendon organs seems pivotal, since their response to such a contraction seems to be to set the tendon and the muscle to a new length by inhibiting it (Moritan et al. 1987).

As previously mentioned, many authors have described a "critical" zone of relative hypovasculartiy within the supraspinatus tendon (Hawkins and Kennedy, 1980; Loehr et al., 1990; Souza, 1994 and Dela Rosa et al. 2001). This area is located near the tendon's insertion onto the greater tuberosity. It is this "critical" zone that gets compressed under the coracoacromial arch when the arm is abducted. The main source of nociception in the motor system might be due to changes in soft tissues in the deep layers of fascia or muscles, requiring soft tissue techniques. PIR can often reduce a muscular spasm and eliminate pain points where a tendon is attached to the periosteum (Hammer, 1999).

The tone of a muscle is largely the job of the Golgi tendon organs. These detect the load applied to the tendon via muscular contraction. Reflex effects, in the appropriate muscles, are the result of this information being passed from the Golgi tendon organ back along the cord. The reflex is an inhibitory one (Chaitow, 1998). When the tension on the muscles, and hence the tendon, becomes extreme, the inhibitory effect from the tendon organ can be so great that there is sudden relaxation of the entire muscle under stretch. This effect is called the lengthening reaction. The tendon reflex serves as a reflex to control the muscle tone. MET provides the ability to influence both muscle spindles, and also the Golgi tendon organs and is ideal for releasing tone in acute conditions (Sandler, 1983). The ability to lengthen and strengthen muscles, increase fluid mechanics, decrease local edema, and mobilize a restricted articulation is of great importance in many musculoskeletal conditions.

There have been few articles published on the topic of MET (Goodridge, 1981) and little has been published in the way of randomized control trials involving MET (Schenk, 1997). While MET has become widely used with clinicians, very little has been published on this intervention (Gibbons, 1998). The use of this technique in clinics makes it imperative that we determine whether this technique is a viable procedure for the treatment of neuromusculoskeletal disorders such as supraspinatus tendonitis.

2.9 Summary

Rotator cuff tendonitis is a common problem, especially in athletes. Although most patients respond well to conservative treatment, professionals still disagree as to which treatment approach is most effective. The literature reveals contradictory information pertaining to the treatment of rotator cuff tendonitis (Green *et al.* 1998), and further research is required regarding the diagnosis and management of rotator cuff tendonitis (Almekinders and Temple, 1998). It has been hypothesized that MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and decrease local edema, and to mobilize a restricted articulation (Greenman, 1996). However, little has been published in the way of randomized control trials involving MET (Schenk, 1997).

Thus, the aim of this dissertation was to compare the use of Muscle Energy Technique versus placebo ultrasound in the treatment of rotator cuff tendonitis, in an attempt to find out if Muscle Energy Technique is effective, not only as a primary therapy, but also as an adjunctive therapy for this common disorder.

Chapter Three

MATERIALS AND METHODS

Introduction:

This chapter aims to describe the research methodology as well as the materials used in collecting data and their analysis.

3.1 Design

This study was designed as a comparative, clinical investigation, involving two sample groups of 15 patients each. The objective was to compare two treatment groups (Muscle Energy Technique versus placebo ultrasound) to assess for inter-group improvement. An intra-group statistical analysis was also performed. The purpose of the study was to determine whether Muscle Energy Technique is effective as a form of treatment for rotator cuff tendonitis.

3.2 Sampling

3.2.1 Method

Advertisements were posted around the D.I.T campus, in the local newspaper and placed at various sporting clubs in the greater Durban area (Appendix A). Thus patients were obtained by means of consecutive convenience sampling (Mouton, 2002). Random allocation was utilised to allocate the patients into either of the two groups. No restrictions were placed on a patient's sex, racial group, income bracket or area of residence.

Any patient presenting to the Chiropractic Day Clinic with shoulder pain was considered a potential candidate for the study. These patients were then briefly screened and further investigations took place only if the researcher deemed the patient suitable for the study.

Patients telephonically contacting the clinic underwent a telephonic interview in order to rule out unsuitable candidates.

In both instances questions pertaining to age, duration and area of pain, disability from the injury, occupation, etc. were asked in order to ensure maximal compliance with the inclusion and exclusion criteria.

3.2.2 Size and Allocation:

All subjects accepted into the study were randomly split into two equal groups of 15 patients each, giving a total of 30 patients. This was done according to the process of randomization described by Scott-Dawkins (1995). Fifteen labels representing "Muscle Energy Technique" and fifteen representing "placebo ultrasound" were placed in an envelope and each patient was asked to draw out a label to determine which group they were assigned to.

3.3 Research Methodology

3.3.1 Inclusion Criteria:

- All subjects chosen were between 18 and 50 years of age. This was done to help rule out causes of rotator cuff pathology found exclusively in the older population (Neer, 1983:70-77), and in addition to assist the researcher to achieve sample homogeneity (Mouton, 2002)
- Only those with subacute (more than 48 hours after initial injury), and chronic (more than 5 days after the initial injury) were considered (Reid, 1992) in order to achieve sample homogeneity (Mouton, 2002).
- Only patients diagnosed by the researcher as having rotator cuff tendonitis were considered. This was evaluated according to the following tests:
    - Positive Orthopedic tests: Hawkins-Kennedy and Empty can (Supraspinatus). (Vizniak, 2002).
- The patients condition had to comply with at least three of the four following physical findings:
    - Palpable tenderness over the greater tuberosity of the humerus of the involved shoulder
    - Palpable tenderness along the edge of the acromion of the involved shoulder
    - A painful arc of abduction between 60° –120°
    - A positive shoulder abduction stress test

  (Schafer and Faye, 1990).

No one orthopedic test guarantees a diagnosis or rates severity consistently (Laslett and Williams, 1994). It has therefore been suggested that multiple tests triangulated to arrive at a clinical diagnosis was the best and most accurate in the clinical situation (Walsh, 1998).

- In addition to the above patients, had to have an NRS rating of between 4 and 8, to further achieve sample homogeneity (Mouton, 2002:136), in terms of the clinical symptomatology therefore allowing more accurate recordings of patient improvement and therefore comparisons between the two patient groups.
- An informed consent form (Appendix E) had to be signed by the patient in order to allow them entrance into the study.
- Participants were also required to stop all pain and anti-inflammatory medication at least 48 hours before the study (Poul et al., 1993), and not use any medication during the course of the study, in order that these interventions did not result in skewed data and to achieve accurate results.
- A total of 30 patients were included in this study. If a participant fell out due to other commitments and was unable to continue with this study, they were then replaced until data from 30 participants had been collected.

3.3.2 Exclusion Criteria:

- Patients had to meet the inclusion criteria in order to be accepted into the study.
- Those who did not sign the consent form were not able to take part in the study, due to the lack of consent provided.
- Further clinical tests where utilised to exclude differential diagnoses that could also present as shoulder pain and included amongst others C5/6 radiculopathy and brachial plexus injuries (Travell and Simons, 1999).
- If there was a history of traumatic shoulder dislocation or if there was a positive drop arm test that could indicate a rupture of the rotator cuff, the patient was excluded.
- If there was a history of shoulder surgery.

- If they had, or if the physical examination suggested they had, cardiac, pulmonary or systemic diseases, which may refer pain to the shoulder.
- Patients with contraindications to Muscle Energy Technique (MET). These include osteoporosis, arthritis, joint hypermobility or instability, fracture, full thickness tears, tumour or infection.
- Patients who have received any ultrasound treatment in the past three months will be excluded from the study to ensure naivety. (Mouton, 1996)

Those subjects who had not met the inclusion criteria were referred to other students at the Chiropractic Day Clinic for treatment of their condition, as paying outpatients.

3.4 Intervention

Group 1 received Muscle Energy Technique while group 2 received placebo ultrasound.

The patients in group 1 received Muscle Energy Technique in 2 specific positions. These 2 positions were: the neutral position of the arm, and complete external rotation of the arm with the arm by the patient's side.

The patients were required to sit in a comfortable position with the shoulder exposed. Once the arm was in the correct position the patient was instructed to sub-maximally contract the supraspinatus muscle for 6-10 seconds. This means the patient does not contract the muscle with their maximum strength but rather is asked to contract the muscle with approximately 20% of their strength. Asking the patient to lift the affected arm in vertical abduction contracts the supraspinatus muscle.

The researcher then applied an equal counter force (vertical adduction) so there was isometric contraction of the supraspinatus muscle. This contraction was followed immediately by further stretching of the patient's supraspinatus muscle by the researcher for 15 seconds. The supraspinatus muscle was stretched by placing the participant's affected arm in internal rotation and adduction (Chaitow, 1998).

At each treatment consultation this contraction and stretch procedure was done 3 times in each of the two specific ranges of motion (Neutral position, external rotation). Clinically, any additional times does not provide any meaningful release (Ierna, 2005).

The patients in group 2 were required to sit in a comfortable position with the shoulder exposed and in the neutral position during the treatment. The ultrasound unit was set to zero, and the time set to 5 minutes.

Group A, receiving Muscle Energy Technique, will undergo four treatments over a three week period. Group B will receive detuned ultrasound over four consultations in a three-week period. A fifth consultation within the 3-week period will be for data collection only. A maximum of 3 consultations per week will be allowed to increase accuracy.

3.5 Measurements

3.5.1 Subjective Measures

At the initial consultation the case history (Appendix B), physical examination (Appendix C) and shoulder regional examination (Appendix D) were completed. Each patient was required to fill out a patient consent form (Appendix E) agreeing to take part in the research study. In addition, each patient was instructed to read a research information sheet with a full description of the study and their role therein (Appendix F). The patient was obliged to fill out the Numerical Pain Rating Scale-101 (Appendix G) and the Pain Disability Scale (Appendix H).

The subjective measurements were performed at treatments one, three and five, so that any improvement during the treatment could be assessed.

3.5.1.1 The **Numerical Pain Rating Scale** (NRS 101 – Appendix G) was used to determine the subjective pain intensity experienced by the patient. Jensen et al. (1986) established its validity and reliability when proving subjective information about the levels of pain perceived by the patient. It was used to monitor the patient's progress with a decrease in pain intensity indicating improvement. The patient was asked to indicate, between 0 and 100, when the pain was at its worst. Likewise this was repeated on a second identical line when the pain was at its least with "0" indicating no pain and "100" indicating the most severe pain. The two values from the "worst pain" and the "least pain" were added together, divided by two and expressed as a percentage of 100.

3.5.1.2 The **Pain Disability Scale** (Appendix H) was used to determine the degree to which several aspects of the patient's life were disrupted by pain (Salen et al. 1994). In each category disability is rated from 1 to 10, "1" indicating no disability and "10" indicating the most severe disability.

3.5.2 Objective Measurements

An objective assessment of changes in the patient's condition during the treatment was required for this study. For this three instruments, the algometer, inclinometer and diagnostic ultrasound unit, were used.

The ***algometer*** was used to measure tenderness and the readings were carried out where the rotator cuff tendon can be palpated near its insertion at the greater tuberosity of the humerus.
Range of motion at the shoulder was measured using the ***inclinometer***. Vertical abduction of the shoulder was measured as this is the most specific to the rotator cuff muscles and the supraspinatus muscle in particular.

The algometer and inclinometer were used at the first, third and fifth consultations.

The ***diagnostic ultrasound*** was used to visualize the rotator cuff tendon and objectively assess the inflammation by measuring the amount of swelling of the inflamed tendon in millimeters. The diagnostic ultrasound was used at the first and fifth consultations.

3.5.2.1 The Algometer

Fischer (1986) studied the use of the algometer in the quantification of tender spots and concluded a high reproducibility and an excellent validity of measurements obtained. According to Fischer (1986), the reliability of the algometer as a tool for the diagnosis of tender spots as well as assessment of treatment results has been documented. Fischer (1986) states that changes in the patient's pressure threshold under standard clinical conditions can be regarded as reliable data.

The algometer used in this study was the FDK 20 from Wagner Instruments. P.O. Box 1217 Greenwich CT 06836 USA.

The procedure for the use of the algometer was as follows:

- The dial on the gauge was set to zero.
- The algometer was placed on a point where the rotator cuff tendon can be palpated near its insertion at the greater tuberosity of the humerus.
- The pressure was gradually increased at a rate of one kilogram per second as recommended by Fischer (1986).
- The patient was told to express the point at which pain is first perceived.
- The reading on the dial was then recorded on the Data Sheet (appendix I).

3.5.2.2 Shoulder range of motion – The Inclinometer

The inclinometer was used to measure range of motion of the shoulder. In this study vertical abduction was measured specifically as it is the most common movement of the shoulder affected in rotator cuff pathology. In this study the Dualer Digital Inclinometer from JTech Medical Instruments was used.

The procedure for the use of the digital inclinometer was as follows:

- The patient was asked to stand with both feet positioned flat on the floor and the arms positioned in the anatomical position at the sides.
- The unit was attached to the mid-point of the biceps muscle on the anterior aspect of the arm.
- The sensor was zeroed.
- The patient was asked to perform vertical abduction of the shoulder.
- The angle was recorded at the limit of vertical abduction of the shoulder.

The results were recorded in degrees (°) of range of motion. The inclinometer has successfully been used in studies (Mayer *et al*. 1993).

3.5.2.3 Diagnostic Ultrasound

The diagnostic ultrasound was used to visualize the rotator cuff tendon and objectively assess the inflammation by measuring the amount of swelling of the inflamed tendon in millimeters. Diagnostic ultrasound is an excellent tool for detecting inflammation and thickening of a tendon (Thoirs, 2001).

In sub acute cases of tendonitis, tendon thickening can be observed (Van Holsbeeck and Introcaso, 2001). In chronic tendonitis the most common finding is thickening of the tendon itself (Middleton *et al.* 1986). Tendonitis produces no reliable morphological changes in the supraspinatus tendon but the tendon is obviously thickened. There is no relationship between tendon size and the dominant arm (Van Holsbeeck and Introcaso, 2001). Therefore, comparison with the contra lateral side can also be used to aid in the assessment of tendon thickening. The majority of rotator cuff pathology is located in the "critical zone" of the supraspinatus tendon, which is approximately 1 cm proximal to its insertion on the greater tuberosity.

In this study the thickness of the supraspinatus tendon was assessed and recorded at the "critical zone", which is approximately 1 cm proximal to its insertion on the greater tuberosity. The contra lateral tendon was then assessed to ensure there was enlargement of the involved tendon.

The diagnostic ultrasound unit used was the Siemens CC-13E71-MT2, serial number 56421311. The date of manufacture was January 1999. The probe used the Siemens VF 13.5 MHz.

The procedure for the use of the diagnostic ultrasound was as follows:

- The patient is seated comfortably facing the examiner with the involved shoulder exposed.
- The arm is internally rotated with the forearm behind the back and the hand near the opposite scapular tip.
- Diagnostic ultrasound gel in placed on the probe and the tendon is evaluated.
- The measurement is recorded on the data sheet

The procedure was repeated on the contra lateral side to confirm the thickening of the involved shoulder.

3.6 Statistical analysis

Data were entered into a MS Excel spreadsheet and imported into SPSS version 13 (SPSS Inc., Chicago, Illinois, USA), which was used for data analysis.

Demographics were compared between the two treatment groups using Pearson's chi square tests or Fisher's exact tests as appropriate for categorical variables, and independent t-tests for quantitative variables.

In the assessment of a treatment effect, 3 effects were tested:
1) the effect of time
2) the effect of group (MET vs. placebo), and
3) the interaction effect of time and group (treatment effect)

Since there were no missing data points at all follow up times, and since the outcome variables were quantitative and reasonably normally distributed, repeated measures ANOVA was used to assess the treatment effect. A time by group interaction effect of $p<0.05$ was considered as a significant treatment effect. Profile plots were generated to examine the direction in which the treatment effect was found and to examine trends in the data.

Changes in quantitative variables over time were correlated together intra-group using Pearson's correlation coefficient to assess whether changes in subjective measures related to changes in objective measures.

Changes in quantitative variables over time were correlated together intra-group using Pearson's correlation coefficient to assess whether changes in subjective measures related to changes in objective measures.

Chapter Four

RESULTS

4.1) Introduction

The statistical findings and results obtained from the data will be discussed in this chapter.

Primary data was obtained from:

1.) The Algometer readings

2.) The Inclinometer readings

3.) The Diagnostic Ultrasound readings

4.) The Numerical Pain Scale-101

5.) The Pain Disability Index

Secondary data was obtained from the relevant literature, books, journals, articles.

Key of symbols

N = number

% = percentage

SD = standard deviation

p-value = probability value

4.2) Demographics

The sample consisted of 30 participants, 28 of whom were male (93.3%) and 2 of whom were female (6.7%). This indicates that rotator cuff tendonitis may be more common in men than woman. However, previous studies on rotator cuff tendonitis have not been consistent with regards to male : female ratios (Van der Windt et al. 1995). The type of sport activity is of greater importance than the gender of the patient.

In this study the mean age of the sample was 30.8 years with a standard deviation of 9.5 years and a range of 19 to 50 years. The most frequent occupation was student (n=11, 36.7%).

Table 2: Occupation of sample participants (n=30)

	Frequency	Percent
Student	11	36.7
Personal Security	2	6.7
Architect	2	6.7
Self Employed	2	6.7
Accountant	2	6.7
TV Production	1	3.3
Housewife	1	3.3
IT	1	3.3
Baker	1	3.3
Service Specialist	1	3.3
Entertainer	1	3.3
Game Ranger	1	3.3
Shop worker	1	3.3
Industrial Broker	1	3.3
Unemployed	1	3.3
Salesman	1	3.3
Total	30	100.0

The majority were affected in their right shoulder (n=19, 63.3%), while 11 (36.7%) were affected in their left shoulder. The most frequently reported cause of the tendonitis was gym (n=11, 36.7%). This is shown in Figure 1. This may indicate the prevalence of incorrect training techniques used by many people. Of the patients reporting "gym" as the cause of their tendonitis, there were 4 (26.7%) in the MET group and 7 (46.7%) in the placebo group. The difference was not significant (p=0.271).

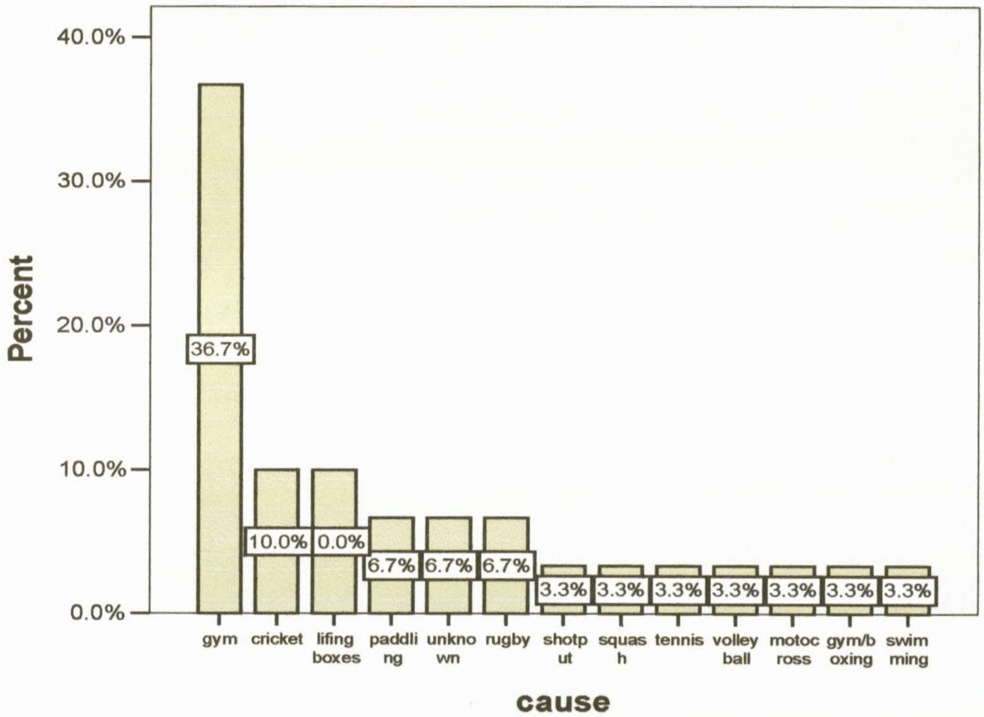

Figure 1: Reported cause of the tendonitis

The participants were randomized into 2 treatment groups of n=15 each. The demographics were compared between the treatment groups to ensure that there were no significant differences, which could result in differential outcomes after treatment.

Tables 3 to 5 below show that the demographic factors were equivalently distributed between the two treatment groups so there were no significant differences between the groups with respect to these factors.

Table 3: Comparison of gender between treatment groups (n=30)

			sex		
			Male	Female	Total
group	MET	Count	13	2	15
		% within group	86.7%	13.3%	100.0%
	Placebo Ultrasound	Count	15	0	15
		% within group	100.0%	.0%	100.0%
Total		Count	28	2	30
		% within group	93.3%	6.7%	100.0%

Fisher's exact p = 0.483

Table 4: Comparison of affected shoulder between treatment groups (n=30)

			shoulder		
			Right	Left	Total
group	MET	Count	10	5	15
		% within group	66.7%	33.3%	100.0%
	Placebo Ultrasound	Count	9	6	15
		% within group	60.0%	40.0%	100.0%
Total		Count	19	11	30
		% within group	63.3%	36.7%	100.0%

Pearson's chi square 0.144, p=0.705

Table 5: Comparison of age between treatment groups (n=30)

	Group	N	Mean	Std. Deviation	Std. Error Mean	p value
Age	MET	15	31.60	10.363	2.676	0.665
	Placebo Ultrasound	15	30.07	8.746	2.258	

4.3) Assessment of the treatment effect

4.3.1) Objective outcome measurements

4.3.1.1) Algometer

Algometer readings were taken at three time points (baseline, day 3 and day 5).

A highly significant time effect was observed in both groups ($p<0.001$, Table 6). Figure 2 shows that both treatment groups showed a general increase in algometer measurements over time, however the rates of increase (slopes of the lines) varied with each group.

There was a significant interaction between time and group ($p=0.008$, Table 6) meaning that the placebo group and the MET group improved at different rates over time. Thus, for this outcome a significantly beneficial treatment effect was demonstrated. In Figure 2 it can be seen that both groups did not improve at the same rate over time, i.e. the slopes of the lines are not parallel, and that the MET group showed a greater rate of increase in algometer measurement over time.

The MET group started at a mean of 8.8 and the placebo at 11. This baseline difference occurred because the participants were randomized into the 2 groups. Thus the MET group was at an initial disadvantage because they had more pain than the control group at the beginning. However, the treatment managed to bring their pain down to almost the same level as the control group by the end of the study. The repeated measures ANOVA takes baseline differences into account, and is thus not biased by baseline differences between groups, rather it looks at the rates of change over time between the 2 groups and as we can see by Figure 2 the MET group had a steeper slope of the line (improved at a faster rate) than the control group.

Table 6: Within-subjects and between- subjects effects for Algometer

Effect	Statistic	p value
Time	Wilk's lambda =0.230	<0.001
Time*group	Wilk's lambda = 0.702	0.008
Group	F=1.518	0.228

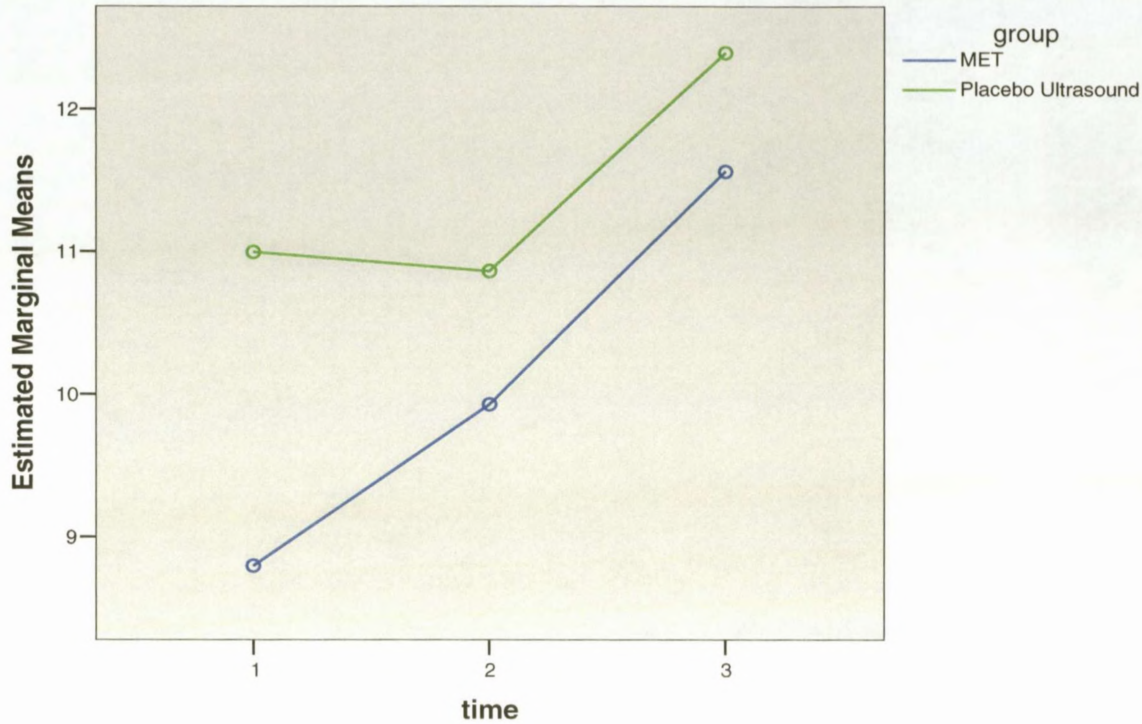

Figure 2: Profile plot of mean algometer reading over time by treatment group

Although the MET group improved at a faster rate then the placebo group the results were not as highly significant as was expected. This may have been due to the effect of post treatment muscle stiffness and discomfort. DiGiovanna (1991), states that occasionally there is some muscle stiffness and soreness after treatment. According to Greenman (1989), the patient will frequently experience some increase in muscle soreness following MET treatment. Therefore, although MET may be directly and positively effecting the tendon itself, these benefits may at first not be expressed by a great decrease in pain and tenderness.

4.3.1.2) Inclinometer - Vertical Abduction (VA)

For the outcome of vertical abduction, there was a highly significant time effect ($p<0.001$) meaning that both groups changed significantly over time. Figure 3 shows that both groups displayed an increase in VA over time.

The time*group interaction effect (treatment effect) was not significant ($p=0.833$, Table 7). This means that for this outcome there was no differential effect between the treatment groups. Figure 3 shows that both groups increased in mean value to the same extent over time (i.e. the profiles were parallel over time) and thus the treatment did not work better than the placebo for this outcome.

The rates of change over time are what was measured and compared between groups, baseline differences aside. Here the rates are the same (slopes of the lines are same) and thus the time by group interaction was not significant ($p=0.833$), thus there was no benefit of the treatment over and above the placebo.

Table 7: Within-subjects and between- subjects effects for VA

Effect	Statistic	p value
Time	Wilk's lambda =0.418	<0.001
Time*group	Wilk's lambda = 0.987	0.833
Group	F=0.297	0.590

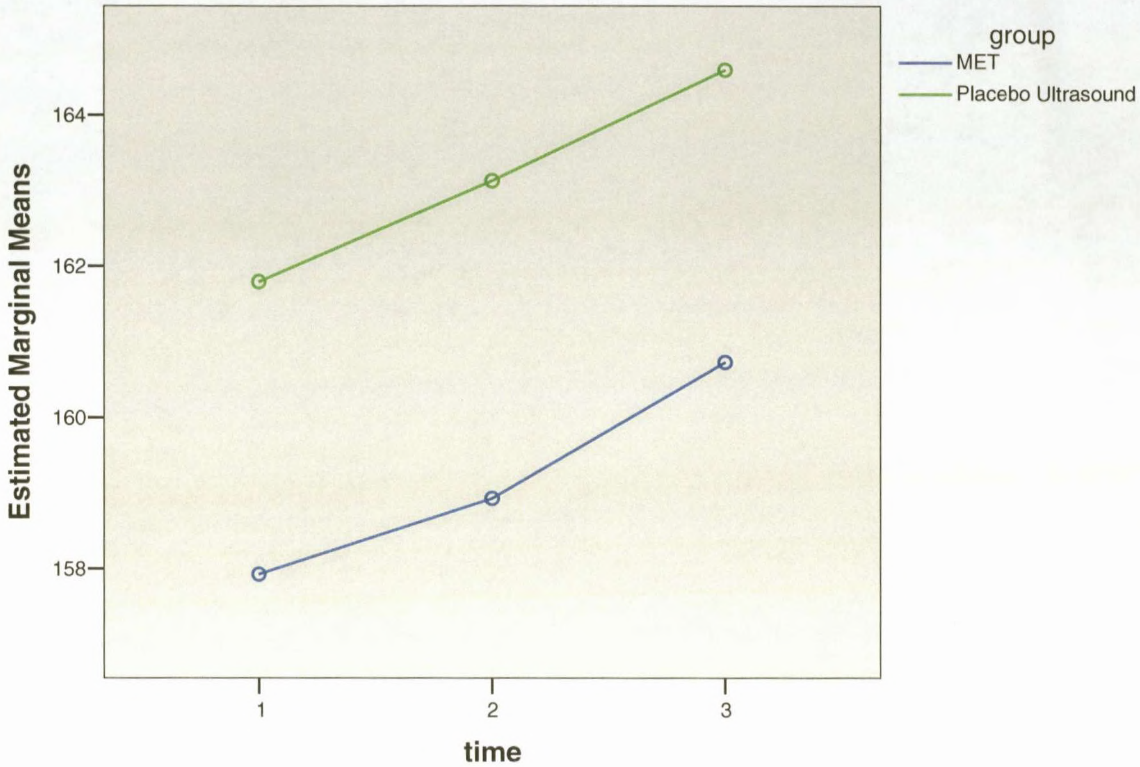

Figure 3: Profile plot of mean VA measurement over time by treatment group

The MET group showed no clinical benefit over and above the placebo group. Therefore in this study the hypothesized benefits of MET of lengthening muscles and mobilizing a restricted joint was not represented in a change in range of motion. However, as with the algometer readings, the range of motion may have been affected by post treatment stiffness that may have limited the amount of vertical abduction to some degree.

4.3.1.3) Diagnostic Ultrasound

Tendon thickness was measured at two time points (baseline and at the end of the study). Table 8 shows that there was a significant time effect ($p<0.001$) and a significant time by group interaction effect ($p=0.002$). Figure 4 shows that the thickness in the MET group decreased at a faster rate than in the placebo group. Thus, for this outcome there was a significant benefit to treatment with the MET compared with placebo.

Table 8: Within-subjects and between- subjects effects for thickness (mm)

Effect	Statistic	p value
Time	Wilk's lambda =0.559	<0.001
Time*group	Wilk's lambda = 0.703	0.002
Group	F=0.015	0.904

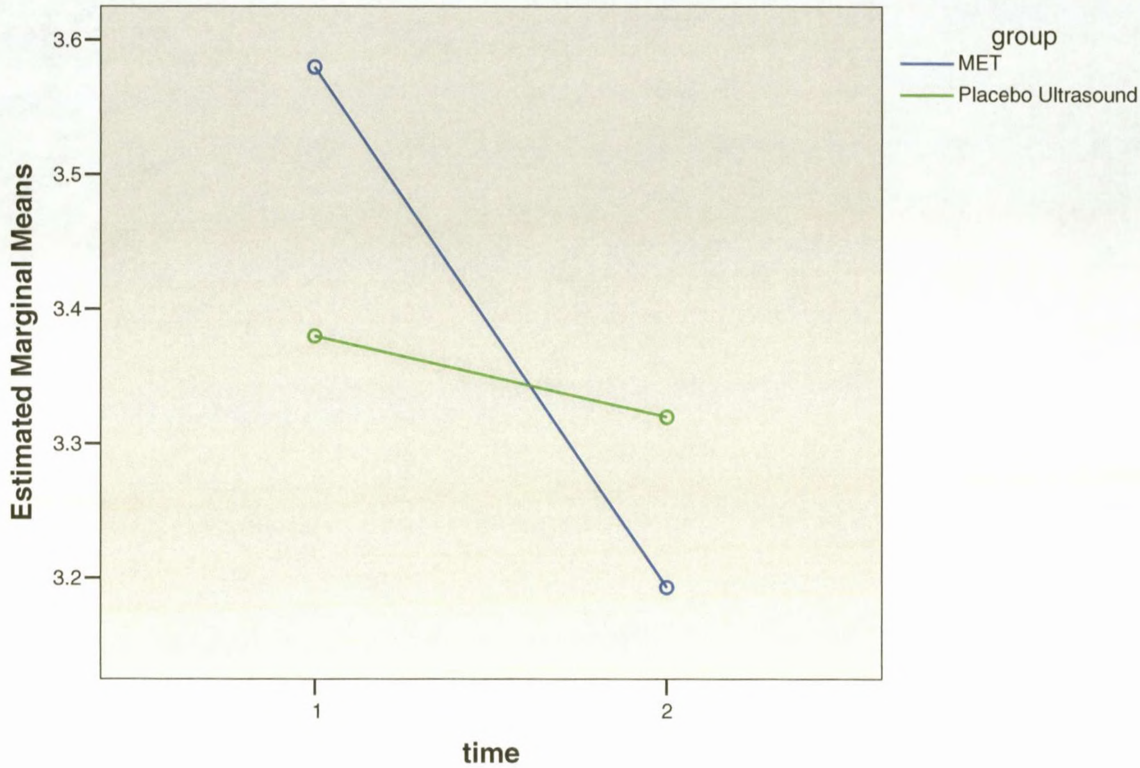

Figure 4: Profile plot of mean thickness (mm) over time by treatment group

The diagnostic ultrasound scan revealed that the MET had a far more beneficial treatment effect than the placebo. According to Greenman (1996), MET can be used to increase fluid mechanics and decrease local edema. These beneficial effects on the tendon itself could be seen by the decrease in tendon inflammation and thickness. The significant affect of MET on the tendon in this study may suggest that diagnostic ultrasound is a more accurate way to objectively assess the effects of MET on an inflamed tendon than "pain" and range of motion.

4.3.2) Subjective Outcome Measurements

4.3.2.1) NRS-101

Mean NRS decreased significantly in both groups over time ($p<0.001$, Table 9) and this can be seen in Figure 5. However, they both decreased at the same rate, since the time by group interaction effect was not significant ($p=0.135$). It can be seen in Figure 5 that the rate of change over time was similar in both groups and the slopes are nearly parallel. Thus, for this outcome there was no evidence that the treatment had any effect over and above the placebo. This correlated with the algometer readings, as they were also not as significant as expected even though they did show a faster rate of improvement than the placebo group.

Table 9: Within-subjects and between- subjects effects for NRS

Effect	Statistic	p value
Time	Wilk's lambda =0.214	<0.001
Time*group	Wilk's lambda = 0.862	0.135
Group	F=3.347	0.078

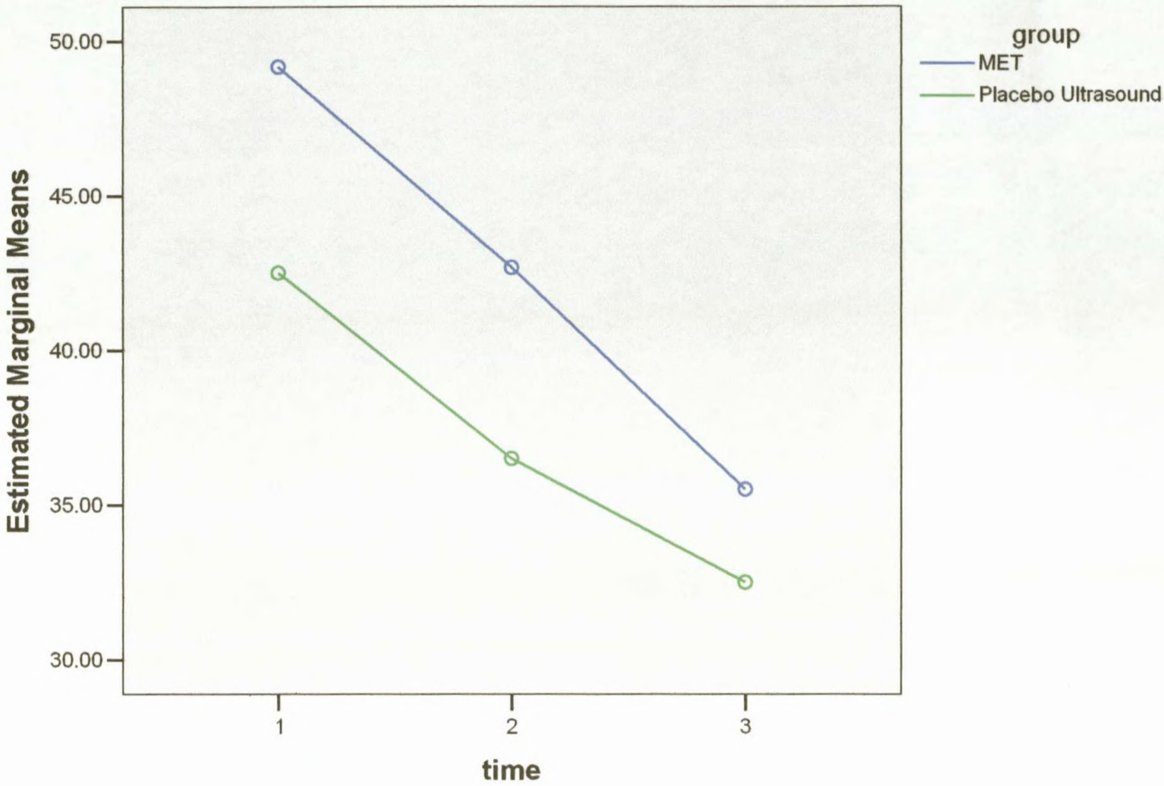

Figure 5: Profile plot of mean NRS over time by treatment group

4.3.2.2) Pain Disability scale

Summing the scores for the five items of the disability scale generated a total disability score. Disability scores changed significantly over time ($p<0.001$), but did not vary over time by treatment group ($p=0.435$). Thus, there was no evidence of a treatment effect for this outcome either. Figure 6 shows that the profiles of the two groups were almost parallel over time and that between the 3rd and the 5th visit there may have been some small benefit of the MET treatment over the placebo but it was not statistically significant. There was a trend towards a beneficial effect of the MET treatment when results were viewed graphically and this trend may have been better shown with a larger sample size and possibly a longer treatment period.

Table 10: Within-subjects and between- subjects effects for Disability Score

Effect	Statistic	p value
Time	Wilk's lambda =0.282	<0.001
Time*group	Wilk's lambda = 0.943	0.435
Group	F=0.007	0.936

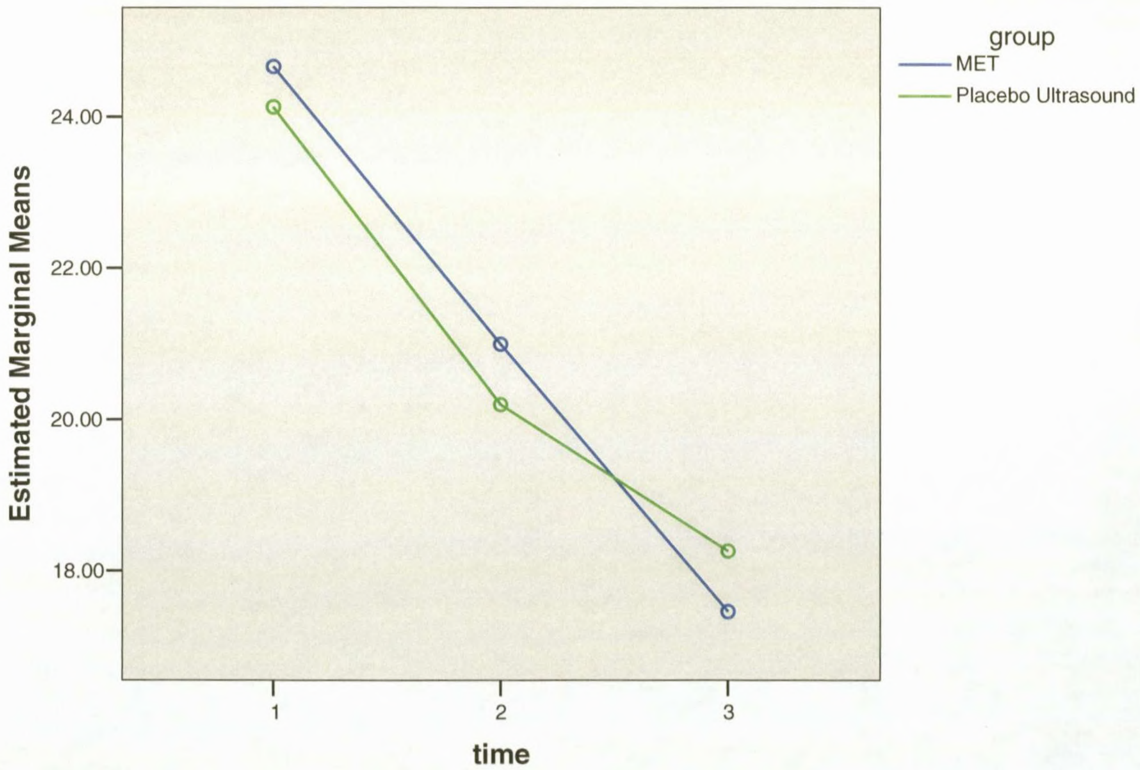

Figure 6: Profile plot of mean disability score over time by treatment group

4.4) Correlations between changes in subjective and objective outcome measurements

4.4.1) MET group

In the MET group there was a significant moderate negative correlation between change in algometer and change in disability score (r= -0.521, p=0.046). NRS and disability score were positively correlated together (r=0.532, p=0.041). Thus, as pain subsided over time, disability decreased. No other measurements were correlated together in this group. This is shown in Table 11.

Table 11: Pearson's correlation matrix between changes in outcomes over time in the MET group

		Change in algometer	Change in VA	Change in thickness	Change in NRS	Change in disability
Change in algometer	Pearson Correlation	1	-.301	.090	-.020	-.521(*)
	p value		.276	.749	.945	.046
	N	15	15	15	15	15
Change in VA	Pearson Correlation	-.301	1	-.043	-.082	.170
	p value	.276		.880	.772	.544
	N	15	15	15	15	15
Change in thickness	Pearson Correlation	.090	-.043	1	-.094	.071
	p value	.749	.880		.740	.802
	N	15	15	15	15	15
Change in NRS	Pearson Correlation	-.020	-.082	-.094	1	.532(*)
	p value	.945	.772	.740		.041
	N	15	15	15	15	15
Change in disability score	Pearson Correlation	-.521(*)	.170	.071	.532(*)	1
	p value	.046	.544	.802	.041	
	N	15	15	15	15	15

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

4.4.2 Placebo group

There were no significant correlations between changes in outcome measurements in the placebo group. This is shown in Table 12.

Table 12: Pearson's correlation matrix between changes in outcomes over time in the placebo group

		Change in algometer	Change in VA	Change in thickness	Change in NRS	Change in disability
Change in algometer	Pearson Correlation	1	-.190	.297	.263	.098
	p value		.497	.282	.343	.729
	N	15	15	15	15	15
Change in VA	Pearson Correlation	-.190	1	-.254	.302	.136
	p value	.497		.362	.274	.628
	N	15	15	15	15	15
Change in thickness	Pearson Correlation	.297	-.254	1	.099	.017
	p value	.282	.362		.725	.953
	N	15	15	15	15	15
Change in NRS	Pearson Correlation	.263	.302	.099	1	.153
	p value	.343	.274	.725		.586
	N	15	15	15	15	15
Change in disability score	Pearson Correlation	.098	.136	.017	.153	1
	p value	.729	.628	.953	.586	
	N	15	15	15	15	15

4.5 Conclusion

This study has detected a statistically significantly beneficial treatment effect of MET over the placebo effect for the following outcomes: algometer measurements and tendon thickness measurements. For the subjective outcomes of NRS and disability score however the treatment effect was not statistically significant, there was a trend towards a beneficial effect of the MET treatment when results were viewed graphically. Participants treated with MET showed correlated decreases in pain and disability while those who were treated with the placebo did not show these correlations. The most significant beneficial treatment effects of MET were demonstrated with the diagnostic ultrasound. This may suggest that the hypothesized benefits of increasing fluid mechanics and decreasing local edema are best evaluated by assessing the tendon itself with visualization tools such as diagnostic ultrasound. The benefits of mobilizing an articulation, lengthening a muscle and pain relief were less evident in this study.

The statistical analysis therefore confirms the hypothesis that both MET and de-tuned ultrasound will have a beneficial effect in the treatment of rotator cuff tendonitis in terms of both subjective and objective clinical findings.

The statistical analysis also confirms the hypothesis that MET will have a greater beneficial effect than de-tuned ultrasound in the treatment of rotator cuff tendonitis in terms of objective clinical findings. However the statistical analysis rejects the hypothesis that MET will have a greater beneficial effect than de-tuned ultrasound in the treatment of rotator cuff tendonitis in terms of subjective clinical findings.

Chapter Five

Conclusions and Recommendations

5.1) Introduction

This chapter will discuss the outcomes of this research and make recommendations with regards to further research.

5.2) Conclusions

The aim of this study was to assess the efficacy of Muscle Energy Technique (MET) in the treatment of rotator cuff tendonitis in terms of subjective and objective clinical findings.

The results of this study indicate that Muscle Energy Technique appears to be more effective then placebo ultrasound in the treatment of rotator cuff tendonitis. Statistically, the MET group showed a beneficial treatment effect in regards to the objective findings of the algometer and diagnostic ultrasound scan compared with the placebo ultrasound group. However, for the objective findings of the inclinometer as well as the subjective findings of the NRS and Disability Score, there was no statistically significant evidence of an effect of the MET treatment over and above that of the placebo ultrasound. However, the MET was at no point worse than the effect of the placebo ultrasound, and even showed a possible non-significant trend towards a beneficial effect in some of the outcomes in which no statistical significance was shown.

The most significant beneficial treatment effects of MET were demonstrated with the diagnostic ultrasound. This suggests that in this study the effects of reducing local oedema and increasing fluid mechanics were better demonstrated than relief of pain or increase in range of motion. This would indicate that although Muscle Energy Technique may be more effective then placebo ultrasound in the treatment of rotator cuff tendonitis in terms of objective findings, it alone is not clinically effective in the treatment of this condition and should be used more as an adjunct to other primary treatment methods.

5.3) Recommendations

It is recommended that in future research a larger sample size be used in order to achieve a higher level of validity. In some instances the MET group showed a trend towards a beneficial effect and these trends may have been better demonstrated with a larger sample size and a slightly longer treatment period.

Diagnostic ultrasound is considered highly operator dependant. O'Connor *et al.* 2005, stated that good reproducibility of quantitative tendon measurements can be achieved within a study by using two observers and following a defined scanning protocol. Based on the limitations of this study, a single operator with a specific and unchanging scanning protocol was used throughout, to ensure accuracy however it is recommended that, if available, two observers be considered in future research.

DiGiovanna (1991), states that occasionally there is some muscle stiffness and soreness after treatment with Muscle Energy Technique. Post treatment stiffness and soreness may have had some effect on certain readings (e.g. NRS and algometer) and so it is recommended that this be considered in future research involving Muscle Energy Technique. Thus pain and disability scores should be interpreted with caution, as they may not reflect actual clinical improvement. Therefore, it is suggested that future research / data collection methods consider this and / or be adjusted to reduce these effects.

Due to the high number of participants in this study who related their shoulder pain to weight training it is also recommended that similar research be done with participants from specific sporting codes such as weight training. It is also recommended that research be done on the techniques employed by weight trainers and the effects of these techniques on the rotator cuff of the shoulder.

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APPENDICES

A – Advertisement

B – Case history

C – Physical examination

D – Shoulder regional examination

E – Consent form

F – Research Information sheet

G – NRS-101

H – Pain Disability Scale

I – Data Collection Sheet

DO YOU SUFFER FROM

SHOULDER PAIN?

RESEARCH IS CURRENTLY BEING DONE AT THE

DURBAN INSTITUTE OF TECHNOLOGY CHIROPRACTIC DAY CLINIC

PARTICIPATION IS **FREE** IF YOU ARE ACCEPTED INTO THIS STUDY.

CONTACT MANNY AZIZI ON (031) 2042205

Appendix B

DURBAN INSTITUTE OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: ______________________________ Date: __________

File # : __________ Age: __________

Sex : __________ Occupation: ______________________

Intern : ______________________ Signature ______________________

FOR CLINICIANS USE ONLY:
Initial visit
Clinician: Signature :

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

CASE STATUS:

PTT:	Signature:	Date:
CONDITIONAL: Reason for Conditional:		
Signature:		Date:

Conditions met in Visit No:	Signed into PTT:	Date:
Case Summary signed off:		Date:

Intern's Case History:

1. **Source of History:**

2. **Chief Complaint : (patient's own words):**

3. **Present Illness:**

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

4. **Other Complaints:**

5. **Past Medical History:**

< General Health Status

< Childhood Illnesses

< Adult Illnesses

< Psychiatric Illnesses

< Accidents/Injuries

< Surgery

< Hospitalizations

6. Current health status and life-style:

< Allergies

< Immunizations

< Screening Tests incl. xrays

< Environmental Hazards (Home, School, Work)

< Exercise and Leisure

< Sleep Patterns

< Diet

< Current Medication
Analgesics/week:

< Tobacco

< Alcohol

< Social Drugs

7. Immediate Family Medical History:

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

8. Psychosocial history:
< Home Situation and daily life

< Important experiences

< Religious Beliefs

9. **Review of Systems:**

< General

< Skin

< Head

< Eyes

< Ears

< Nose/Sinuses

< Mouth/Throat

< Neck

< Breasts

< Respiratory

< Cardiac

< Gastro-intestinal

< Urinary

< Genital

< Vascular

< Musculoskeletal

< Neurologic

< Haematologic

< Endocrine

< Psychiatric

Appendix C

Durban Institute of Technology

PHYSICAL EXAMINATION: SENIOR

Patient Name : ____________________ **File no :** ________ **Date :** ________

Student : **Signature :**

VITALS:

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

GENERAL EXAMINATION:

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

SYSTEM SPECIFIC EXAMINATION:

CARDIOVASCULAR EXAMINATION

RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION

NEUROLOGICAL EXAMINATION

COMMENTS

Clinician: **Signature :**

SHOULDER REGIONAL EXAMINATION

Patient: .... File No: .... Date: ....

Intern: ....Signature: ....

Clinician: ....Signature: ....

Observation

Posture		S-C Joints	
Skin		Clavicles	
Swelling		A-C Joints	
Shoulder levels		Scapulae	
Comments			

Palpation

S-C Joint:	SCM:	Scalenes:
Sternum:	Ribs and costal cartridge:	
Clavicle:	Coracoid process:	
A-C Joint:	Acromion:	
Greater Tuberosity:		
Lesser Tuberosity:		
Intertubercular (bicipital groove):		
Trapezius:	Deltoid:	
Biceps:	Triceps:	
Supraspinatus insertion:		
Musculotendinous portion of supraspinatus:		
Axilla:	Lymph nodes:	
	Brachial artery:	
	Serratus anterior (medial wall):	
	Pectoralis major (anterior wall):	
	Lattisimus dorsi (posterior wall):	
Scapula	Borders:	Spine:
	Supraspinous fossa:	

	Infraspinous fossa:
Cervico-thoracic spine:	

Active Movements (note ROM and pain)

Elevation through abduction (170-180°):	
Painful arc with abduction:	
Elevation through forward flexion (160-180°):	
Elevation through scapula plane (170-180°):	
Lateral rotation (80-90°):	Medial rotation (60-100°):
Extension (50-60°):	Adduction (50-75°):
Horizontal adduction/abduction (130°):	
Circumduction (200°):	
Apley's Scratch:	

Passive movements (note end-feel, ROM and pain)

Elevation through abduction (bone to bone or tissue stretch)..

Elevation through forward flexion (tissue stretch)...

Lateral rotation (tissue stretch)...

Medial rotation (tissue stretch)...

Extension (tissue stretch)..

Adduction (tissue approximation)

....

Horizontal adduction (tissue stretch or approximation)...

Horizontal abduction (tissue stretch)...

Quadrant Test..
..

Resisted Isometric Movements (note strength and pain)

Flexion		Medial rotation	
Extension		Lateral Rotation	
Adduction		Elbow flexion	
Abduction		Elbow extension	

Joint Play Movements (and motion palpation)

SC Joint	Supero-inferior (shrug shoulder with arm at side):	
	Horizontal add/abduction (arm abducted 90°):	
AC Joint	A-P Shear:	
	Supero-inferior shear:	
Scapula	Normal scapulo-humeral rhythm?:	
	General mobility of scapula:	

Glenohumeral Joint

Lateral movement of humeral head __________

Inferior movement of humeral head (Caudal glide)(50°) __________

Anterior movement of humeral head (P-A glide) (25°) __________

Posterior shear of humeral head (A-P glide) **>50%** At 10° flexion __________

At 90° flexion __________

Backward glide of humeral head in abduction __________

Long-axis distraction of humeral head in abduction __________

Downward and backward (S-I → A-P) __________

Outward and backward (med-lat → A-P __________

External rotation of humeral head __________

Internal rotation of humeral head __________

Instability Tests

1. Anterior Instability Tests

	Right			Left		
	Pos	Neg	n/a	Pos	Neg	n/a
Anterior drawer Test						
Rowe Test						
Fulcrum Test						
Apprehension (crank) Test						
Clunk Test (tear of labrum)						
Rockwood Test						

2. Posterior Instability Tests

	Pos	Neg	n/a	Pos	Neg	n/a
Posterior Apprehension Test						
Norwood Stress Test						

Push-pull Test						
Jerk Test						

3. Inferior and Multi-directional instability tests

	Pos	Neg	n/a	Pos	Neg	n/a
Inferior Shoulder Instability Test						
Feagin Test (antero-inferior instability)						

A-C Joint Stress Test: ____________________

S-C Joint Stress Test: ____________________

Tests for Muscle or Tendon Pathology

1.	Speed's Test (bicipital tendonitis)	
2.	Gilchrest Sign (bicipital tendonitis)	
3.	Supraspinatus Test (supraspinatus tendonitis)	
4.	Hawkins-Kennedy Impingement Test (supraspinatus tendonitis)	
5.	Drop –arm Test (rotator cuff tear)	
6.	Impingement Test	
7.	Pectoralis Major Contracture Test	
8.	Ludington's Test (rupture of long head of biceps)	

Tests for neurological function

Brachial Plexus Tension Test	Radial Nerve												
	Median Nerve												
Tinel's Sign (Scalene triangle)													
Dermatones	C4		C5		C6		C7		C8		T1		T2
Reflexes	Biceps(C5/6)		Triceps (C7/8)										

Thoracic Outlet Syndrome Tests

Adson's Test		Halstead's Test	
Costoclavicular Test		Eden's Test (cervical rib)	
Hyperabduction Test		Roos Test	
Allen's Test			

Appendix E

INFORMED CONSENT FORM

DATE:

TITLE OF RESEARCH PROJECT:
Clinical efficacy of Muscle Energy Technique (MET) in the treatment of rotator cuff tendonitis

NAME OF SUPERVISOR:
Dr. Micah Atkinson (0848000232) (M.Tech Chiropractic)

NAME OF RESEARCH STUDENT:
Manny Azizi (0845499132)

Please circle the appropriate answer	YES	/NO
1. Have you read the research information sheet?	Yes	No
2. Have you had an opportunity to ask questions regarding this study?	Yes	No
3. Have you received satisfactory answers to your questions?	Yes	No
4. Have you had an opportunity to discuss this study?	Yes	No
5. Have you received enough information about this study?	Yes	No
6. Do you understand the implications of your involvement in this study?	Yes	No
7. Do you understand that you are free to		
a) Withdraw from this study at any time?	Yes	No
b) Withdraw from the study at any time, without reasons given	Yes	No
c) Withdraw from the study at any time without affecting your future health care or relationship with the Chiropractic day clinic at the Durban Institute of Technology.	Yes	No
8. Do you agree to voluntarily participate in this study	Yes	No
9. Who have you spoken to regarding this study?		

If you have answered NO to any of the above, please obtain the necessary information from the researcher and / or supervisor before signing. Thank You.

Please print in block letters:

Patient: ______________________ Signature: ________________

Parent/Guardian: ______________________ Signature: ________________

Witness Name: ______________________ Signature: ________________

Research Student: ______________________ Signature: ________________

Appendix F

RESEARCH INFORMATION

Dear Participants,

Title: Clinical efficacy of Muscle Energy Technique (MET) in the treatment of rotator cuff tendonitis

Researcher: Manny Azizi (0845499132)

Supervisor: Dr. Micah Atkinson (M.Tech. Chiropractic)

Rationale for the study:
Shoulder conditions are extremely common. The most common shoulder injury is a condition known as rotator cuff tendonitis which is an inflammation of the common tendon of a group of muscles called the rotator cuff. These muscles provide stability and allow movement of the shoulder joint. Currently, treatment of this disorder appears controversial and often contradictory. This study will shed some light on the efficacy of a new treatment option for this very common shoulder condition. There will be two randomly selected groups in the study. One group of participants will receive Muscle Energy Technique and the other group will receive ultrasound.

Procedures:
Participants will be required to attend an initial consultation at the Chiropractic Day Clinic and 4 follow-up consultations within a three week period. At the initial consultation a case history, physical examination, shoulder regional examination and diagnostic ultrasound will be conducted to ensure participants are eligible to take part in the study and do not have any contraindications to treatment. Treatment will be administered on the first to fourth consultations and the fifth will be for data collection only at which time another diagnostic ultrasound will be conducted. Participants should not receive any other treatment or therapy and should not take any medication for their shoulder complaint during the research period. If participants pain is completely reduced during the research period they are still expected to attend all consultations in the 3 week period.

Inclusion Criteria
Only patients diagnosed as having rotator cuff tendonitis will be considered. An informed consent form must be signed by each patient. Only patients between the ages of 18-50 will be accepted into the study.

Exclusion Criteria
Those who do not sign the consent form will not take part in the study. Patients with contraindications to the treatment will not be accepted into the study. These contraindications will be evaluated during the initial consultation.
Patients who have received any ultrasound treatment in the past three months or who have taken any medication for their shoulder complaint in the week before their first research consultation will not be allowed to take part in the study. Patients should also not take any medication for their shoulder complaint during the research period.

Those patients who did not meet the inclusion criteria will be referred to other interns at the Chiropractic Day Clinic for treatment of their condition.

Costs and risks:
Involvement in this study is voluntary and free of charge. Participants are also free to withdraw from the study at any stage without repercussions of any kind. All treatment is non-invasive, pain free and has no side effects.

Exclusion from the study:
Participants can be excluded from the study if they cannot attend the required number of consultations or if they receive any other treatment or medication during the research period.

Benefits of the study:
Participants may notice improvement in their shoulder condition due to the hypothesized benefits of the treatment modalities.
Participants will also be contributing to the research knowledge concerning this common shoulder condition and its treatment.

Confidentiality:
All data collected is confidential and will be maintained in a secure patient file at the Chiropractic Day Clinic. Patients will be required to sign an Informed Consent Form.

If there are any complaints please contact Mr Vikesh Singh (2042701)
Research Ethics and Biosafety Committee

Thank you for participating in the study

Manny Azizi
Research Student

Dr M.Atkinson
Supervisor
(M.Tech. Chiropractic)

Appendix G

NUMERICAL PAIN RATING SCALE-101

NUMERICAL PAIN RATING SCALE-101

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

<u>Please write only one number:</u>

0 ____ 100

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

<u>Please write only one number:</u>

0 ____ 100

Appendix H

Pain Disability Index

Patient Name: ....

File No: ....   **Date:**...........................

The rating scales below are designed to measure the degree to which several aspects of your life are presently disrupted by pain. In other words how much your pain is preventing you from doing what you normally do, or from doing it as well as you normally would. Please respond to each question by indicating the overall impact of the pain on your life and not just when it is at its worst.

For each of the categories of activities listed, please circle the number on the scale that describes the level of the disability you typically experience. A score of one (1) means no disability at all and a score of ten (10) signifies that all of the activities in which you normally be involved have been totally disrupted or prevented by your pain.

A. Family and home responsibilities. This category refers to activities related to the home and family

1	2	3	4	5	6	7	8	9	10

B. Recreation. This category includes hobbies, sports and other similar leisure time activities.

1	2	3	4	5	6	7	8	9	10

C. Social activity. This category refers to activities which involve participation with friends and family

1	2	3	4	5	6	7	8	9	10

D. Occupation. This category refers to activities that are part of or are directly related to one's job.

1	2	3	4	5	6	7	8	9	10

E. Self care. This category includes activities which involve personal maintenance and independence

1	2	3	4	5	6	7	8	9	10

....

Appendix I

Data Sheet

Patient Name: ____

Age: ________________________________ Sex: ____________

Occupation: ___________________________ Shoulder Involved: ________

Cause of Shoulder Injury ______________________________________

Treatment Group:	Muscle Energy Technique	De-Tuned Ultrasound

1. Algometer Readings

Consultation One	Consultation Three	Consultation Five

2. Inclinometer Readings

Direction	Consultation One	Consultation Three	Consultation Five
Vertical Abduction			

3. Diagnostic Ultrasound

	Tendon Thickness (mm)
Consultation One	
Consultation Five	

THE EFFICACY OF MUSCLE ENERGY TECHNIQUE (MET) IN THE TREATMENT OF ROTATOR CUFF TENDONITIS IN TERMS OF SUBJECTIVE AND OBJECTIVE CLINICAL FINDINGS.

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Manny Azizi from Durban Institute of Technology, South Africa.

Abstract

Objectives: To assess the efficacy of Muscle Energy Technique (MET) in the treatment of rotator cuff tendonitis in terms of subjective and objective clinical findings.

Methods: 30 patients diagnosed with rotator cuff tendonitis, were randomly allocated into one of two equal groups. There was a treatment group who received Muscle Energy Technique over four consultations within a 3-week period. There was also a measurement group who received detuned (placebo) ultrasound over for consultations within a 3-week period. Diagnostic ultrasound assessments were used to evaluate the inflammation of the involved tendon. Other objective measurements included an algometer, which was used to assess point tenderness, and a digital inclinometer, which was used to evaluate range of motion. Subjective measurements were the Numerical Rating Scale – 101 (NRS-101) and the Pain and Disability Scale.

Results: This study showed evidence for a beneficial effect of Muscle Energy Technique in the treatment of rotator cuff tendonitis. The group receiving Muscle Energy Technique showed significant improvement over the placebo group in terms of the objective findings of the diagnostic ultrasound and algometer. However in terms of the range of motion and the subjective findings of the Numerical Pain Rating Scale and the Pain and Disability Scale, both groups improved

however the difference between the groups was not clinically significant. Participants treated with MET did however show correlated decreases in pain and disability while those who were treated with the placebo did not show these correlations.

Conclusions: The results of this study indicate that Muscle Energy Technique appears to be more effective than placebo ultrasound in the treatment of rotator cuff tendonitis. The most significant beneficial treatment effects of MET were demonstrated with the diagnostic ultrasound which demonstrated the significant effects of reducing local edema and increasing fluid mechanics. However due to the inclinometer findings and subjective measurement findings it was concluded that although Muscle Energy Technique may be more effective then placebo ultrasound in the treatment of rotator cuff tendonitis, it alone is not clinically effective in the treatment of this condition and should be used more as an adjunct to other primary treatment methods.

Key Terms: Rotator Cuff Tendonitis, Muscle Energy Technique

Introduction

The most frequently recorded shoulder disorder in general practice is rotator cuff tendonitis (Van der Windt et al. 1995). Primary impingement of the supraspinatus tendon is responsible in the majority of cases (Fu et al. 1995). The dynamic and static stabilizers of the shoulder are placed under stress with overhead movements. These repetitive stresses result in microtrauma to the glenohumeral ligaments. Eventually fatigue of the rotator cuff allows the humeral head to translate anteriorly, with resultant mechanical impingement of the supraspinatus tendon. At this point inflammatory changes become evident (Fu et al. 1995).

It has been hypothesized that MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and decrease local edema, and to mobilize a restricted articulation (Greenman 1996). While MET has become widely used with clinicians, little has been published on this intervention (Gibbons 1998) and very little has been published in the way of randomized control trials involving MET (Schenk 1997).

The aim of this study was to assess the efficacy of Muscle Energy Technique (MET) in the treatment of rotator cuff tendonitis in terms of subjective and objective clinical findings.

Materials and Methods

The study consisted of a total of 30 subjects (28 males, 2 females). Participants were between the ages of 18 and 50 (mean, 30.8 years). Diagnosis was based on history and examination. Only patients diagnosed by the researcher as having rotator cuff tendonitis were considered. This was evaluated according to the following tests:

- Positive Orthopedic tests: Hawkins-Kennedy and Empty can (Supraspinatus). (Vizniak, 2002).
- The patients condition had to comply with at least three of the four following physical findings:
  - Palpable tenderness over the greater tuberosity of the humerus of the involved shoulder
  - Palpable tenderness along the edge of the acromion of the involved shoulder

- A painful arc of abduction between 60° –120°
- A positive shoulder abduction stress test

(Schafer and Faye, 1990).

The study consisted of two groups of 15, Group 1 received 4 treatments in the form of Muscle Energy Technique, whereas Group 2 received detuned (placebo) ultrasound over 4 consultations. Both groups received all four consultations within a 3-week period.

Subjects underwent clinical assessments, which included both objective and subjective findings assessments. These were done at the first (pre-intervention), third and fifth consultations.

Diagnostic ultrasound assessments were used to evaluate the inflammation of the involved tendon.

An algometer was used to assess point tenderness and a digital inclinometer was used to evaluate range of motion (abduction). Subjective measurements were the Numerical Rating Scale –101 (NRS-101) and the Pain and Disability Scale.

Data were entered into a MS Excel spreadsheet and imported into SPSS version 13 (SPSS Inc., Chicago, Illinois, USA), which was used for data analysis.

Demographics were compared between the two treatment groups using Pearson's chi square tests or Fisher's exact tests as appropriate for categorical variables, and independent t-tests for quantitative variables.

In the assessment of a treatment effect, 3 effects were tested:
1) the effect of time
2) the effect of group (MET vs. placebo), and
3) the interaction effect of time and group (treatment effect)

Results and Discussion

Diagnostic Ultrasound

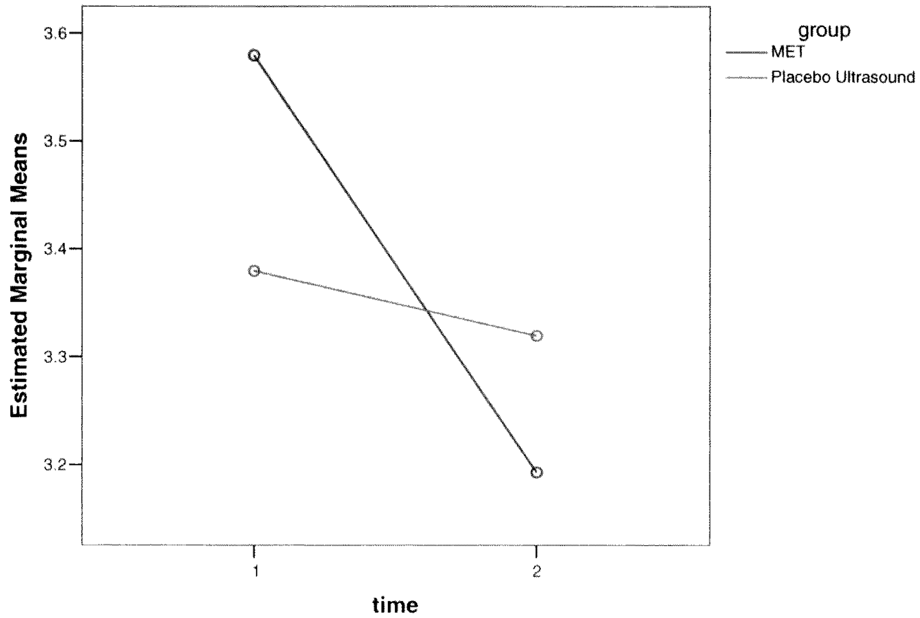

Figure 1: Profile plot of mean thickness (mm) over time by treatment group

There was an overall decrease in tendon thickness in both groups, however the Muscle Energy Technique group improved to a more significant level than the placebo group.

According to Greenman (1996), MET can be used to increase fluid mechanics and decrease local edema. These beneficial effects on the tendon itself could be seen by the decrease in tendon inflammation and thickness.

Algometer readings

The placebo group and the MET group improved however they did so at different rates over time, the MET group improving at a significantly faster rate than the placebo group. Thus for this outcome a beneficial treatment effect was demonstrated. Although the MET group improved at a faster rate then the placebo group, the results were not as highly significant as was expected. This may have been due to the effect of post treatment muscle stiffness and discomfort. DiGiovanna (1991), states that occasionally there is some muscle stiffness and soreness after treatment.

Inclinometer readings

Vertical abduction was assessed using the digital inclinometer and both groups displayed an increase in vertical abduction over time.

The MET group showed no clinical benefit over and above the placebo group. Therefore in this study the hypothesized benefits of MET of lengthening muscles and mobilizing a restricted joint was not represented in a change in range of motion. However, as with the algometer readings, the range of motion may have been affected by post treatment stiffness, which may have limited the amount of vertical abduction to some degree.

NRS-101

There was an overall decrease in pain levels experienced by both groups and the rate of change over time was similar in both groups. Thus, for this outcome there was no evidence that the treatment had any effect over and above the placebo. This correlated with the algometer readings that measured point tenderness objectively.

Shoulder Pain and Disability Index (SPADI)

The disability scores changed significantly over time but did not vary between groups. There was a trend towards a beneficial effect of the MET treatment when results were viewed graphically and this trend may have been better shown with a larger sample size and possibly a longer treatment period. It would seem that in this study MET did not decrease the patient's disability anymore than the placebo ultrasound.

Correlation

This study has detected a statistically significantly beneficial treatment effect of MET over the placebo effect for the following outcomes: algometer measurements and tendon thickness measurements. Participants treated with MET showed correlated decreases in pain and disability while those who were treated with the placebo did not show these correlations.

Conclusion

Both groups improved over the 3-week period, however the treatment group seemed to improve to a greater or more significant level, especially with regards to visualization of tendon inflammation and thickness using diagnostic ultrasound. However range of motion, pain and disability showed less significant outcomes. Therefore, this study concludes that although Muscle Energy Technique may be more effective than placebo ultrasound in the treatment of rotator cuff tendonitis in terms of objective findings, it alone is not clinically effective in the treatment of this condition and should be used more as an adjunct to other primary treatment methods.

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