AN EXPLORATORY STUDY OF THE IMMEDIATE AND SHORT TERM EFFECTIVENESS OF DRY NEEDLING THE PRIMARY, ACTIVE TRIGGER POINT ON CLINICAL DIAGNOSTIC FINDINGS IN PATIENTS WITH MYOFASCIAL PAIN SYNDROME OF THE BICEPS MUSCLE.

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Chiropractic at The Durban Institute of Technology.

I, Jacqueline Ann Cowie, do hereby declare that this dissertation represents my own work both in concept and execution.

Jacqueline Ann Cowie Date

Approved for final submission

Dr Corrie Myburgh, M.Tech Chiro CCFC, CCSP Date

DEDICATION.

To my Mom and Dad, whose belief in me has never wavered.

It is always my intention to make you proud.

To Eugene, who waited patiently and without question for me

to achieve this goal.

ACKNOWLEDGEMENTS.

Thanks must go to the people who helped me achieve my goal.

To Dr Myburgh, my supervisor, who was there through the ups and downs.

To Linda, Pat and Mrs Ireland who all went out of their way to help me. Their humour can really help a person through the day.

To all the patients who participated in the study, I thank you for your time and contributions.

ABSTRACT.

The purpose of this study was to investigate the immediate and short term effectiveness of dry needling the primary, active Biceps TrP on the pain experienced during shoulder flexion and abduction range of motion, as well as on an associated bicipital tendonitis and satellite TrP's.

The study was a prospective, controlled, pilot study that included 30 patients from the greater Durban area. All patients were between the ages of 20 and 45 years and all were diagnosed with an active trigger point (TrP) in the Biceps muscle.

Each patient was required to attend three visits on three consecutive days. The treatment intervention was dry needling of the active Biceps TrP. Subjective and objective data was obtained from the patients before and after the first consultation. At the second consultation, if the Biceps

TrP was still present and active, the subjective and objective data was obtained before and after the treatment again (Group 1A). If, however, at this consultation, the TrP had resolved, no treatment intervention was given and both types of data were obtained only once (Group 1B). The third consultation was reserved for data collection only, no treatment intervention was given to the patients. Subjective data was obtained using the Numerical Rating Scale 101 (NRS 101) and the Shoulder Pain and Disability Index (SPADI). Objective data was obtained by range of motion (ROM) readings using an inclinometer and the Myofascial Diagnostic Scale (MDS).

Associated findings of satellite TrP's in the Supraspinatus and Deltoid (anterior and middle) muscles were also noted. The diagnosis of these TrP's was standardised using the MDS. Associated bicipital tendonitis was also noted and diagnosis was standardised using the Biceps Tendonitis Scale. These associated findings were assessed at the beginning of each consultation.

Non-parametric tests were used for statistical analysis and all tests were performed at the 95% level of significance. Inter-group comparison was made using the Mann Whitney U-test for both subjective and objective data. Intra-group comparisons of subjective and objective data were made using the Wilcoxon Signed Ranks test.

Evaluation of the results obtained from the inter-group analyses revealed a significant difference between Group A and B in terms of MDS, NRS 101 and SPADI scores at the second consultation implying that Group A was significantly worse than Group B. The groups were no longer significantly different by the third consultation in terms of NRS 101, SPADI and ROM measurements.

Intra-group analyses revealed immediate improvement in objective and subjective data. Short-term improvement was observed for MDS, NRS 101 and SPADI scores. Overall improvement was observed for all subjective and objective data.

The prevalence of satellite TrP's in Supraspinatus and Deltoid muscles was reduced as was the prevalence of biceps tendonitis, when the primary, active Biceps TrP was inactivated.

It was concluded that dry needling was an effective treatment intervention for MPS of the Biceps muscle. It was also concluded that shoulder ROM (in flexion and abduction) was increased, as was shoulder functionality when the Biceps TrP was treated. Pain intensity also decreased. Treatment of the Biceps TrP also had a direct effect on the associated findings.

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CHAPTER ONE.

1.1 INTRODUCTION.

This chapter serves to broadly discuss the background, aims and objectives of this study. The hypotheses that motivate this study will also be discussed.

Travell, Simons and Simons (1999 1:5) define Myofascial Pain Syndrome (MPS) as "the sensory, motor and autonomic symptoms" produced by myofascial trigger points (TrP's). TrP's are the hyperirritable spots within skeletal muscles that are associated with palpable nodules in taut muscle bands.

Myofascial TrP's are extremely common and become a distressing part of nearly everyone's life at one stage or another (Travell, Simons and Simons, 1999 1:12). The high prevalence of pain arising from MPS is not surprising since voluntary skeletal muscle constitutes 40% or more of total body weight and is the largest tissue mass in the human body

(Gatterman, 1990:285). Despite the advances in modern health care, a void still exists in the understanding, diagnosing and treatment of this day-to-day musculoskeletal pain (Bruce, 1995).

Little or no research has previously been done on MPS of the Biceps muscle. This muscle is, however, engaged during a variety of activities and is prone to the development of active TrP's.

The Biceps muscle functions in abduction of the shoulder when the arm is laterally rotated and weakly assists in forward flexing the arm at the shoulder. It also flexes the arm at the elbow and supinates the forearm (Travell, Simons and Simons, 1999 1:650). The Biceps acts synergistically with the anterior Deltoid to flex the arm at the shoulder and with the middle Deltoid and Supraspinatus to abduct the arm, also at the shoulder (Travell, Simons and Simons, 1999 1:651).

Active TrP's are usually found in the midportion of the muscle belly and refer pain upwards over the muscle to the anterior

Deltoid region. Referred pain sometimes skips the shoulder to the suprascapular area and can also produce mild pain in the antecubital space (Travell, Simons and Simons, 1999 1:648).

When the Biceps TrP is present and active, the patient complains of vague anterior shoulder pain. Other symptoms of active Biceps TrP's include tenderness over the bicipital tendon and possible weakness (Travell, Simons and Simons, 1999 1:652).

The key TrP in the Biceps muscle may neurogenically or mechanically induce satellite TrP's in the Deltoid and Supraspinatus muscles. This is because the Deltoid and Supraspinatus muscles lie in the zone of reference of the key Biceps TrP and they are overloaded because they substitute for the Biceps muscle harbouring the TrP (Travell, Simons and Simons, 1999 1:6).

With this background, the researcher questioned whether treatment of the active Biceps TrP would affect the satellite

TrP's as well as the bicipital tendon pain and shoulder range of motion in flexion and abduction.

1.2 AIM OF THE STUDY.

The purpose of this study was to investigate the immediate and short term effectiveness of dry needling the primary, active Biceps TrP on pain experienced during shoulder flexion and abduction range of motion (ROM), as well as on an associated bicipital tendonitis and associated satellite TrP's, in terms of objective and subjective clinical findings.

1.3 OBJECTIVES OF THE STUDY.

The first objective was to evaluate the incidence of associated Supraspinatus and anterior or middle Deltoid TrP's, as well as bicipital tendonitis, when the active Biceps TrP was present.

The second objective was to determine whether these associated findings affected shoulder ROM in forward flexion and abduction as well as pain and/or disability.

The third objective was to note the changes that occurred to the diagnosis as well as the associated findings when the primary, active Biceps TrP was treated.

1.4 THE HYPOTHESES.

The first hypothesis was that the incidence of associated Supraspinatus and anterior or middle Deltoid TrP's, as well as bicipital tendonitis, would be high when the primary, active Biceps TrP was present.

The second hypothesis was that the associated findings would negatively affect shoulder ROM in forward flexion and abduction and they would also increase shoulder pain and disability.

The third hypothesis was that the diagnosis and associated findings would change when the primary, active Biceps TrP was treated.

1.5 BENEFITS OF THE STUDY.

An episode of shoulder pain that lasts for more than one month affects over 5% of Americans each year. Despite this incidence, few studies have addressed the treatment and outcome of these patients (Williams et al., 1995). This study aims to identify the possible manifestation of satellite TrP's and bicipital tendon dysfunction in patients with active Biceps TrP's. This will in turn allow the physician a better understanding of the condition as a whole and therefore treat it as such. Treating the condition with a fuller knowledge of associated findings will allow a better treatment protocol and therefore improved overall management. Anterior shoulder pain can be a vague and confusing condition and this study may give physicians another option to explore when developing a differential diagnosis. When shoulder ROM is not full and pain free, the physician may now look towards the Biceps muscle.

CHAPTER TWO.

2.1 INTRODUCTION.

This chapter will provide an overview of the literature related to MPS as a condition as well as MPS of the Biceps muscle in particular. This overview will summarise current concepts in TrP aetiology, pathophysiology, diagnosis and treatment in order to build a composite picture of MPS of the Biceps muscle.

2.2 ACTIVATION AND PERPETUATION OF TRP'S IN THE BICEPS MUSCLE.

Travell, Simons and Simons (1999 1:110-111) have effectively divided the aetiology of TrP's into two groups. Acute events are said to have a sudden onset of symptoms while chronic stresses produce a more gradual onset of symptoms. Schneider (1995) also suggests that TrP's arise from some form of damage to muscle cells, either by gross trauma (acute) or from repetitive microtrauma (chronic). Han and Harrison (1997) suggest that

these types of trauma damage the sarcoplasmic reticulum of muscle fibres.

The understanding of perpetuating factors is important, especially in patients with chronic myofascial pain. If the perpetuating factors are not identified and addressed, the therapy is susceptible to failure (Travell, Simons and Simons, 1999 1:178).

Biceps TrP's are activated and perpetuated by a variety of activities. These may include:

1. Overstressing the Biceps muscle during the backhand stroke in tennis, especially if the elbow is straight and the forearm is supinated
2. Overloading the Biceps muscle by lifting heavy objects with the forearm supinated
3. Sudden lifting stresses to the muscle will activate TrP's, especially if the arm is extended eg. lifting the bonnet of a car.

4. Episodic loading of the muscle when the elbow is flexed will activate Biceps TrP's eg. using an electric weed-eater.

5. Repetitive supination of the forearm will activate TrP's in the Biceps eg. using a screwdriver.

6. Overexertion when one is unaccustomed to the activity activates TrP's eg. shovelling sand.

7. Sudden overstretching of the Biceps muscle will also activate TrP's eg. catching a fall on a rail.

8. Frequently repeated activities activate and perpetuate Biceps TrP's eg. playing the violin (Travell, Simons and Simons, 1999 1:652).

2.3 PREVALENCE OF TRP'S.

There are currently no available statistics on the incidence and prevalence of Biceps TrP's. There is, however, abundant data on the incidence and prevalence of TrP's in general. Therefore, in order to extrapolate the incidence and prevalence for this condition, a discussion of general epidemiological findings will follow.

This data was first available from as early as 1955, when Sola et al. conducted a study that included two hundred unselected and asymptomatic patients. Each patient was examined for the presence of TrP's, their locations and their abilities to produce referred pain upon local stimulation. Of the two hundred patients, 49,5% were found to have one or more TrP's. The females showed a higher incidence with 54 of the hundred female patients having positive findings. Referred pain could be elicited in 12,5% of all patients. There was no significant sex difference here as 12% of the males and 13% of the females demonstrated such referred pain. Of the patients with TrP's, 62,5% had more than one and this trend was more common in males. 73,3% of males had more than one TrP while only 53,6% of females demonstrated this finding.

Of the hundred and seventy-two patients presenting to an American university primary care practice, Skootsky et al. (1989) found that fifty-four patients (31,3%) stated pain as

their reason for the visit. 30% of this group could be clinically diagnosed with MPS.

Ninety-six patients from a community centre were examined by a neurologist, who found that 93% of patients had part of their pain caused by MPS and in 74% of these cases, MPS was the primary cause of their pain (Gerwin, 1995).

In a review article by Han and Harrison (1997), it was stated that the incidence of MPS appears to be between 30-85% of all patients presenting to pain clinics in America. The incidence appears to be higher in females although TrP's are found in both sexes.

Travell, Simons and Simons (1999 1:12) agree that active TrP's are extremely common and are an important source of musculoskeletal pain and dysfunction.

SUMMARY OF EPIDEMIOLOGICAL FINDINGS.

	Sola et al.	Skootsky et al.	Gerwin	Han and Harrison
Presence of 1 or more TrP's	49,5%			30-85%
Clinical diagnosis of MPS		30%	74%	
Presence of more than 1 TrP	62,5%			
Presence of referred pain	12,5%			
Presence of more than 1 TrP (males)	73,3%			
Presence of more than 1 TrP (females)	53,6%			
Presence of referred pain (males)	12%			
Presence of referred pain (females)	13%			

2.4 CLINICAL FEATURES OF MPS OF THE BICEPS MUSCLE.

2.4.1 SYMPTOMS

Myofascial pain from active TrP's is usually dull and aching and varies in intensity from low-grade discomfort to severe pain (Gatterman, 1990:295). Patients with active TrP's commonly complain of "poorly localized, regional, aching pain in subcutaneous muscles and joints". The patient may also be aware of numbness or paresthesia instead of pain (Travell, Simons and Simons, 1999 1:20).

The muscle may be physiologically inhibited and may seem "weak" to the patient when they attempt to contract the muscle against resistance (Schneider, 1995). True muscle weakness is rarely found (Gatterman, 1990:295).

The chief symptom when an active Biceps TrP is present is vague, superficial anterior shoulder pain. This pain is evident especially when the arm is elevated above the shoulder during

active flexion or abduction. There may also be diffuse aching over the Biceps muscle itself or over the antecubital space, but this is not common. The patient may experience pain and weakness when raising the hand above the head. The taut long head tendon of the Biceps may produce snapping or grating sounds when the arm is abducted. There may be an associated soreness in the upper Trapezius area (Travell, Simons and Simons, 1999 1:652).

2.4.2 SIGNS

"Pathognomonic of MPS is the palpable TrP that evokes the characteristic referred pain on compression" (Gatterman, 1990:296). Gatterman (1990:296) also states that the area over the TrP may feel warm and edematous to the touch when the TrP is acute.

Harden et al. (2000) conducted a mailed survey using one thousand six hundred and sixty-three members of the American Pain Society. Of the four hundred and three surveys returned,

more than 80% of respondents agreed that the presence of TrP's, normal neurological exam, reduced pain with anaesthetic or spray and stretch, taut bands, tender point, palpable nodules, muscle ropiness and decreased ROM were signs essential to, or at least associated with a diagnosis of MPS.

When the taut band, containing the TrP, is stimulated by snapping palpation or needle insertion, the muscle fibres respond with a twitch response, called a local twitch response (LTR) (Travell, Simons and Simons, 1999 1:21). This response may be vigorous enough to jerk the body part involved (Gatterman, 1990:296).

Compression of the TrP using digital pressure may cause the patient to jump or cry out. This phenomenon is known as the "jump sign" and is a sign of MPS (Gatterman, 1990: 296).

These signs are exhibited in all skeletal muscles and are therefore also true for the Biceps muscle.

2.4.3 DIAGNOSIS

Since "standard diagnostic procedures, laboratory work and radiography" shows no signs of joint pathology and no metabolic changes, the clinical importance of pain must be recognised (Sandman, 1981). The diagnosis of MPS therefore depends on the ability of the physician to demonstrate the presence of pain producing TrP's in muscles (Baldry, 2000:78).

Schneider (1995) has described a set of criteria to be used in the diagnosis of MPS. The researcher has adapted these to be specific for MPS of the Biceps muscle. They are:

Major Criteria:

1. regional pain complaint over the anterior shoulder or over the Biceps muscle itself.
2. pain pattern follows that known to be true for the Biceps muscle (ie. pain referred upwards over the muscle and over the anterior shoulder area, occasionally skipping to the suprascapular area and possibly mild pain down towards the antecubital space).

3. palpable taut bands.
4. exquisite focal tenderness at one point or nodule in the taut band.
5. resticted ROM in flexion and abduction or slight muscle weakness if measurable.

Minor Criteria:

1. manual pressure on the TrP nodule reproduces chief pain complaint in the muscle itself or over the anterior shoulder.
2. snapping palpation of the taut band at the TrP elicits a LTR.
3. pain is decreased or eliminated by therapeutic muscle treatment eg. dry needling, ischaemic compression.

Schneider (1995) recommends that all 5 major criteria should be present and at least one of the 3 minor criteria.

Travell, Simons and Simons (1999 1:31) however suggest that there is a lack of agreement regarding the diagnostic criteria

for examining TrP's. Four recent studies, quoted in Travell, Simons and Simons (1999 1:31-31), have been conducted on the inter-rater reliability of TrP examinations. The first study, conducted by Wolfe et al. (1992), involved the evaluation of eight muscles in eight patients by four experienced physicians. These physicians examined the muscles for five characteristics of TrP's and results showed poor inter-rater reliability. The second study, by Nice et al. (1992), evaluated fifty patients with low back pain. The twelve examiners also obtained poor inter-rater reliability, even after a practice session. The third study, conducted by Njoo et al. (1994), evaluated two muscles sixty-one patients with low back pain. The examiners in this study were trained for three months, but three of the four examiners were inexperienced. The inter-rater reliability was better, but not satisfactory.

In the fourth study, Gerwin et al. (1997) used four experienced physicians to determine the reliability with which the physical features of TrP's could be determined. Each physician attended

a three hour training session immediately before the study and were then asked to examine five pairs of muscles, for five physical characteristics of TrP's, in all ten subjects. Inter-rater reliability was at least substantial to sometimes almost perfect for:

- the detection of spot tenderness
- a taut band
- the presence of referred pain
- and the reproduction of the patients symptomatic pain

The presence of an LTR was not considered a satisfactory diagnostic criterion for a TrP because it is a difficult and unreliable diagnostic test when elicited manually.

This highlights the need for examiners to be experienced and well trained. It also highlights the need for diagnostic criteria to be standardised.

Travell, Simons and Simons (1999 1:117) therefore conclude that the most reliable diagnostic criterion of TrP's on examination appears to be the "presence of exquisite tenderness at a nodule in a palpable taut band". If the patient recognises the pain elicited by manual pressure on the TrP as the clinical pain complaint, then the TrP is active. Associated phenomena like referred pain, or an LTR are only supportive evidence of a TrP. Decreased ROM and increased tension of the muscle are strong characteristics of a TrP, but are not critically evaluated.

2.4.4 CONFIRMATORY DIAGNOSIS

Gatterman (1990:296) acknowledges that "routine laboratory tests show no abnormalities or significant changes attributable to TrP's". Simons (1999) however has identified three objective confirmatory findings. These are:

1. Electromyographic reading and Ultrasound Imaging of LTR's.

   Hubbard and Berkoff (1993) designed a study whereby they recorded needle EMG activity from the "nidus" of a TrP as well as from adjacent, non-tender fibres of the same muscle simultaneously. Results showed that there was spontaneous EMG activity recorded from within the TrP's of the patients. When the needle was moved, by as little as 1mm, the EMG activity ceased. No activity was noted from non-TrP sites. In all cases, the spontaneous EMG activity correlated with the patients' report of pain.

   In a review article by Hong and Simons (1998), the presence of spontaneous EMG activity was confirmed when it was

recorded from a tender spot in a palpable band when the spot was stimulated by snapping palpation. Adjacent skeletal muscle without a TrP or a taut band exhibited no EMG activity.

Studies quoted by Travell, Simons and Simons (1999 1:23) that have been done on the Diagnostic Imaging of LTR's have demonstrated the visualisation of a LTR using ultrasound. However, this requires the examiner to be skilled in the techniques of snapping palpation and needle insertion into the TrP in order to elicit a LTR.

Electromyographic reading and the Diagnostic Imaging of LTR's will allow for a better method of studying the LTR as well as diagnosing the TrP (Travell, Simons and Simons, 1999 1:23).

2. Spontaneous Electrical Activity of multiple active loci in the TrP.

Spontaneous electrical activity (SEA) describes the spontaneous and low-amplitude action potentials that can be recorded from active or latent TrP's. This should be distinguished from the intermittent spike activity of an active TrP only. The minute locus that exhibits SEA is known as the active locus of a TrP (Hong and Simons, 1998).

3. Biopsies of TrP's.

Simons (1999) suggests that biopsies of TrP's show "contraction knots and giant round muscle fibres". Schneider (1995) quoted studies by Awad (1973) and Fassbender (1975) on the biopsies taken from "fibrositic nodules" in muscles. Awad (1973) examined the exudates from the extracellular fluid surrounding TrP's, drawn by needle biopsy. He found damage to the sarcolemmal membrane of muscle cells indicated by the presence of serotonin, bradykinins and hyaluronic acid. Fassbender (1975) studied the different stages of chronicity and pain intensity and found structural changes that related to chronicity. Acute changes involved

myofilament destruction and mitochondral swelling while the more chronic cases showed "destruction of sarcomeres and fibres, necrosis and fibrosis in muscle cells and collagen and scar accumulation". Schneider (1995) believes these degenerative changes may be due to ischaemia and metabolic dysfunction.

Although these diagnostic procedures allow more accurate detection of TrP's, they are often expensive and require skills beyond those taught in the tertiary institution, clinical environment. These diagnostic criteria are therefore not practical in the clinical setting of a tertiary institution.

2.5 PATHOPHYSIOLOGY OF TRP'S.

Understanding the mechanism of TrP's is essential and allows physicians to treat them more effectively (Hong and Simons, 1998).

The energy crisis concept seems to fit current electrodiagnostic and histopathalogical findings and is touched on by different authors (Travell, Simons and Simons, 1999; Han and Harrison, 1997; Auleceims, 1995; Sandman, 1981).

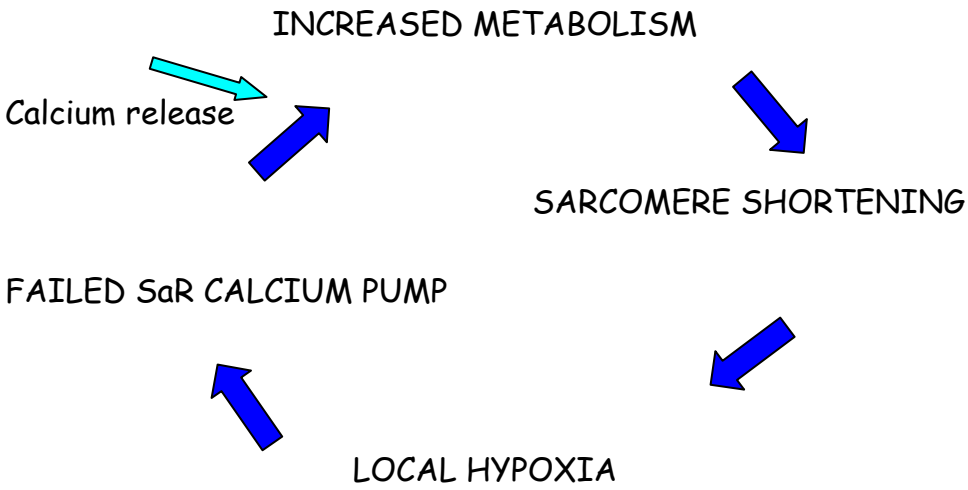
The concentration of calcium increases outside the Sarcoplasmic Reticulum (SaR) due to mechanical damage, either to the SaR or the muscle cell membrane or sarcolemma. This increase in calcium, if sufficient enough, maximally activates the actin and myosin contractile activity. This activity may be sustained by abnormal depolarisation of the post-junctional membrane. This could continue indefinitely if acetylcholine (ACH) is excessively released from a dysfunctional nerve terminal. In this manner, contracture of the muscle fibres in

the vicinity of the motor end plate may persist indefinitely, without the action potentials of the motor unit. This sustained contracture increases the metabolic demands while decreasing the metabolic supplies. This theory has been dubbed the "energy crisis".

The calcium pump returns calcium to the SaR and is dependant on an adequate supply of ATP. The pump is sensitive to low levels of ATP and therefore impairs the calcium uptake into the SaR. The contractile elements are exposed to a further increase in calcium and so contractile activity, completing the cycle. The severe local hypoxia and energy crisis within the tissues stimulates the production of vasoreactive substances that may sensitise local nociceptors.

SCHEMATIC OF THE ENERGY CRISIS

(Auleciems, 1995).



2.6 TREATMENT OF MPS.

The effective treatment of MPS requires more than just the application of a procedure to a TrP (Travell, Simons and Simons, 1999 1:30). Management of MPS must take into account the chronicity of the disease process, as well as any perpetuating, physiologic or psychological factors that may be involved. The purpose of the treatment is not only to reduce or eliminate the clinical pain complaint, but also to enable the patient to cope with pain (Han and Harrison, 1997). MPS can range from a

simple case involving a single muscle to a complex case involving multiple muscles. There is a critical need to match the complexity of the management protocol with the complexity of the individual patient and syndrome. Failure to address the entire syndrome may lead to its perpetuation and failure to resolve (Fricton, 1994:868).

The common denominator in all treatment modalities used for MPS is the release of contractures in the taut bands of skeletal muscle (Schneider, 1995). TrP's can be treated or inactivated by one of several methods, or a combination of a few methods (Murphy, 1989).

2.6.1 TECHNIQUES USED IN THE TREATMENT OF MPS

2.6.1.1 TrP injection and dry needling

"Needle techniques employ one of the oldest methods of pain relief" (Gatterman, 1990:296). Melzack (1981) describes hyperstimulation analgaesia as the moderate to intense application of sensory input stimuli (eg, injection, dry needling,

intense cold), directly over the site of pain or distant to it. The brief painful stimulus is believed to "close the gate" by means of a central biasing mechanism, that may be located in the reticular formation of the brainstem. The Gate Control Theory explains how sensory nerve impulses are regulated by inhibitory mechanisms in the central nervous system (Melzack, 1981).

Han and Harrison (1997) describe TrP injection as one of the most effective therapeutic techniques used in the treatment of MPS. The injection of the TrP with local anaesthetic provides short and long term pain relief, as well as offering anaesthetic agents to surrounding tissues. An injection that is well executed can inactivate a TrP immediately (Travell, Simons and Simons, 1999 1:151).

Over the years, many substances have been injected into TrP's (eg. corticosteriods, NSAID's, saline) and Baldry (2000:79) suggests that there is no evidence to support one substance being more effective than another. Baldry (2000:79) is

therefore of the opinion that the analgaesic effect is produced by the nerve stimulating effect of the needle, and not the substance being injected.

Dry needling relies on the "mechanical disruption or direct stimulation" of the TrP (Han and Harrison, 1997). Lewit (1979) first described the immediate analgaesic effect produced by the needle puncture of a TrP and called it the "needle effect". Han and Harrison (1997) state that the greatest analgaesic effect is produced when the most tender spot is infiltrated by the needle.

Travell, Simons and Simons (1999 1:151) are of the opinion that dry needling is as effective as injection of anaesthetics in the treatment of TrP's, provided that the needle insertion elicits a LTR. Hong (1994), in a study comparing the effectiveness of lidocaine injections to dry needling in the treatment of MPS, found that there was no significant difference between the two methods in the immediate symptomatic relief of TrP's ($p=0.83$

and 0.93 respectively for pain intensity). His conclusion was that it was essential to elicit a LTR to obtain the desired effect.

Rowley (2001) compared the effectiveness of a single dry needle insertion to multiple fanning needle insertions in the treatment of MPS in the cervical and thoracic spines. Thirty patients were divided into two groups. Group 1 received the single needle insertion technique whereby the needle was inserted directly into the TrP and then left for five minutes. The needle was then manually stimulated using the thumb and forefinger. The needle was left in position for another five minutes before it was again manually stimulated. This process was repeated three times. Group 2 received the multiple fanning needle insertion technique. The needle is inserted one to two centimetres away from the TrP and directed towards it so that the needle approaches the TrP at a 30° angle to the skin. The needle is then withdrawn from the TrP and redirected to penetrate a new point, ensuring maximum coverage of the

TrP area. Results showed that there was no statistical difference between the two techniques in terms of objective and subjective findings. (Algometer readings: p = 0.678; NRS 101: p = 0.713; Short Form McGill Pain Questionnaire: p = 0.632). The author recommended that the two techniques be combined ie. inserting the needle into the TrP and then fanning it until the most painful point is found. The needle would be left in this position and manually stimulated at intervals.

2.6.1.2 Electrotherapeutic Modalities

There is a strong research base supporting the use of TENS (Transcutaneous Electrical Nerve Stimulation) as a modality for pain relief. It is considered more an accessory to TrP therapy. The electrical stimulus uses a series of "relatively low voltage square waves of variable polarity, duration and frequency" (Travell, Simons and Simons, 1999 1:147). Its therapeutic effect is again explained by the Gate Control Theory (Melzack, 1981). The low intensity stimulation selectively activates large

diameter fibres to "close the gate" in the spinal cord (Han and Harrison, 1997).

Hseuh et al. (1997) investigated the effects of electrical nerve stimulation (ENS) and electrical muscle stimulation (EMS) against placebo for the treatment of MPS. Sixty patients with clinically diagnosed TrP's were divided into three groups. Group A received placebo (sham electrotherapy), Group B received ENS (TENS machine) and Group C received EMS (functional EMS machine). Group B showed the most significant improvement ($p<0.01$) with respect to pain intensity, measured by a visual analogue scale, and pain threshold, measured by algometry. ROM, however was most improved in Group C ($p<0.01$) as compared to Groups A and B. It was concluded that ENS was more effective for immediate relief of TrP's than EMS, but EMS was more effective for muscle hypertonicity.

Ultrasound therapy has also been found effective in inactivating TrP's. Ultrasound transmits sound vibrations at the

molecular level and generates heat within the tissues. It may also produce chemical effects due to intense excitation of the molecules, this is however poorly understood (Travell, Simons and Simons, 1999 1:146).

Esenyl et al. (2000) compared the effectiveness of ultrasound treatment and TrP injection in combination with stretching exercises. One hundred and two patients were randomly assigned to one of three groups. Group 1 received ultrasound therapy over the TrP in combination with stretching exercises, Group 2 received TrP injection with the stretching exercises and Group 3 only received stretching exercises and was therefore the control group. The effectiveness of the treatment was assessed using pain intensity (visual analogue scale), pain threshold (algometry) and ROM (goniometry) measurements. Results showed that Groups 1 and 2 significantly improved in terms of pain intensity and pain threshold ($p < 0.001$) as well as ROM ($p < 0.05$), but there was no statistically significant difference between Groups 1 and 2.

Gam et al. (1998) also investigated the therapeutic effect of ultrasound in the treatment of MPS. In the final analysis, fifty-eight patients were included and randomised into three groups. Group A was treated with ultrasound, massage and exercise, Group B received sham-ultrasound, massage and exercise, while Group C was the control group. Pain intensity (visual analogue scale) and analgaesic usage were the outcomes measures used and showed at the end of the study that there was no significant difference between Groups A and B.

2.6.1.3 Manual Soft Tissue Therapies

Ischaemic compression has been used by Chiropractors for more than thirty years and is known to be effective in the treatment of central or primary TrP's when it is indicated (Travell, Simons and Simons, 1999 1:140; Gatterman, 1990:296). It is an easily learned, manual skill that requires no specialised equipment (Schneider, 1995). Gatterman (1990:296) explains ischaemic compression as a mechanical treatment, consisting of

the application of pressure over the TrP for a sufficient period of time so as to inactivate the muscle spasm.

Travell, Simons and Simons (1999 1:141) call the technique TrP Pressure Release and add that pressure should be applied gently and gradually until tissue resistance is felt. At this point the patient may experience some discomfort. This pressure is maintained until the tension in the muscle is released. Pressure is increased at this point to take up excess tissue slack. This technique is painless and imposes no additional stress to muscle attachments. Sandman (1981) adds that if the pressure is painful, the patient may respond by reflexly tightening the muscle, thereby further complicating the initial muscle dysfunction.

Hanten (2000) investigated the effectiveness of a home programme of ischaemic compression followed by stretching of the muscles. Forty patients were randomly divided into a control group, given active ROM exercises and a treatment

group, given a home programme of ischaemic compression and stretching. The treatment group was shown to be more effective in reducing pain intensity and TrP sensitivity.

2.6.1.4 Spray and stretch

Auleciums (1995) states that spray and stretch is an effective technique used in the treatment of MPS. The vapocoolant spray aids in blocking the pain and spasm reflexes and gradually allows the passive stretch of the muscle, harbouring the TrP, to its full length. This stretch allows sarcomeres to return to their normal lengths.

The technique requires parallel sweeps of spray over the muscle containing the TrP, as well as the zones of reference (Han and Harrison, 1997). The vapocoolant spray causes a sudden decrease in skin temperature, which produces more tactile stimulation. The motion of the stream causes a continuous barrage of impulses to the spinal cord. This has an inhibitory

effect on locally generated pain (Travell, Simons and Simons, 1999 1:133).

2.6.2 SUMMARY OF TREATMENT TECHNIQUES

Many techniques are used with success in the treatment of MPS. TrP injection and dry needling are the most frequently suggested methods of inactivating TrP's and have been found to be very effective by different authors (Travell, Simons and Simons, 1999; Han and Harrison, 1997; Rachlin, 1994). The research base supporting the use of TrP injection and dry needling is also extensive. Electrotherapeutic modalities eg. TENS, are effective for pain relief and are used following TrP injection and dry needling (Rachlin, 1994:188). Spray and stretch is also an effective technique used in the treatment of TrP's and is considered an excellent adjunct to TrP injection and dry needling (Rachlin, 1994:189). TrP pressure release may cause excessive post-treatment soreness with bruising (Rachlin, 1994:459). Laser therapy is also suggested as a treatment

modality but in conclusion, dry needling was the treatment of choice.

2.6.3 TECHNIQUES USED IN THE TREATMENT OF MPS OF THE BICEPS MUSCLE

Travell, Simons and Simons (1999 1:655-658) describe TrP injection and the spray and stretch technique as the two favoured methods of treatment for active Biceps TrP's. TrP injection and dry needling of Biceps TrP's follows the same theory as was discussed earlier.

The spray and stretch approach to Biceps TrP inactivation requires that the Biceps muscle be extended to its full length while vapocoolant spray is applied over the length of the muscle and all zones of reference (Travell, Simons and Simons, 1999 1:656). The muscle is stretched with the elbow extended and pronated while the shoulder is abducted and extended (Rachlin, 1994:329).

2.7 REVIEW OF THE DELTOID MUSCLE.

This powerful shoulder muscle originates at the anterior border of the clavicle, the outer border of the acromion and the spine of the scapula. It inserts into the humerus (Rachlin, 1994:318). The muscle is divided into three parts: anterior, middle and posterior. For the purpose of this study, only the anterior and middle parts will be discussed. The anterior fibres of the Deltoid muscle serve to medially rotate the humerus, while the middle fibres strongly abduct the shoulder (Moore, 1992:533).

Active TrP's in the Deltoid muscles do not generally refer to a distant site. Anterior TrP's refer to the anterior and middle regions of the muscle while the middle TrP's refer in the region with some spillover of pain into adjacent areas (Travell, Simons and Simons, 1999 1:623).

The primary symptoms of active Deltoid TrP's are pain on abduction, flexion and elevation of the shoulder. There may be

some associated pain in the neck, upper back and arm (Rachlin, 1994:318).

2.8 REVIEW OF THE SUPRASPINATUS MUSCLE.

The Supraspinatus muscle lies in the supraspinatus fossa and attaches proximally here. This muscle attaches distally to the superior facet of the greater tubercle of the humerus. It serves to abduct the arm and helps to seat the head of the humerus in the glenoid cavity during shoulder movements (Moore, 1992:537).

Active TrP's in this muscle cause a deep ache in the shoulder and may cause pain down the arm and forearm to the lateral epicondyle of the elbow (Travell, Simons and Simons, 1999 1:538).

Symptoms of active Supraspinatus TrP's include pain with elevation of the arm as well as abduction. Limited ROM may also be present (Rachlin, 1994:320).

2.9 REVIEW OF BICEPS TENDONITIS.

Biceps tendonitis is a term used to describe degenerative changes that occur from failure of the tendon to self-repair. The condition is usually secondary to impingement of the tendon under the coracoacromiol arch, although primary tendonitis is possible. Although the exact function of the Biceps tendon is unclear, there is supporting evidence of its role as a stabiliser of the glenohumeral joint (Patton, 2001). Reid (1992 2:943-944) describes overuse as the prominent aetiological factor for bicipital tendonitis and suggests that the syndrome goes through stages of discomfort. Biceps tendonitis also has a natural history and will often times resolve spontaneously, without treatment in 4 weeks provided there is no further aggravation of the tendon.

2.10 SUMMARY OF THE LITERATURE.

MPS is a commonly encountered complaint in the outpatient setting (Auleciems, 1995). Although no statistics are available specifically for the incidence of Biceps TrP's, we do know that

any sports requiring a throwing action, long hand writing and typing for example, strongly engage this muscle and activate TrP's (Travell, Simons and Simons, 1999 1:651). Associations have been established between the Biceps muscle, the anterior and middle Deltoid muscles, the Supraspinatus muscle and bicipital tendonitis. It has also been established that dysfunctions in the above mentioned muscles affects shoulder ROM, especially in flexion and abduction.

The use of dry needling in the treatment of MPS has been extensively researched with favourable results as compared to other treatment techniques and modalities. The practice is widely accepted. It seems pertinent then to investigate the immediate and short-term effectiveness of dry needling the primary, active biceps TrP on the pain experienced during shoulder flexion and abduction ROM, as well as on an associated bicipital tendonitis and satellite TrP's, in terms of objective and subjective clinical findings.

CHAPTER THREE.

3.1 INTRODUCTION.

This chapter serves to describe the study design and protocols used in the study. Included is also a description of the samples used, the measurements taken as well as an analysis of the statistical data.

3.2 STANDARD OF ACCEPTANCE.

Only patients presenting to the chiropractic clinic with a positive diagnosis of MPS of the biceps muscle were accepted into the study. Additional inclusion and exclusion criteria were observed.

3.2.1 INCLUSION CRITERIA

1. Patients had to fit the diagnostic criteria for active Biceps TrP's. These criteria were:

- A history of rapid onset, during or shortly after acute overload stress. Alternatively,

gradual onset due to chronic overload of the biceps muscle.

- A characteristic referred pain pattern for the biceps muscle.
- A taut, palpable band within the biceps muscle.
- Intense focal tenderness when pressure was applied to the taut band.
- A local twitch response to snapping palpation or needling of the TrP.
- Elimination of these symptoms after specific TrP therapy (Travel, Simons and Simons, 1999 1:34-35).

These criteria were attained using the Myofascial Diagnostic Scale (Chettiar, 2001). This scale was used as an alternative to the diagnostic procedures discussed earlier (EMG's, ultrasound and biopsies). These diagnostic procedures were too expensive and specialised to be used in this study. This scale was also used

for standardisation purposes and will be discussed in greater detail in section 3.4.

2. All patients were within the 20 – 45 years age range. Although the peak incidence of MPS is between the ages of 16 and 65 years (Rowley 2001), this age group was too broad and patients from either extreme of the age limit would have reacted entirely differently to the treatment intervention due to the increasing variables associated with increasing age (eg. concomitant age related disease).

3.2.2 EXCLUSION CRITERIA

1. Patients with broken or anaesthetic skin over the biceps area.

2. Patients with local or systematic disorders that aggravate or contribute to MPS eg. SLE, TB, RA.

3. Patients who were already receiving manual therapy for the condition were excluded unless they discontinued that therapy.

4. Patients who were receiving medical therapy for the condition (eg. anti-inflammatories) were excluded until they

discontinued that therapy and underwent a 48-hour wash–out period.

5. Patients who were using anti-coagulant therapy (Han and Harrison, 1997).

6. Patients with an aversion to the use of acupuncture needles. This included patients who had a genuine fear of any type of needle.

7. Patients with deep pain in the shoulder.

8. Patients with C5 radiculopathy, bicipital or subdeltoid bursitis or glenohumeral arthritis (Travell, Simons and Simons, 1999 1:654). These exclusion criteria were observed during the case history, physical or shoulder regional examinations.

3.3 STUDY DESIGN AND SAMPLE SIZE.

This study was a prospective, controlled, pilot study. Non-probability sampling was used, however, as random allocation was employed. It was an understanding in this study that due to its pilot nature, any inferences drawn would be casual. The research programme was limited to residents of the greater

Durban area. Patients were informed of the study via flyers that were handed out as well as advertisements that were posted in local and leading newspapers.

A study population of thirty patients was used. Epidemiological studies on the incidence of bicipital tendonitis are scant, but the condition is not common (Carretta et al., 1994).

3.4 DETAILED PATIENT PROCEDURE.

All patients were initially screened in the treatment rooms before they were accepted into the study. Patients were asked if they had vague anterior shoulder pain or pain in the Biceps muscle itself. The primary aim was to diagnose MPS of the Biceps muscle.

Satellite TrP's in the Supraspinatus and Deltoid muscles were noted as associated findings. Patients who did not have these associated findings present were not excluded. The same procedure was applied for bicipital tendonitis for

standardisation purposes. This finding was included in the study as an associated finding and patients who did not exhibit this finding were not excluded from the study. The clinical consensus is that the more severe the MPS, the more likely one will be to encounter satellite TrP's and bicipital tendon dysfunction. These factors contribute to the vague anterior shoulder pain and decreased shoulder ROM in flexion and abduction. It was a consideration in this study that these findings could be used as indicators for more severe MPS.

Therefore, any patient within the specified age range of 20 to 45 years, and fitting the criteria for MPS of the Biceps muscle, was included, since the primary aim of the study was to decrease pain and increase functionality in the shoulder region by treating the Biceps TrP. The use of this age group in particular also limited the variables that chronic conditions would have introduced to the study.

SCHEMATIC OF THE CONSULTATIONS.

1 = Myofascial Diagnostic Scale for Biceps TrP's

2 = ROM in flexion and abduction

3 = NRS 101 questionnaire

4 = Shoulder Pain and Disability Index

5 = Myofascial Diagnostic Scale for satellite TrP's

6 = Biceps Tendonitis Scale

CONSULT 1:

30 Patients with MPS of Biceps muscle

BEFORE RX

1 – 6

DRY NEEDLING INTERVENTION

AFTER RX

1 - 3

CONSULT 2:

30 Patients were divided into 2 groups

GROUP 1A

(active Biceps TrP)

BEFORE RX

1 – 6

DRY NEEDLING INTERVENTION

AFTER RX

1 - 3

GROUP 1B

(Biceps TrP inactivated)

AT RX

1 - 6

CONSULT 3:

All 30 patients

1 – 6 (no dry needling intervention)

On acceptance into the study, patients were asked to read the Patient Information Letter (Appendix A) and then sign the Informed Consent Form (Appendix B). Each patient was then asked a thorough Case History (Appendix C) and given a Physical Examination (Appendix D). A Shoulder Regional Examination (Appendix E) was then carried out on each patient. The patient was diagnosed with MPS of the Biceps muscle using the Myofascial Diagnostic Scale (Chettiar, 2001) (Appendix F). Patients were then assessed for satellite TrP's in the Supraspinatus and Deltoid muscles (anterior and middle) using the same standardised scale. Patients were also assessed for bicipital tendon dysfunction using a standardised Biceps Tendonitis Scale (Appendix G).

STANDARDISATION: The Myofascial Diagnostic Scale was used as a criterion to standardise the inclusion of patients into the study. Only patients with a score of 9 or more out of a possible 17 points were included. It was further used to measure any improvement in the extent

to which the patient was suffering from MPS in the Biceps, Deltoid or Supraspinatus muscles in subsequent visits. This scale is discussed in greater detail in section 3.6.2.2.2.

The Biceps Tendonitis Scale was also used to standardise the diagnosis of bicipital tendonitis in patients who participated in the study. If "yes" was answered to two of the three criteria, a diagnosis of bicipital tendonitis was made. This scale is also discussed in greater detail in section 3.6.2.3.

The patient was then asked to fill in two questionnaires. The first was the Numerical Rating Scale 101 (Appendix H) and the second was the Shoulder Pain and Disability Index (Appendix I). The researcher then took two measurements. The first was shoulder ROM in flexion and the second was shoulder ROM in abduction (Appendix J). Both of these measurements were

taken using an inclinometer. The reliability and validity of the inclinometer are discussed in section 3.6.2.2.1.

INTERVENTION: The treatment itself was dry needling of the Biceps muscle. Gloves were worn for all needling procedures. The Biceps area was sterilized using 70% alcohol before a 30mm, 0.3G acupuncture needle was inserted into the TrP. The multiple fanning technique developed by Rowley (2001) was used until a twitch response was elicited. The needle was then left in that position for 10 minutes with no stimulation. The needle was removed and the area was again sterilized with alcohol.

The patient was asked after the treatment to answer another NRS 101 and the researcher again took both flexion and abduction range of motion measurements. The Biceps TrP was also re-assessed using the Myofascial Diagnostic Scale. This assessment enabled the researcher to determine any immediate

improvements. The patient was not asked to fill in another SPADI as this questionnaire required the patient to carry out daily activities at home. The satellite TrP's and biceps tendon were not re-assessed at this point.

On the second visit, all subjective and objective data was collected again. The satellite TrP's and biceps tendon were also re-assessed using the same scales as were used on the first visit. If the active Biceps TrP was still present, the patient was given another treatment. These patients became "Group 1A". They were again asked to fill in an NRS 101 following the treatment while the researcher gathered the ROM measurements and re-assessed the Biceps TrP using the Myofascial Diagnostic Scale.

If the active Biceps TrP had become latent or had resolved, no treatment was given, only the subjective and objective data was obtained, as was data on associated findings. These patients became "Group 1B".

The third visit was purely for the collection of data, both subjective and objective. No treatment intervention was given to the patients. The satellite TrP's and biceps tendon were also assessed for a final time.

Sola (1981), based on his clinical experience, advocates that 2 – 5 treatments is usually sufficient for patients suffering with MPS.

All the data collected from the patients was kept confidential. This information will be stored for five years and then shredded.

3.5 ETHICAL CONSIDERATIONS.

The following ethics were reviewed by an Ethics Committee:

The welfare and rights of the patient were protected.

Informed consent was always obtained from the patient.

The patient was not coerced into participating in the study.

Information pertaining to the study was given in an understandable language.

The research did not involve any more than a minimal risk.

Confidentiality was maintained throughout the study.

Participation in the study was voluntary and did not involve any financial benefit.

The patient was free to withdraw from the study at any point.

All risks and benefits were clearly explained to the patient.

3.6 MEASUREMENTS AND OBSERVATIONS.

3.6.1 THE DATA

The study involved the collection of both primary and secondary data.

3.6.1.1 Primary Data

This included all the data that was collected from the patient.

Case History (Appendix C)

Physical Examination (Appendix D)

Shoulder regional examination (Appendix E)

Numerical Rating Scale 101 (Appendix H)

(subjective)

Shoulder Pain Shoulder Disability Index (Appendix I)

(subjective)

Myofascial Diagnostic Scale (Appendix F)

(objective)

ROM Readings (Appendix J)

(objective)

Associated findings (Appendix K)

3.6.1.2 Secondary Data

This data was collected from current journal articles, textbooks and the internet.

3.6.2 METHODS OF MEASUREMENT

Both subjective and objective data were obtained before and after the first treatment. If the Biceps TrP was still active on the second treatment, both types of data were collected before and after the second treatment again (Group 1A). If on

the second visit the Biceps TrP was latent or had resolved, subjective and objective data was collected only once as no treatment was given (Group 1B). The third visit was only for subjective and objective data collection, no treatment was given to patients on this visit.

3.6.2.1 Subjective Data

3.6.2.1.1 Numerical Rating Scale 101 (NRS 101)

This questionnaire asked the patient to rate his or her perceived level of pain intensity on a numerical scale from 1 – 100. The scale was designed so that 100 represented "pain as bad as it could be" and 0 was no pain at all (Jensen et al. 1986).

In a study conducted by Jensen et al. in 1986, six methods of measuring pain intensity were compared using seventy-five chronic pain patients. It was concluded that the NRS 101 had several advantages over other methods. These included:

- the questionnaire was simple to administer and score

- this scale did not appear to be associated with incorrect responding any more than any other scale
- it could be administered in written or verbal form
- difficulty with the scale did not appear to be associated with age

The two scores obtained, worst and least, were combined to determine the mean percentage for each time the questionnaire was administered.

3.6.2.1.2 Shoulder Pain and Disability Index (SPADI)

The SPADI is a 13 item, self-administered questionnaire that measures the functional status of the shoulder region. It is scored from 0 – 100 by averaging the two subscales. The pain subscale has 5 items while the disability subscale has 8 items. The higher the score from 0 – 100, the worse the function of the shoulder region.

Williams et al. (1995) measured shoulder dysfunction using the SPADI. One hundred and two primary care patients in America with shoulder pain were followed for three months. Each patient completed a Health Assessment Scale (HAS), a Medical Outcomes Assessment SF-20, as well as the visual and numerical versions of the SPADI on several occasions. Results showed that the visual and numerical versions of the SPADI were highly concordant (intra-class correlation coefficient = 0.86). The SPADI showed high correlations with both the HAS and the physical functioning and pain domains of the SF-20. The SPADI was also accurately able to distinguish between patients who improved, those who stayed the same and those who worsened.

3.6.2.2 Objective Data

3.6.2.2.1 Range of Motion (ROM)

Measurements of shoulder ROM in flexion and abduction were obtained by using the Dualer Inclinometer (J Tech Medical Industries, 357 West 910 South, Heber City, Utah, USA.

Model: Dualer Lite). The inclinometer has been tested for both validity and reliability. Lantz et al. (1999) conducted a study using the inclinometer to measure cervical ROM in sixty-two asymptomatic patients. For validity, the inclinometer was used simultaneously with an electrogoniometer, twice a week over a one week period. Both instruments were found to be valid, with a mean between instrument discrepancy of close to 0. Clinical reliability for inter- and intra-examiner reliability was high for cervical ROM ($p = 0.0001$, except for extension, $p = 0.014$).

The inclinometer was secured to the patients arm over the midbelly of the Biceps muscle. The inclinometer was zeroed with the patients arm by their side in the neutral position. The patient then moved the shoulder in flexion and then abduction in an active manner to the fullest of their capacity.

3.6.2.2.2 Myofascial Diagnostic Scale (MDS)

This scale assesses the extent to which the patient has MPS. It was designed by Chettiar in 2001 and no validity studies have yet been completed on this scale.

The scale is comprised of four indicators. The first indicator consists of five grades of soft tissue tenderness. The grades were scored as follows: grade 0 - no pain = 0, grade 1 – tenderness to palpation without grimace or flinch = 1, grade 2 - tenderness to palpation with grimace and/or flinch = 2, grade 3 – tenderness with withdrawal = 3, grade 4 – withdrawal to non-noxious stimuli = 4. The second and third indicators scored the presence of a local twitch response and a taut band respectively. Each of these was given a score of 4 pts. The fourth indicator was the presence of referred pain. This indicator was given a score of 5 pts as this is the strongest indicator of an active TrP.

Total scores of 9 and above were indicative of an active TrP. For the purpose of this study, the scale was used to standardise the inclusion of patients, as well as score the changes that occurred within the Biceps, Deltoid and Supraspinatus muscles throughout the treatment programme. No reliability or validity studies are available for this scale.

3.6.2.3 Bicipital Tendonitis Scale

This scale was designed by the researcher to evaluate the simplest signs and symptoms of bicipital tendon dysfunction. It was the purpose of this scale to allow for greater diagnostic standardisation when assessing the biceps tendon. Reid (1992 2:943-944) states that the primary aetiological factor for bicipital tendonitis is overuse. Associated with a bicipital tendonitis is also pain in the bicipital groove. The third sign of bicipital tendonitis used was a positive Speed's Test. A "yes" or "no" answer was assigned to each of the criteria. For the purpose of this study, if 2 of the 3 criteria were present, a diagnosis of bicipital tendonitis was made.

3.6.2.4 Associated Findings

The associated findings noted were the incidence and prevalence of satellite TrP's in the Supraspinatus and Deltoid muscles throughout the treatment programme. The incidence and prevalence of associated biceps tendonitis was also observed over the duration of the study.

3.7 TREATMENT OF THE DATA.

3.7.1 SUBJECTIVE DATA

NRS 101 – The two scores obtained (worst and least) were expressed as mean percentages for each time the questionnaire was administered.

SPADI – This was scored from 0-100 by averaging the two scores obtained from the two subscales.

3.7.2 OBJECTIVE DATA

ROM – The scores obtained before and after the treatments were expressed as whole numbers for each consultation for both forward flexion and abduction.

MDS – These scores were expressed as whole numbers up to 17. A single score was obtained for each consultation by determining the mean of all scores obtained.

3.8 STATISTICAL ANALYSIS.

The SPSS statistical package (as supplied by SPSS Inc., Marketing Department, 444 North Michigan Avenue, Chicago, Illinois, 60611) was used for data entry analysis.

3.8.1 METHODS OF DATA ANALYSIS

Since the study population was small (n = 30), non-parametric tests were used for inter- and intra-group analysis.

3.8.2 INTER-GROUP COMPARISON USING MANN WHITNEY U-TEST

The Mann Whitney U-test was used for inter-group comparisons between Group 1A and 1B produced at the second treatment for consultations 2 and 3. The test was performed on both objective and subjective data obtained at these treatments. In each test, the null hypothesis (Ho), states that there is no difference between the two groups being compared, with respect to the variable being tested, at the α = 0.05 level of significance. The alternative hypothesis (H_1) states that there is a difference.

Ho: There is no difference between Group 1A and 1B

H_1: There is a difference between Group 1A and 1B

α = 0.05

Decision Rule: If $p < \alpha$: reject Ho

If $p \geq \alpha$: accept Ho

Where p is the observed level of significance or p-value.

3.8.3 INTRA-GROUP COMPARISON USING WILCOXON SIGNED RANKS TEST

Intra-group comparison was made for the ROM readings, the MDS and the NRS 101 obtained before and after the first consultation. Wilcoxon Signed Ranks Test was again used for the intra-group analysis between consultations one and two (Group 1A), A comparison was also made between the first and third consultations for subjective and objective variables using this test. Again, the null hypothesis (Ho), states that there is no improvement between the consultations, with respect to the variable being tested, at the α = 0.05 level of significance. The alternative hypothesis (H_1) states that there is an improvement.

Ho: There is no improvement between the consultations

H_1: There is an improvement between the consultations

α = 0.05

Decision Rule: If p < α: reject Ho

If p ≥ α: accept Ho

Where p is the observed level of significance or p-value.

3.8.4 ASSOCIATED FINDINGS

No tests were performed on the associated findings, these were merely discussed as observations in terms of prevalence.

CHAPTER FOUR.

4.1 INTRODUCTION.

This chapter tabulates the results of the statistical analysis of the data collected over the duration of the study. The data observed was:

Myofascial Diagnostic Scale (MDS)

Range of motion (Inclinometer readings) (ROM)

Shoulder Pain and Disability Index (SPADI)

Numerical Rating Scale 101 (NRS 101)

4.2 CRITERIA GOVERNING ADMISSABILITY OF DATA.

Only data that was obtained from patients who met the research criteria and completed the entire programme was used in the final analysis. Only subjective data that was obtained in the presence of the researcher was used and only objective data that was obtained by the researcher was used in the statistical analysis.

4.3 TABLES OF DEMOGRAPHIC DATA.

Table 1: Gender Distribution

GENDER	NUMBER OF PATIENTS (n)	TOTAL % OF PATIENTS
MALES	21	70
FEMALES	9	30

Table 2: Age Distribution

AGE GROUP	NUMBER OF PATIENTS (n)	TOTAL % OF PATIENTS
20 -25	15	50
26 - 30	5	16.6
31 – 35	5	16.6
36 - 40	2	6.6
41 - 45	3	10

Table 3: Race Distribution

RACE	NUMBER OF PATIENTS (n)	TOTAL % OF PATIENTS
CAUCASIAN	24	80
INDIAN	5	16.6
BLACK	1	3.3

Table 4: Patient Occupations

OCCUPATION	NUMBER OF PATIENTS (n)	TOTAL % OF PATIENTS
Student	9	30
Self employed	5	16.6
Technician	1	3.3
Gymnastics Instructor	2	6.6
Teacher	2	6.6
Admin	2	6.6
Shop manager	1	3.3
Chiropractor	2	6.6
Commercial diver	2	6.6
Stores manager	1	3.3
Reflexologist	1	3.3
CEO	1	3.3
Rep	1	3.3

Table 5: Activity associated with onset

ACTIVITY	NUMBER OF PATIENTS (n)	TOTAL % OF PATIENTS
Painting	1	3.3
Rugby	2	6.6
Gym training	12	40
Kite surfing	1	3.3
Massage	2	6.6
Lifting heavy objects	10	33.3
Typing	2	6.6

4.4 TABLES OF THE STATISTICAL RESULTS.

N = Sample size

M.R. = Mean rank

S.R. = Sum of ranks

NEG R = Negative ranks

POS R = Positive ranks

4.4.1 TABLES OF THE STATISTICAL RESULTS OF INTRA-GROUP COMPARISON WITH REGARDS TO OBJECTIVE DATA.

Table 6: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from flexion ROM readings, before and after consultation 1.

FLEXION			
	N	M.R.	**P-VAL**
NEG R	5	6.5	
POS R	23	16.24	
TIE	2		
TOTAL	30		**0.000 (<0.001)**

NEG R = Flexion after cons 1 was less than flexion before cons 1.

POS R = Flexion after cons 1 was more than flexion before cons 1.

TIE = Flexion after cons 1 was equal to flexion before cons 1.

The null hypothesis was rejected for flexion ROM readings, indicating there was an increase after consultation 1, at the $\alpha = 0.05$ level.

Table 7: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from abduction ROM readings, before and after consultation 1.

ABDUCTION			
	N	M.R.	**P-VAL**
NEG R	1	3	
POS R	26	14.42	
TIE	3		
TOTAL	30		**0.000 (<0.001)**

NEG R = Abduction after cons 1 was less than abduction before cons 1.

POS R = Abduction after cons 1 was more than abduction before cons 1.

TIE = Abduction after cons 1 was equal to abduction before cons 1.

The null hypothesis was rejected for abduction ROM readings, indicating there was no increase after consultation 1, at the $\alpha = 0.05$ level.

Table 8: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from MDS readings, before and after consultation 1.

MDS			
	N	M.R.	**P-VAL**
NEG R	30	15.5	
POS R	0	0	
TIE	0		
TOTAL	30		**0.000 (<0.001)**

NEG R = MDS scores after cons 1 were less than MDS scores before cons 1.

POS R = MDS scores after cons 1 were more than MDS scores before cons 1.

TIE = MDS scores after cons 1 were equal to MDS scores before cons 1.

The null hypothesis was rejected for MDS readings, indicating there was an increase after consultation 1, at the α = 0.05 level.

Table 9: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from flexion ROM readings, at consultations 1 and 2.

FLEXION (after)			
	N	M.R.	**P-VAL**
NEG R	4	6.75	
POS R	11	8.45	
TIE	1		
TOTAL	16		**0.060**

NEG R = Flexion after cons 2 was less than flexion after cons 1.

POS R = Flexion after cons 2 was more than flexion after cons 1.

TIE = Flexion after cons 2 was equal to flexion after cons 1.

The null hypothesis was accepted for flexion ROM readings, indicating there was no increase between consultations 1 and 2, at the α = 0.05 level.

Table 10: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from abduction ROM readings, at consultations 1 and 2.

ABDUCTION (after)			
	N	M.R.	**P-VAL**
NEG R	5	11.3	
POS R	11	7.23	
TIE	0		
TOTAL	16		**0.552**

NEG R = Abduction after cons 2 was less than abduction after cons 1.

POS R = Abduction after cons 2 was more than abduction after cons 1.

TIE = Abduction after cons 2 was equal to abduction after cons 1.

The null hypothesis was accepted for abduction ROM readings, indicating there was no increase between consultations 1 and 2, at the α = 0.05 level.

Table 11: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from MDS readings, at consultations 1 and 2.

MDS (after)			
	N	M.R.	**P-VAL**
NEG R	10	5.90	
POS R	1	7	
TIE	5		
TOTAL	16		**0.019**

NEG R = MDS scores after cons 2 were less than MDS scores after cons 1.

POS R = MDS scores after cons 2 were more than MDS scores after cons 1.

TIE = MDS scores after cons 2 were equal to MDS scores after cons 1.

The null hypothesis was rejected for MDS readings, indicating there was an increase between consultations 1 and 2, at the α = 0.05 level.

Table 12: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from flexion ROM readings, at consultations 1 and 3.

FLEXION			
	N	M.R.	**P-VAL**
NEG R	1	1	
POS R	29	16	
TIE	0		
TOTAL	30		**0.000 (<0.001)**

NEG R = Flexion at cons 3 was less than flexion before cons 1.

POS R = Flexion at cons 3 was more than flexion before cons 1.

TIE = Flexion at cons 3 was equal to flexion before cons 1.

The null hypothesis was rejected for flexion ROM readings, indicating there was an increase between consultations 1 and 3, at the α = 0.05 level.

Table 13: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from abduction ROM readings, at consultations 1 and 3.

ABDUCTION			
	N	M.R.	**P-VAL**
NEG R	3	6.33	
POS R	27	16.52	
TIE	0		
TOTAL	30		**0.000 (<0.001)**

NEG R = Abduction at cons 3 was less than abduction before cons 1.

POS R = Abduction at cons 3 was more than abduction before cons 1.

TIE = Abduction at cons 3 was equal to abduction before cons 1.

The null hypothesis was rejected for abduction ROM readings, indicating there was an increase between consultations 1 and 3, at the α = 0.05 level.

Table 14: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from MDS readings, at consultations 1 and 3.

MDS			
	N	M.R.	**P-VAL**
NEG R	30	15.5	
POS R	0	0	
TIE	0		
TOTAL	30		**0.000 (<0.001)**

NEG R = MDS scores at cons 3 were less than MDS scores before cons 1.

POS R = MDS scores at cons 3 were more than MDS scores before cons 1.

TIE = MDS scores at cons 3 were equal to MDS scores before cons 1.

The null hypothesis was rejected for MDS readings, indicating there was an increase between consultations 1 and 3, at the α = 0.05 level.

4.4.2 TABLES OF THE STATISTICAL RESULTS OF INTRA-GROUP COMPARISON WITH REGARDS TO SUBJECTIVE DATA.

Table 15: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from NRS 101 readings, before and after consultation 1.

NRS 101			
	N	M.R.	**P-VAL**
NEG R	18	9.75	
POS R	1	14.5	
TIE	11		
TOTAL	30		**0.001**

NEG R = NRS 101 after cons 1 was less than NRS 101 before cons 1.

POS R = NRS 101 after cons 1 was more than NRS 101 before cons 1.

TIE = NRS 101 after cons 1 was equal to NRS 101 before cons 1.

The null hypothesis was rejected for NRS 101 readings, indicating there was an improvement after consultation 1, at the α = 0.05 level.

Table 16: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from NRS 101 readings, at consultations 1 and 2.

NRS 101			
	N	M.R.	**P-VAL**
NEG R	15	8.27	
POS R	1	12	
TIE	0		
TOTAL	16		**0.004**

NEG R = NRS 101 after cons 2 was less than NRS 101 after cons 1.

POS R = NRS 101 after cons 2 was more than NRS 101 after cons 1.

TIE = NRS 101 after cons 2 was equal to NRS 101 after cons 1.

The null hypothesis was rejected for NRS 101 readings, indicating there was an improvement between consultations 1 and 2, at the α = 0.05 level.

Table 17: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from SPADI readings, at consultations 1 and 2.

SPADI			
	N	M.R.	**P-VAL**
NEG R	28	14.5	
POS R	0	0	
TIE	2		
TOTAL	30		**0.000 (<0.001)**

NEG R = SPADI after cons 2 was less than SPADI after cons 1.

POS R = SPADI after cons 2 was more than SPADI after cons 1.

TIE = SPADI after cons 2 was equal to SPADI after cons 1.

The null hypothesis was rejected for SPADI readings, indicating there was an improvement between consultations 1 and 2, at the α = 0.05 level.

Table 18: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from NRS 101 readings, at consultations 1 and 3.

NRS 101			
	N	M.R.	**P-VAL**
NEG R	30	15.5	
POS R	0	0	
TIE	0		
TOTAL	30		**0.000 (<0.001)**

NEG R = NRS 101 at cons 3 was less than NRS 101 before cons 1.

POS R = NRS 101 at cons 3 was more than NRS 101 before cons 1.

TIE = NRS 101 at cons 3 was equal to NRS 101 before cons 1.

The null hypothesis was rejected for NRS 101 readings, indicating there was an improvement between consultations 1 and 3, at the α = 0.05 level.

Table 19: Intra-group comparison using Wilcoxon Signed Ranks Test to analyse results obtained from SPADI readings, at consultations 1 and 3.

SPADI			
	N	M.R.	**P-VAL**
NEG R	30	15.5	
POS R	0	0	
TIE	0		
TOTAL	30		**0.000 (<0.001)**

NEG R = SPADI at cons 3 was less than SPADI before cons 1.

POS R = SPADI at cons 3 was more than SPADI before cons 1.

TIE = SPADI at cons 3 was equal to SPADI before cons 1.

The null hypothesis was rejected for SPADI readings, indicating there was an improvement between consultations 1 and 3, at the α = 0.05 level.

4.4.3 TABLES OF THE STATISTICAL RESULTS OF INTER-GROUP COMPARISON FOR GROUPS 1A AND 1B, WITH REGARDS TO OBJECTIVE DATA.

Table 20: Inter-group comparison between Groups 1A & 1B using the Mann Whitney U Test to analyse results obtained from flexion and abduction inclinometer readings and the MDS, at consultation 2.

CONSULT 2							
	GROUP 1A				GROUP 1B		
	N	M.R.	S.R.	**P-VAL**	N	M.R.	S.R.
FLEX	16	16.47	263.5	**0.519**	14	14.39	201.5
ABDUC	16	16.03	256.5	**0.723**	14	14.89	208.5
MDS	16	21.5	344	**0.000 (<0.001)**	14	8.64	121

For consultation 2, the null hypothesis was accepted for flexion and abduction ROM readings, indicating there was no difference between Group 1A and 1B, at the α = 0.05 level.

For consultation 2, the null hypothesis was rejected for the MDS, indicating there was a difference between Group 1A and 1B, at the α = 0.05 level.

Table 21: Inter-group comparison between Groups 1A & 1B using the Mann Whitney U Test to analyse results obtained from flexion and abduction inclinometer readings and the MDS, at consultation 3.

CONSULT 3							
	GROUP 1A				GROUP 1B		
	N	M.R.	S.R.	**P-VAL**	N	M.R.	S.R.
FLEX	16	16.19	259	**0.647**	14	14.71	206
ABDUC	16	15.81	253	**0.835**	14	15.14	212
MDS	16	18.63	298	**0.027**	14	11.93	167

For consultation 3, the null hypothesis was accepted for flexion ROM readings, indicating there was no difference between Group 1A and 1B, at the α = 0.05 level.

For consultation 3, the null hypothesis was accepted for abduction ROM readings, indicating there was no difference between Group 1A and 1B, at the α = 0.05 level.

For consultation 3, the null hypothesis was rejected for the MDS, indicating there was a difference between Group 1A and 1B, at the α = 0.05 level.

4.4.4 TABLES OF THE STATISTICAL RESULTS OF INTER-GROUP COMPARISON FOR GROUPS 1A AND 1B, WITH REGARDS TO SUBJECTIVE DATA.

Table 22: Inter-group comparison between Groups 1A & 1B using the Mann Whitney U Test to analyse results obtained from NRS 101 and SPADI readings, at consultation 2.

CONSULT 2							
	GROUP 1A				GROUP 1B		
	N	M.R.	S.R.	**P-VAL**	N	M.R.	S.R.
NRS 101	16	19.63	314	**0.006**	14	10.79	151
SPADI	16	20.31	325	**0.001**	14	10	140

For consultation 2, the null hypothesis was rejected for NRS 101 readings, indicating there was a difference between Group 1A and 1B, at the $\alpha = 0.05$ level.

For consultation 2, the null hypothesis was rejected for SPADI readings, indicating there was a difference between Group 1A and 1B, at the $\alpha = 0.05$ level.

Table 23: Inter-group comparison between Groups 1A & 1B using the Mann Whitney U Test to analyse results obtained from NRS 101 and SPADI readings, at consultation 3.

CONSULT 3							
	GROUP 1A				GROUP 1B		
	N	M.R.	S.R.	**P-VAL**	N	M.R.	S.R.
NRS 101	16	17.84	285.5	**0.112**	14	12.82	179.5
SPADI	16	17.84	285.5	**0.114**	14	12.82	179.5

For consultation 3, the null hypothesis was accepted for NRS 101 readings, indicating there was no difference between Group 1A and 1B, at the α = 0.05 level.

For consultation 3, the null hypothesis was accepted for SPADI readings, indicating there was no difference between Group 1A and 1B, at the α = 0.05 level.

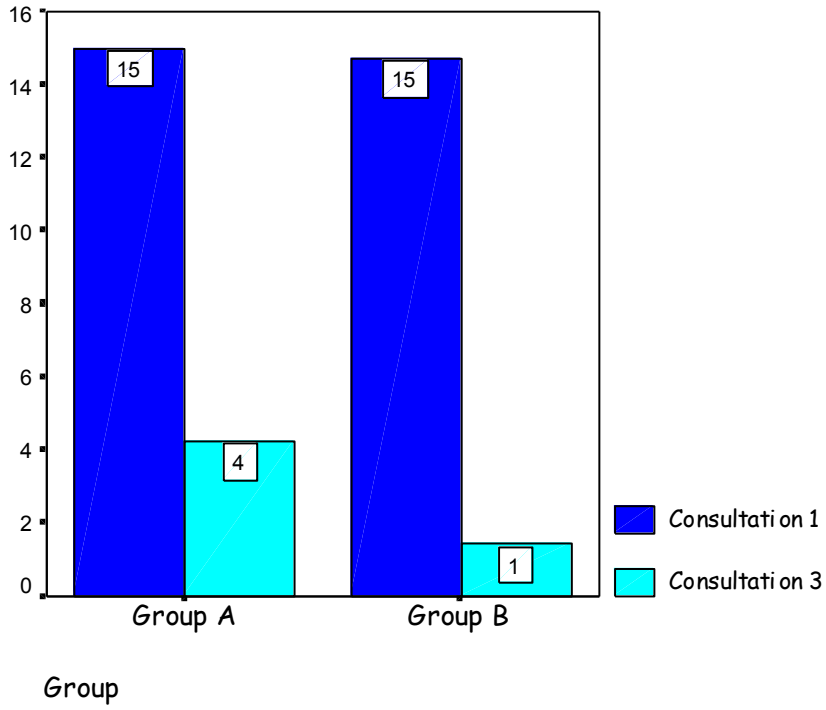
4.5 TABLE OF ASSOCIATED FINDINGS.

Table 24. Realtionship between associated findings and the course of the Biceps TrP.

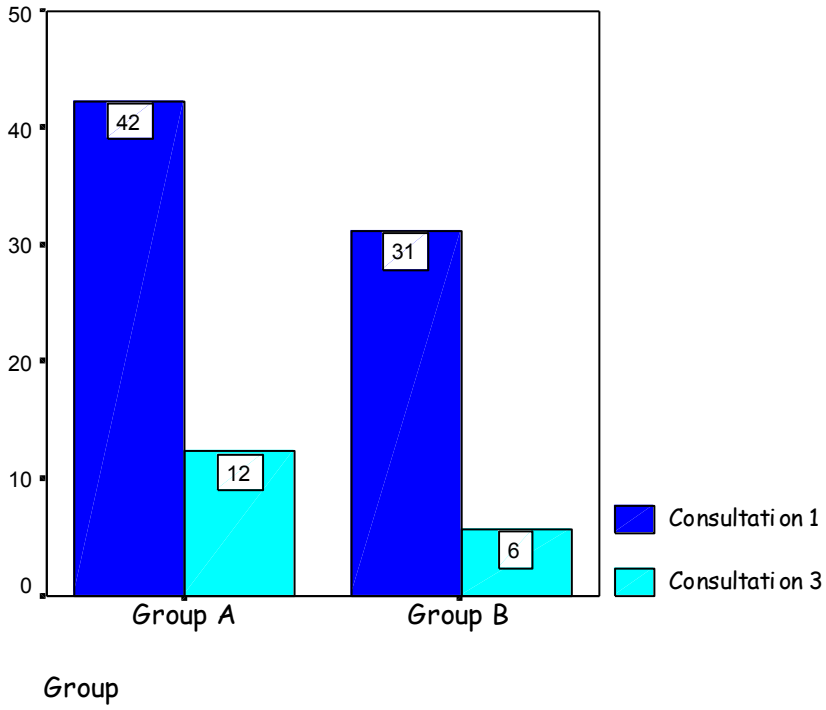
ASSOC FINDINGS AT CONS 1	NO. BICEPS TRP'S STILL ACTIVE AT CONS 2	NO. BICEPS TRP'S INACTIVE AT CONS 2	NO. BICEPS TRP'S STILL ACTIVE AT CONS 3
3 ASSOC FINDINGSS			
5	3	2	0
2 ASSOC FINDINGS			
10	8	2	1
1 ASSOC FINDING			
12	4	8	0
0 ASSOC FINDINGS			
3	1	2	0

4.6 GRAPHS OF STATISTICAL RESULTS AND ASSOCIATED FINDINGS.

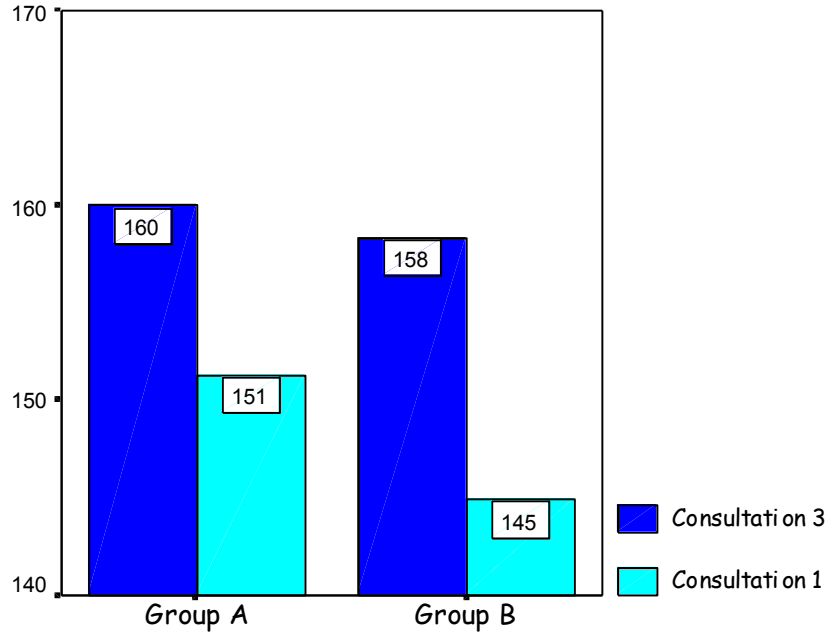
Graph 1: Myofascial Diagnostic Scale (Cons 1 & 3)



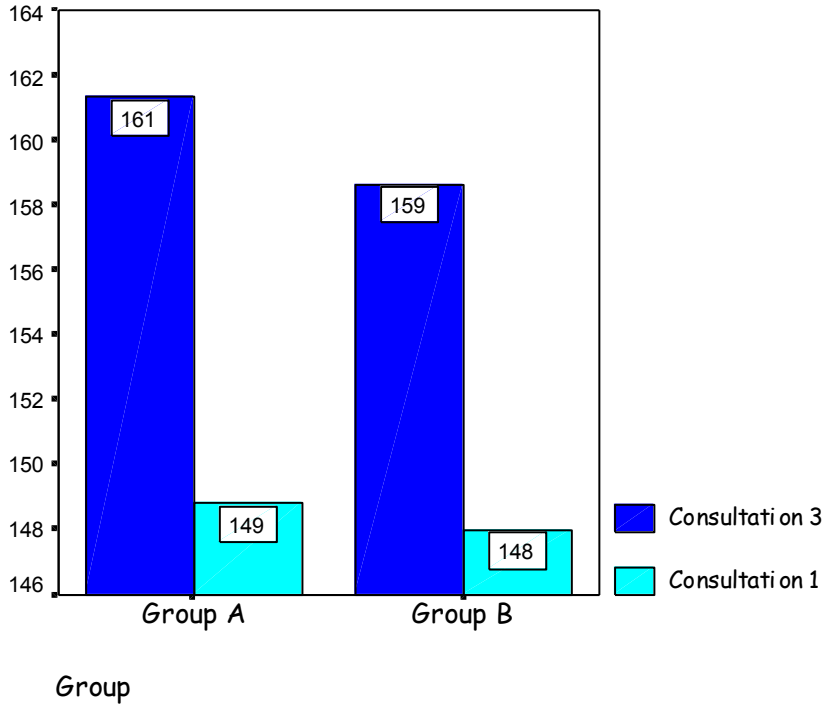
Graph 2: Numerical Rating Scale 101 (Cons 1 & 3)



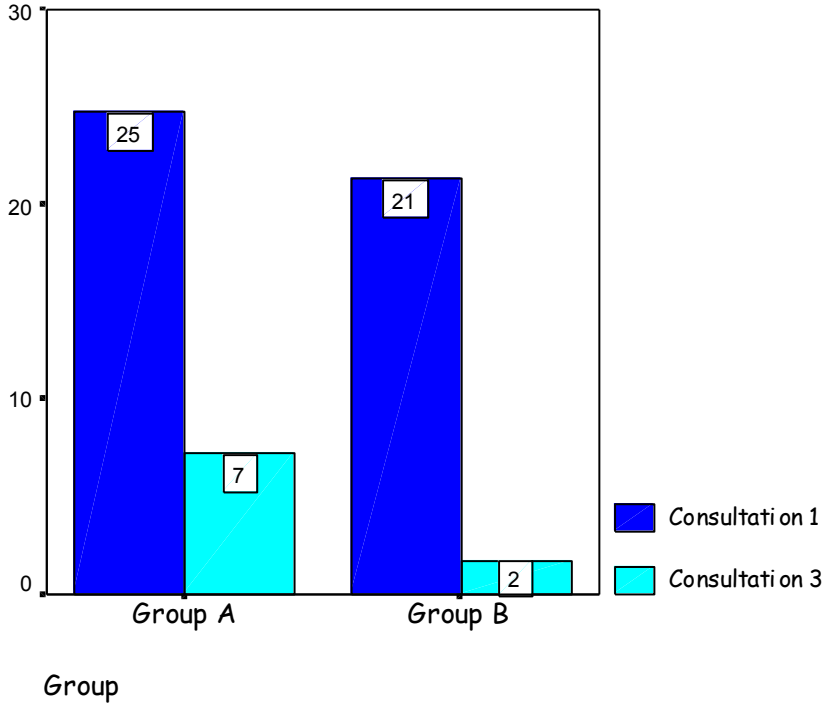
Graph 3: Flexion Range of Motion (Cons 1 & 3)



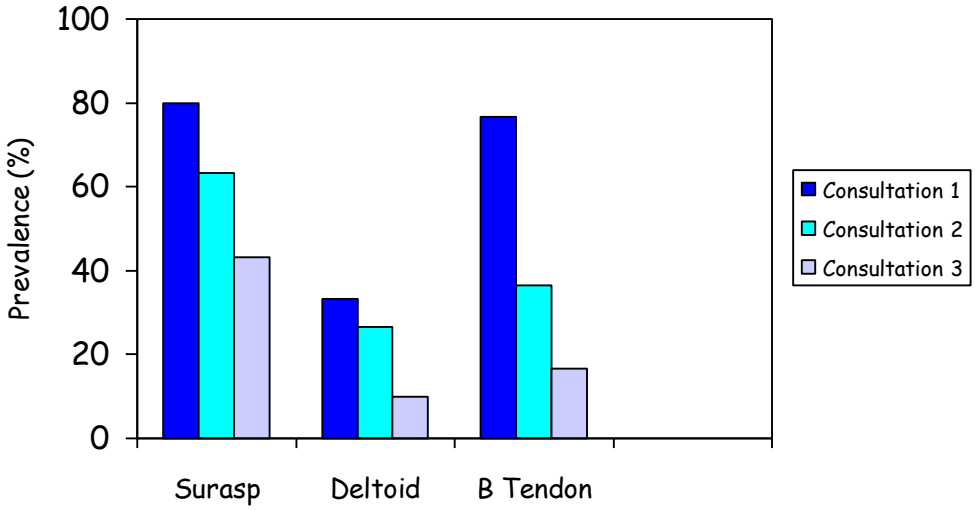
Graph 4: Abduction Range of Motion (Cons 1 & 3)



Graph 5: Shoulder Pain and Disability Index (Cons 1 & 3)



Graph 6: Associated Findings (Cons 1, 2 & 3)



CHAPTER FIVE.

5.1 INTRODUCTION.

This chapter provides a discussion of the demographic data, the results of the statistical analysis of the subjective and objective data and the associated findings. Problems with the research programme and study design are also discussed.

Results discussed are divided into intra- and inter-group comparisons and these are evaluated in terms of objective and subjective findings.

Evaluation of results from the intra-group comparison between the first and third consultations (overall measurement interval) gives an indication of the overall effectiveness of the treatment programme. Evaluation of results from the comparisons made before and after consultation one give the immediate effectiveness of the treatment intervention while results obtained between the first and second consultations

(first measurement interval) gives an indication of the short-term effectiveness of the treatment programme.

Evaluation of inter-group comparisons between Group 1A and 1B, produced at the second consultation, depending on whether the patient was treated or not, reveals any variances between subjective and objective variables at the second and third consultations.

5.2 DISCUSSION OF THE DEMOGRAPHIC DATA.

Of the thirty patients that completed the research programme, nine were female and twenty-one were male (Table 1). It is difficult to comment on this ratio as there is no data on the sex distribution of MPS of the Biceps muscle. This ratio contradicts previous opinion by Han and Harrison (1997) that MPS is more common in females. These authors were however commenting on the more commonly researched muscles of the head and neck as well as the low back.

The age range chosen for this study was 20 to 45 years so as to eliminate patients from both extremes of the age spectrum. The age group of greatest prevalence in this study was 20 to 25 years (Table 2). Travell, Simons and Simons (1999 1:13) are of the opinion that TrP's are more common between the ages of 31 and 50 years while Han and Harrison (1997) state that 30 to 49 years is the age range with the highest prevalence of TrP's. With regards to this study, it is the opinion of the author that the most prevalent age group is much lower because the study was carried out in a tertiary institution and the Chiropractic Day Clinic was easily accessible to younger individuals. Advertisements were also more readily available to students. This is concordant with the findings of Walker (2002) who performed a similar study in a similar environment.

A review of the race distribution in the study (Table 3) shows a high majority of Caucasian patients (80%). Only 16.6% of patients were Indian and 3.3% were Black. This does not accurately reflect the race distribution in South Africa. It was

the experience of the researcher that non-white patients had an aversion to the use of acupuncture needles. In particular, black patients who volunteered to participate in the study dropped out at the mention of the use of acupuncture needles, however well the procedure was explained to them.

The occupations of the patients (Table 4) were so widely varied that it was difficult to come to a conclusion as to which occupations were most likely to cause MPS of the Biceps. Perhaps the activity that caused the TrP is of more importance (Table 5). Gym training (40%) and lifting heavy objects (33.3%) were the most commonly reported causes of onset of Biceps TrP's. This correlates with Travell, Simons and Simons (1999 1:652), who also site lifting heavy objects as an activating factor of Biceps TrP's. These two activating factors may also account for the sex distribution in this study as males are more inclined to lift heavier weights in the gym as well as lifting heavier objects than a female would be able to.

5.3 DISCUSSION OF THE OBJECTIVE RESULTS.

5.3.1 ROM READINGS

5.3.1.1 Inter-group

Evaluation of the inter-group comparison between Group 1A and 1B at the second consultation revealed no significant difference between the two groups for flexion and abduction ROM (Table 20). This implies that there was little variance between the groups with regards to these objective findings.

The same evaluation at the third consultation also revealed no significant difference between the two groups for flexion and abduction ROM (Table 21). This suggests that Group 1A were no longer significantly worse than Group 1B in terms of ROM readings.

5.3.1.2 Intra-group

Evaluation of flexion and abduction ROM before and after the first consultation revealed a significant difference in both variables (Table 6, 7). These findings suggest an immediate increase in ROM after the first treatment intervention.

Evaluation of flexion and abduction ROM after consultations one and two revealed no significant difference in both variables (Table 9, 10). This suggests that there was minimal improvement in ROM in the short term after a second treatment intervention. These results however include only those patients who were treated again (Group 1A). Since n=16, the results may not accurately reflect the clinical findings due to the small sample size.

Comparisons made for flexion and abduction ROM between consultations one and three both revealed significant differences (Table 12, 13). This comparison was made using

n=30 patients and more accurately reflects the overall improvement in ROM over the treatment programme.

5.3.2 MYOFASCIAL DIAGNOSTIC SCALE READINGS

5.3.2.1 Inter-group

Evaluation of the inter-group comparison between Group 1A and 1B at the second consultation revealed a significant difference for the MDS (Table 20). This implies that Group 1A were significantly worse than Group 1B before the second consultation. At the third consultation, results also showed a significant difference between Group 1A and 1B, in terms of the MDS, but this was a less significant difference, showing that Group 1A had improved (Table 21).

5.3.2.2 Intra-group

Intra-group comparison, before and after the first consultation, between the first and second, and first and third consultations, all showed a significant difference for the MDS (Tables 8, 11 & 14). These results imply an immediate, short

term and overall improvement in the signs indicated on the Myofascial Diagnostic Scale.

5.4 DISCUSSION OF SUBJECTIVE RESULTS.

5.4.1 SPADI READINGS

5.4.1.1 Inter-group

Evaluation of the inter-group comparison between Group 1A and 1B at the second consultation showed a significant difference between the groups for SPADI readings (Table 22). This suggests Group 1A were significantly worse than Group 1B before the second consultation.

The same comparison was made at the third consultation and this revealed no significant difference between the groups (Table 23). Group 1A was no longer significantly worse than Group 1B.

5.4.1.2 Intra-group

Evaluation of the intra-group comparisons between consultations one and two, and one and three, both showed a significant difference for SPADI readings (Tables 17 & 19). This implies that there was a short term, and overall decrease in pain, and increase in shoulder functionality.

5.4.2 NRS 101 READINGS

5.4.2.1 Inter-group

Evaluation of results obtained from the inter-group comparison between Group 1A and 1B at the second consultation showed a significant difference in terms of NRS 101 scores (Table 22). Group 1A had higher scores for pain intensity at this consultation than Group 1B.

The same comparison at consultation three revealed no significant difference in the pain intensity experienced by the two groups at this consultation (Table 23).

5.4.2.2 Intra-group

Intra-group comparisons were made in terms of the NRS 101 before and after consultation one, between consultations one and two and between one and three (Tables 15, 16 & 18). All showed a significant difference between the consultations indicating an immediate, short term and overall reduction in pain intensity.

5.5 DISCUSSION OF THE ASSOCIATED FINDINGS.

Three sets of data for associated findings were obtained.

The first was the prevalence of satellite TrP's in the Supraspinatus muscle (Graph 6). At the first consultation, 80% of patients were found to have TrP's (active or latent) in this muscle. According to the MDS, 60% of these were active and 20% were latent. By the third consultation, only 43.3% of patients exhibited clinical signs of TrP's in the Supraspinatus muscle, thus indicating a reduction in the prevalence of satellite

TrP's in the Supraspinatus muscle. According to the MDS, all of the TrP's that remained in this muscle were latent.

The second associated finding was the prevalence of satellite TrP's in the Deltoid muscle (Graph 6). On the first consultation, 33.3% of patients had satellite TrP's in this muscle. 23.3% of these were active and 10% were latent. On the third consultation, only 10% of patients still had TrP's in this muscle and again, all were latent. Again, there was a reduction in the prevalence of satellite TrP's in the Deltoid muscle after the treatment programme.

The third associated finding was the presence of biceps tendonitis (Graph 6). 76.6% of patients exhibited the signs of biceps tendonitis on the first consultation, while only 16.6% of patients exhibited these signs on the third consultation. The prevalence of biceps tendonitis was thus reduced after the primary, active Biceps TrP was treated.

Table 24 shows the relationship between these associated findings and the course of the Biceps TrP. The figures shown demonstrate a definite overall decline in the frequency of active TrP's over the three consultations. Furthermore, the table also demonstrates the frequency with which the associated findings are present when the Biceps TrP is active. Most importantly, it can be implied from this table that the more the number of associated findings, the more they influence the clinical picture and the more difficult it is to treat the primary, active Biceps TrP.

5.6 SUMMARY OF THE CLINICAL FINDINGS.

The hypotheses stated in Chapter One are all supported by this study. The incidence and prevalence of associated findings of satellite TrP's in the Supraspinatus and Deltoid muscles were high when the primary active Biceps TrP was present, as was the incidence and prevalence of biceps tendonitis (Graph 6) (Hypothesis one).

The presence of associated findings negatively affected shoulder ROM in flexion and abduction (Tables 6 & 7). These associated findings also increased pain and disability of the shoulder region (Tables 15, 16 & 17) (Hypothesis two).

When the primary, active Biceps TrP was treated, the prevalence of associated findings was reduced (Graph 6). The diagnosis at the conclusion of the study was also changed and no longer included myofasciitis of the Supraspinatus or Deltoid muscles or biceps tendonitis (Table 14) (Hypothesis three).

Inter-group analysis of the data obtained before the second consultation showed a significant difference between Group 1A and 1B for MDS, NRS 101 and SPADI scores, implying that a second treatment was necessary for Group 1A (the group that was treated on the second visit). Analysis of the same data from consultation three revealed there was no longer a significant difference between the two groups for NRS 101 and SPADI scores. This implies that Group 1A were no longer worse

than Group 1B in terms of pain intensity and shoulder dysfunction.

Intra-group analysis before and after consultation one showed an immediate improvement in MDS and NRS 101 scores, indicating a tendency for the Biceps TrP to become latent and the pain intensity to decrease. Flexion and abduction ROM also showed an immediate increase following the first treatment.

The comparison made between the first and second consultations showed an improvement in NRS 101 and SPADI scores, suggesting a short-term improvement in pain intensity and shoulder function. MDS scores also improved showing the tendancy of the Biceps TrP to become latent over the short term as well. Flexion and abduction ROM did not significantly improve over the short term. The statistics obtained here may not accurately reflect the clinical signs as only 16 patients were included in this comparison as only Group 1A were treated on the second consultation.

The intra-group comparison made between the first and third consultations revealed a significant improvement in all subjective and objective data. This suggests that the treatment programme was successful overall.

A comparison between the associated findings that were present at the first consultation and those that were present at the last consultation revealed a decrease in the prevalence of satellite TrP's and biceps tendonitis over the treatment programme. It must be re-iterated that the improvements noted within associated findings occurred despite the fact that no direct treatment intervention was applied to these associated structures.

It is the opinion of the researcher that the treatment protocol chosen was effective for the relief of MPS of the Biceps muscle. This was demonstrated by the tendancy of the TrP to become latent over the duration of the study. Subjective measurement (NRS 101 and SPADI) scores decreased over the

treatment programme while objective measurements (MDS and ROM) also improved over the three treatments. This indicates that both researcher and patient were satisfied with the results of the study. It is also the opinion of the researcher that associated findings are strongly influenced by the severity of the MPS of the Biceps muscle.

5.7 PROBLEMS ENCOUNTERED WITH THE DATA.

5.7.1 OBJECTIVE DATA

It is the opinion of the researcher that accurate ROM readings from the inclinometer were difficult to obtain as a small variation in the placement of the strap over the Biceps muscle produced a variation in the measurement results. It was also the opinion of the researcher that patients did not give the same effort every time the measurements were taken. These factors influenced the measurements.

The researcher found the MDS to be moderately subjective. It was difficult to be certain that the same degree of pressure

was applied to the TrP for each patient and each consultation. This lends itself to researcher bias in favour of the desired result. Validity testing on this tool is however currently being conducted.

5.7.2 SUBJECTIVE DATA

The only problems encountered with the SPADI were that patients may have answered questions based on what they recalled answering the previous time and may have reported improvements to please the researcher, instead of reporting the facts. This is termed "Recall Bias".

There were no problems with patients understanding or answering the NRS 101, but patients found it difficult to answer the questionnaire again directly after a treatment intervention as they had no time to gauge possible changes.

CHAPTER SIX.

6.1 CONCLUSION.

This study attempted to answer many questions that surround the condition of MPS of the Biceps muscle. The questions laid out in the first chapter are answered here.

Statistical analysis revealed that both subjective and objective measures were improved over the duration of the study. It is therefore concluded that dry needling is an effective technique for the treatment of MPS of the Biceps muscle. This is in accordance with many authors (Rowley; Baldry; Travell, Simons and Simons; Han and Harrison and Lewit) who, as previously discussed, also agree that dry needling is an effective treatment intervention.

An association between Biceps TrP's and satellite TrP's in the anterior Deltoid and Supraspinatus muscles was suggested by Travell, Simons and Simons (1999 1:651). This relationship was demonstrated in this study and therefore supports the

suggestion. The incidence and prevalence of satellite TrP's in the Deltoid and Supraspinatus muscles, as well as bicipital tendonitis was questioned when the primary Biceps TrP was active. The incidence of these was also established (Graph 6) and appeared to be proportionate to the severity of the Biceps TrP. Travell, Simons and Simons (1999 1:) suggested this relationship and this study supports it.

This study also aimed to determine whether these associated findings negatively affected pain and/or disability as well as ROM of the shoulder. Statistical analysis revealed an improvement in these measurements (Tables 18, 19, 12 & 13 respectively) over the treatment programme. It was therefore concluded that these associated factors contributed to pain intensity and decreased shoulder ROM and functionality. This finding was expected since the actions the anterior Deltoid and Supraspinatus muscles perform when functioning at their fullest capacity include flexion and abduction (Moore, 1992:533 and Rachlin, 1994:320). The functioning of these muscles is

compromised when the satellite TrP's are present. Table 24 demonstrated the influence that these associated factors had on the Biceps TrP and also revealed a definite relationship between the number of associated factors present and the time taken for the Biceps TrP to resolve. When the number of associated factors was higher, the Biceps TrP remained active for a longer period of time and can be said to be more difficult to treat.

It is therefore concluded that many factors influence MPS of the Biceps muscle and must all be considered when establishing a management protocol. With this insight in mind, the physician may now be able to manage vague anterior shoulder pain with more success.

6.2 RECOMMENDATIONS.

- The study population used in this programme was thirty volunteers. A larger study population may have highlighted smaller variances and reported more accurate results.

- It is recommended that future studies use a double-blinded procedure whereby an independent observer obtains the subjective and objective data while the researcher administers the treatment intervention. This would minimise researcher bias.

- The race distribution in this study inaccurately reflected the situation in South Africa. It is recommended that advertisements be more widely distributed so they are more accessible to all race groups. This would improve future understanding of epidemiological factors of all races.

- No follow up consultation was used in this study. This final consultation would extend the understanding gained from this study to include long-term improvements.

- The MDS still requires further studies to determine its reliability and validity. Until such time, it is recommended that the scale be used only as a method of standardising diagnostic criteria. The scale should not be used in the statistical analysis.

- Future studies in this area could be extended to include a home stretch programme in conjunction with dry needling.

- Pressure algometry of the various TrP's may also be used as another objective measure.

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APPENDIX F

MYOFASCIAL DIAGNOSTIC SCALE

(Chettiar 2001)

Name: _____ Date: _____

File No.: _____ Visit: _____

TRIGGER POINT SIGNS

1. Soft tissue tenderness

Grade: 0 –	No tenderness	0
I –	Tenderness to palpation without grimace	1
II –	Tenderness to palpation with grimace or flinch	2
III -	Tenderness with withdrawal (+ve jump sign)	3
IV –	Withdrawal (+ve jump sign) to non-noxious stimuli (ie. superficial palpation, gentle percussion)	4

2. Snapping palpation of the trigger point evokes a local twitch response. 4

3. The trigger point is found in a palpable taut band. 4

4. Moderate, sustained pressure on the trigger point causes or intensifies pain in the reference zone. 5

TOTAL OUT OF 17

APPENDIX G

BICEPS TENDONITIS SCALE

Name: _____ Date: _____

File No.: _____ Visit: _____

PARAMETER	YES	NO
HX OF OVERUSE		
TENDERNESS IN BICIPITAL GROOVE		
+ve SPEEDS TEST		

APPENDIX I

SHOULDER PAIN AND DISABILITY INDEX

(Williams et al. 1995)

Name: _____ Date: _____

File No.: _____ Visit: _____

PAIN SCALE: HOW SEVERE IS YOUR PAIN	(0=NO PAIN 10=UNABLE TO DO OR N/A)
1. At its worst?	
2. When lying on the involved side?	
3. Reaching for something on a high shelf?	
4. Touching the back of your neck?	
5. Pushing with the involved arm?	
DISABILITY: HOW MUCH DIFFICULTY DO YOU HAVE	
1. Washing your back?	
2. Washing your hair?	
3. Putting on an undershirt or pullover sweater?	
4. Putting on a shirt that buttons down the front?	

5. Putting on your pants?	
6. Placing an object on a high shelf?	
7. Carrying an object of about 10 pounds?	
8. Removing something from your back pocket?	

APPENDIX J

PRIMARY FINDINGS

Name: _____ Date: _____

File No.: _____ Visit: _____

	CONS 1	CONS 2	CONS 3
	B A	B A	
MDS BICEPS			
NRS 101			
FLEXION			
ABDUCTION			

APPENDIX K

ASSOCIATED FINDINGS

Name: _____ Date: _____

File No.: _____ Visit: _____

	CONS 1	CONS 2	CONS 3
SUPRASPINATUS			
DELTOID			
B TENDONITIS			

Are you between the ages of 20 and 45 and suffering from any one of the following:

- ☆ vague pain in the front of the shoulder
- ☆ pain in the biceps muscle
- ☆ pain in the arm/shoulder when you lift your arm above your head?

Research is currently being done in these fields at the Chiropractic Day Clinic at Technikon Natal.

ALL RESEARCH TREATMENT IS FREE OF CHARGE.

Should you wish to participate, contact Jackie on 204 2205 or 204 2512.

TREATMENT 1.

	NAME	MPS BICEPS		NRS 101		FLEXION		ABDUCTION		SUPRA	DELT	B TEND	SPADI	
		before	after	before	after	before	after	before	after				pain	disab
1	K. Cox	11	10	20	20	172	172	161	167	NO	11	NO	8	11
2	M Shriver	12	11	50	40	156	161	133	148	11	NO	YES	12	28
3	C Martin	14	8	25	12.5	144	149	158	160	NO	NO	YES	23	37
4	F Mahomed	15	14	40	20	144	142	105	134	NO	15	YES	37	45
5	L Barnes	14	5	50	45	148	154	160	168	15	NO	YES	11	3
6	J Du Plessis	16	15	45	55	158	159	159	162	NO	11	YES	12	19
7	C van Lingen	15	5	40	35	133	150	140	155	14	6	YES	18	0
8	L Wing	16	15	40	30	139	145	144	150	15	16	YES	13	20
9	W Letsholo	15	2	25	25	138	157	147	158	NO	NO	YES	10	7
10	S Meintjes	16	6	30	25	149	157	148	167	15	NO	YES	18	13
11	E Farland	17	14	35	35	149	156	168	166	16	NO	YES	8	2
12	M Hunter	14	5	25	25	143	154	141	155	14	NO	YES	19	18
13	L Rajagopaul	17	6	65	65	132	137	125	154	15	15	YES	23	8
14	D Marshall	15	5	37.5	37.5	154	155	150	156	5	5	YES	18	12
15	B Schreiner	15	5	50	50	151	158	161	161	15	NO	NO	19	30
16	M Atkinson	15	5	30	30	140	135	125	134	NO	NO	YES	6	3
17	W Garrs	16	5	40	40	146	153	153	158	15	NO	YES	10	11
18	G Barker	15	5	40	40	144	148	154	159	15	NO	NO	29	13
19	J Marquis	15	5	35	30	154	150	156	158	9	NO	YES	10	6
20	J Bezuidenhout	15	5	25	20	133	158	140	160	15	15	YES	8	10
21	R Arjun	15	6	50	40	168	165	163	163	16	16	YES	28	16
22	V Doorgapershad	15	4	30	25	150	154	156	158	14	NO	YES	11	3
23	S Sutherland	14	4	50	40	160	163	158	162	5	5	NO	17	8
24	N Thompson	15	5	20	20	150	150	142	146	5	NO	NO	6	16
25	P Lancashire	14	5	42.5	40	163	162	153	160	5	NO	NO	15	10
26	V Doorgapershad	14	5	25	15	141	149	144	154	5	NO	YES	9	0
27	A Smith	16	5	37.5	30	152	158	142	150	14	NO	YES	22	47
28	A Thomas	15	5	25	20	140	164	151	158	15	NO	NO	12	9
29	S Fonseca	16	5	62.5	55	149	153	149	151	5	NO	YES	23	26
30	B Jones	14	5	25	20	150	157	167	167	15	NO	YES	13	6

TREATMENT 2.

	NAME	MPS BICEPS		NRS 101		FLEXION		ABDUCTION		SUPRA	DELT	B TEND	SPADI	
		before	after	before	after	before	after	before	after				pain	disab
1	K. Cox	10	1	15	15	178	178	172	176	NO	10	NO	4	8
2	M Shriver	11	1	45	25	164	165	165	166	11	NO	YES	7	11
3	C Martin	5		5		157		158		NO	NO	NO	4	6
4	F Mahomed	15	5	45	45	140	141	132	121	NO	1	YES	36	36
5	L Barnes	14	5	40	40	150	152	168	162	14	NO	NO	9	1
6	J Du Plessis	6	5	20	20	158	161	165	158	NO	7	YES	7	6
7	C van Lingen	5		5		153		163		14	6	YES	1	0
8	L Wing	16	6	15	15	167	141	140	153	16	6	NO	8	4
9	W Letsholo	6		5		138		141		NO	NO	YES	0	0
10	S Meintjes	16	15	15	15	146	157	142	148	15	NO	YES	9	8
11	E Farland	5	5	5	5	160	162	169	169	5	NO	NO	1	0
12	M Hunter	5		10		144		149		5	NO	NO	2	0
13	L Rajagopaul	15	5	5	5	139	142	150	146	NO	5	NO	17	10
14	D Marshall	5	5	25	20	164	142	159	158	15	NO	YES	12	15
15	B Schreiner	5		30		163		161		5	NO	NO	9	10
16	M Atkinson	5		10		130		121		NO	NO	NO	2	0
17	W Garrs	14	5	25	25	156	155	159	159	15	NO	YES	10	3
18	G Barker	14	5	30	20	148	149	157	160	5	NO	NO	26	13
19	J Marquis	5		25		154		160		5	NO	NO	6	2
20	J Bezuidenhout	5		10		161		162		9	5	NO	2	2
21	R Arjun	14	5	15	10	166	170	168	169	14	5	YES	14	10
22	V Doorgapershad	14	4	30	20	151	162	158	159	5	NO	YES	12	2
23	S Sutherland	5		10		163		163		NO	NO	NO	3	1
24	N Thompson	5		5		159		155		NO	NO	NO	1	6
25	P Lancashire	6	4	37.5	30	160	169	159	162	NO	NO	NO	12	10
26	V Doorgapershad	5		15		154		160		NO	NO	YES	0	5
27	A Smith	5		17.5		159		153		5	NO	NO	20	30
28	A Thomas	5		15		165		171		5	NO	NO	5	4
29	S Fonseca	14	4	47.5	40	160	161	168	172	5	NO	NO	15	20
30	B Jones	5		12.5		158		173		14	NO	NO	2	0

TREATMENT 2. (Group A)

	NAME	MPS BICEPS		NRS 101		FLEXION		ABDUCTION		SUPRA	DELT	B TEND	SPADI	
		before	after	before	after	before	after	before	after				pain	disab
1	K. Cox	10	1	15	15	178	178	172	176	NO	10	NO	4	8
2	M Shriver	11	1	45	25	164	165	165	166	11	NO	YES	7	11
3	F Mahomed	15	5	45	45	140	141	132	121	NO	1	YES	36	36
4	L Barnes	14	5	40	40	150	152	168	162	14	NO	NO	9	1
5	J Du Plessis	6	5	20	20	158	161	165	158	NO	7	YES	7	6
6	L Wing	16	6	15	15	167	141	140	153	16	6	NO	8	4
7	S Meintjes	16	15	15	15	146	157	142	148	15	NO	YES	9	8
8	E Farland	5	5	5	5	160	162	169	169	5	NO	NO	1	0
9	L Rajagopaul	15	5	5	5	139	142	150	146	NO	5	NO	17	10
10	D Marshall	5	5	25	20	164	142	159	158	15	NO	YES	12	15
11	W Garrs	14	5	25	25	156	155	159	159	15	NO	YES	10	3
12	G Barker	14	5	30	20	148	149	157	160	5	NO	NO	26	13
13	R Arjun	14	5	15	10	166	170	168	169	14	5	YES	14	10
14	V Doorgapershad	14	4	30	20	151	162	158	159	5	NO	YES	12	2
15	P Lancashire	6	4	37.5	30	160	169	159	162	NO	NO	NO	12	10
16	S Fonseca	14	4	47.5	40	160	161	168	172	5	NO	NO	15	20

TREATMENT 2. (Group B)

	NAME	MPS BICEPS	NRS 101	FLEXION	ABDUCTION	SUPRA	DELT	B TEND	SPADI	
									pain	disab
1	C Martin	5	5	157	158	NO	NO	NO	4	6
2	C van Lingen	5	5	153	163	14	6	YES	1	0
3	W Letsholo	6	5	138	141	NO	NO	YES	0	0
4	M Hunter	5	10	144	149	5	NO	NO	2	0
5	B Schreiner	5	30	163	161	5	NO	NO	9	10
6	M Atkinson	5	10	130	121	NO	NO	NO	2	0
7	J Marquis	5	25	154	160	5	NO	NO	6	2
8	J Bezuidenhout	5	10	161	162	9	5	NO	2	2
9	S Sutherland	5	10	163	163	NO	NO	NO	3	1
10	N Thompson	5	50	159	155	NO	NO	NO	1	6
11	V Doorgapershad	5	15	154	160	NO	NO	NO	5	0
12	A Smith	5	17.5	159	153	5	NO	NO	20	30
13	A Thomas	5	15	165	171	5	NO	NO	5	4
14	B Jones	5	12.5	158	173	14	NO	NO	2	0

TREATMENT 3.

	NAME	MPS BICEPS	NRS 101	FLEXION	ABDUCTION	SUPRA	DELT	B TEND	SPADI	
									pain	disab
1	K. Cox	1	0	174	176	NO	1	NO	0	0
2	M Shriver	0	0	160	158	1	NO	NO	0	0
3	C Martin	1	2.5	153	167	NO	NO	NO	0	0
4	F Mahomed	14	35	143	147	NO	NO	NO	29	26
5	L Barnes	5	20	152	163	NO	NO	NO	4	2
6	J Du Plessis	6	10	172	176	NO	6	YES	2	0
7	C van Lingen	0	0	157	162	5	NO	NO	0	0
8	L Wing	0	0	156	156	NO	NO	NO	0	0
9	W Letsholo	0	0	143	142	NO	NO	YES	0	0
10	S Meintjes	5	10	154	152	5	NO	NO	2	2
11	E Farland	5	0	162	178	NO	NO	NO	0	0
12	M Hunter	5	5	148	148	NO	NO	NO	1	0
13	L Rajagopaul	5	0	137	139	NO	1	NO	0	0
14	D Marshall	5	15	175	153	5	NO	YES	8	8
15	B Schreiner	1	10	165	164	NO	NO	NO	2	2
16	M Atkinson	1	10	144	121	NO	NO	NO	2	0
17	W Garrs	1	20	159	149	5	NO	YES	6	0
18	G Barker	1	10	149	161	NO	NO	NO	2	4
19	J Marquis	5	10	167	160	1	NO	NO	2	1
20	J Bezuidenhout	1	0	169	162	1	NO	NO	0	1
21	R Arjun	1	10	172	170	5	NO	NO	12	9
22	V Doorgapershad	10	20	159	163	4	NO	YES	9	1
23	S Sutherland	1	5	167	164	NO	NO	NO	1	1
24	N Thompson	1	2.5	162	155	NO	NO	NO	1	0
25	P Lancashire	5	22.5	170	166	NO	NO	NO	10	8
26	V Doorgapershad	1	10	154	166	NO	NO	NO	2	0
27	A Smith	1	12.5	160	159	1	NO	NO	5	6
28	A Thomas	1	5	167	173	1	NO	NO	1	2
29	S Fonseca	4	25	166	174	1	NO	NO	5	2
30	B Jones	1	7.5	161	178	4	NO	NO	1	0

DEMOGRAPHIC DATA

	NAME	FILE No	AGE	SEX	RACE	OCCUPATION
1	K. Cox	R 119	25	F	W	Student
2	M Shriver	R 283	22	M	W	Self employed
3	C Martin	R 387	21	M	W	Technician
4	F Mahomed	R 451	42	M	I	Self employed
5	L Barnes	O 544	28	M	W	Gymnastics instructor
6	J Du Plessis	G 668	25	M	W	Chiropractor
7	C van Lingen	C 329	25	F	W	Student
8	L Wing	R 716	43	M	W	Deputy principle
9	W Letsholo	R 713	22	M	B	Student
10	S Meintjes	R 729	35	F	W	Admin
11	E Farland	P 431	33	M	W	Gymnastics instructor
12	M Hunter	R 844	40	F	W	Self employed
13	L Rajagopaul	R 603	37	F	I	Admin
14	D Marshall	R 841	33	M	W	Shop manager
15	B Schreiner	I 157	32	M	W	Self employed
16	M Atkinson	C 263	29	M	W	Chiropractor
17	W Garrs	C 681	21	M	W	Self employed
18	G Barker	R 923	43	M	W	Commercial diver
19	J Marquis	A 576	25	F	W	Chiropractor
20	J Bezuidenhout	J 076	25	F	W	Teacher
21	R Arjun	R 917	21	M	I	Student
22	V Doorgapershad	M 217	24	M	I	Student
23	S Sutherland	C 351	25	M	W	Student
24	N Thompson	C 539	25	M	W	Student
25	P Lancashire	R 997	29	M	W	Stores
26	V Doorgapershad	S 047	21	M	I	Reflexologist
27	A Smith	J 127	34	F	W	CEO
28	A Thomas	S 096	30	M	W	Commercial diver
29	S Fonseca	I 854	26	M	W	Student
30	B Jones	S 123	21	F	W	Rep

NRS 101			
	N	M.R.	P-VAL
NEG R	30	15.5	
POS R	0	0	
TIE	0		
TOTAL	30		0

SPADI			
	N	M.R.	P-VAL
NEG R	30	15.5	
POS R	0	0	
TIE	0		
TOTAL	30		0

MDS			
	N	M.R.	P-VAL
NEG	30	15.5	
POS	0	0	
TIE	0		
TOTAL	30		0

FLEXION ROM					
	N	MEAN	S.D.	P-VAL	
CONS 1 BEFORE	30	148.33	9.75		
CONS 1 AFTER	30	154.17	8		

MDS READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1 BEFORE					
CONS 1 AFTER					

SPADI READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1 BEFORE					
CONS 1 AFTER					

NRS 101 READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1 BEFORE					
CONS 1 AFTER					

INCLINOMETER READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2A					

MDS READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2A					

SPADI READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2A					

NRS 101 READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2A					

INCLINOMETER READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2B					

MDS READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2B					

SPADI READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2B					

NRS 101 READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 2B					

INCLINOMETER READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 3					

MDS READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 3					

SPADI READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 3					

NRS 101 READINGS					
	MEAN	S.D.	S.E.	P-VAL	
CONS 1					
CONS 3					