THE RELATIVE EFFECTIVENESS OF LASER VERSUS DRY NEEDLING IN THE TREATMENT OF MYOFASCIITIS

A dissertation submitted in partial compliance with the requirements for a Master's Degree in Technology in the department of Chiropractic at Technikon Natal.

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I, Karen Janette Miller, do hereby declare that this work is my own, both in conception and in execution, except where otherwise indicated in the text.

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05 June 2000
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DEDICATION

This research is dedicated to my parents, David and Margrit Miller.

Thanks to you both for your support over all the years of my studies.

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ABSTRACT

This study compared the relative effectiveness of low intensity laser therapy as opposed to dry needling in the treatment of active myofascial trigger points. The purpose of this study was to determine the more effective method of treating active myofascial trigger points, in terms of subjective and objective clinical findings. This study was a comparative, uncontrolled, unblinded pilot study. It was also intended to expand upon the little understood pathophysiology and treatment of muscular pain, in both chiropractic and medical curricula (Gatterman 1990: 285).

Myofascial trigger points are localised areas of pain within muscles or the overlying fascia, which are exquisitely tender to touch, and cause referred pain upon manual compression of the trigger point (Hubbard 1998). According to this author, muscular pain is the most common work-related injury and the second most common cause of visits by patients to physicians. Dry needling (Han 1997) and laser (Khan 1994: 41) are commonly used in the treatment of active myofascial trigger points.

The population sample consisted of thirty subjects randomly selected from patients presenting at the Technikon Natal Chiropractic Clinic with cervical and

thoracic myofascial trigger points. These subjects, aged between 18 and 50 years old, were randomly assigned to two groups, A and B, consisting of fifteen patients each. Subjects receiving dry needling were allocated to group A. Subjects receiving laser therapy were allocated to group B.

Clinical criteria for the selection of subjects suffering from active myofascial trigger points were based on guidelines set out by Murphy (1989). In all subjects, active myofascial trigger points were identified in one or more of the following muscle groups: the Posterior Cervical, Trapezius, Levator Scapulae, Rhomboid Major, Rhomboid Minor, Supraspinatus, Infraspinatus, Teres Major and Teres Minor.

In the case where more than one active myofascial trigger point was diagnosed in a muscle, only the most symptomatic trigger point was treated. In the case where more than one muscle contained an active myofascial trigger point, the most symptomatic trigger points were assessed and a maximum of three of these were treated (in three different muscles). The same trigger points located during the first consultation were treated on subsequent visits. No new active trigger points were treated, even if they became more symptomatic than the original trigger points chosen for treatment.

Subjects were treated until asymptomatic or for a maximum of five treatments, whichever came first. Treatments were given over a two week period, followed by a non-treatment, follow-up consultation one month later.

Subjective and objective data was collected prior to the first, third and fifth treatment sessions, as well as at the final, follow-up consultation one month later. The subjective data included the Numerical Rating Scale and the CMCC (Canadian Memorial Chiropractic College) Neck Disability Index. The objective data was collected by measuring trigger point sensitivity to pressure using a pressure algometer.

All data collected was used for statistical analysis using the SPSS computer program.

Comparison of treatment responses were made between Groups A and B (intergroup comparison) and within each group (intragroup comparison). Treatment responses were compared between the initial and third consultation, the initial and fifth consultation and the initial and follow-up consultations. Thereafter, comparisons were made between the third and fifth, and the third and follow-up consultations, as well as the fifth and follow-up consultations. This was done using data obtained from the Numerical Rating Scale, CMCC Neck

Disability Index and Algometer readings. Intragroup comparisons, comparing Group A and Group B at the first, third, fifth and final consultation were also made. All results were tested using a 95% Confidence Interval.

Data from the CMCC Neck Disability Index (categorical variables) was analysed using non-parametric tests. The Mann-Whitney-U test was used for inter-group comparisons and the Wilcoxon Signed-Ranks test was used for intra-group comparisons of Groups A and B.

Data from the Numerical Rating Scale and Algometer measurements (continuous variables) was analysed using parametric tests. The two-sample unpaired t-test was used for inter-group comparisons. The two-sample paired t-test was used for intra-group comparisons of Groups A and B.

For the purpose of this dissertation, the null hypothesis stated that there was no statistically significant difference between the experimental groups A and B. The alternate hypothesis stated that there was a statistically significant difference between the experimental groups A and B.

Intragroup comparisons showed a statistically significant improvement in both treatment groups by the fifth and final consultations, with respect to the subjective

and objective clinical findings. Thus, for intragroup comparisons, the alternative hypothesis was accepted.

Intergroup comparisons however, showed no statistically significant difference between laser and dry needling in the treatment of active myofascial trigger points, and the null hypothesis was accepted.

These results thus showed that both treatments were equally beneficial in the treatment of active myofascial trigger points.

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CHAPTER 1: INTRODUCTION

Active myofascial trigger points are local areas of pain within muscles or the overlying fascia, which are exquisitely tender to touch, and elicit referred pain upon manual compression of the trigger point (Murphy 1989).

Myofascial trigger points develop in the presence of strenuous activity, prolonged immobilisation and emotional and physical stress (Hubbard 1998). Other aetiologies include direct or indirect injury that would cause prolonged abnormal muscle function as well as prolonged muscle spasm (Murphy 1989). Gatterman (1990: 285) suggests that due to postural strain and mechanical stresses, the most common sites for the formation of trigger points are the postural muscles of the back and neck and rotator muscles of the hips and shoulders.

Prolonged muscle spasm leads to decreased aerobic oxidation of the muscle and an increase in anaerobic oxidation. Accumulation of metabolic waste (e.g. lactic acid) occurs within the muscle, resulting in inflammation. This disrupts the sarcoplasmic reticulum and calcium is released into the tissues resulting in the formation of a taut band of muscle tissue. Trigger points develop in these bands. (Murphy 1989.) Myofascial trigger points can become a chronic complaint. The ranges of motion of the joints associated with the affected muscle may become

restricted. Thus, further muscle dysfunction and possible involvement of secondary muscles can occur and, occasionally, autonomic dysfunction may also arise (Travell and Simons 1983 1: xi).

Travell and Simons (1983 1: 13) write that patients of any age or gender can develop myofascial trigger points. However, research shows that more females than males experience this type of muscular pain.

Muscular pain is one of the most common problems encountered among outpatients (Auleciems 1995.) Muscular pain syndromes can render workers unable to perform tasks requiring repetitive muscle use, thereby decreasing their work capacity. This can frustrate the patient, and lead to chronic pain. Disabilities and mounting costs of Workers Compensation claims for muscular pain are of major concern to employers (Bruce 1995).

Several therapies and treatments offer relief to the patient suffering from myofascial trigger points. Dry needling (Han 1997) and laser (Khan 1994: 41) are commonly used.

Lewit (1979) states that the use of acupuncture needles in the needling of active trigger points is commonplace, and that the immediate analgesia felt by some

patients upon insertion of a needle into the trigger point is called the 'needle effect'.

Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Khan (1994: 39) writes that low intensity (or cold) laser such as the Helium-Neon (He-Ne) laser, used in this study, is recommended for pain control.

The above references suggest that both Helium-Neon laser and dry needling are effective in the treatment of active myofascial trigger points. The purpose of this study was to show which of these techniques was more effective in the treatment of active myofascial trigger points.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

CHAPTER 2 : THE REVIEW OF THE RELATED LITERATURE

2.1 Introduction

Auleciems (1995) states that myofascial pain is one of the least understood and most commonly encountered problem in the outpatient setting. Myofascial trigger points are a type of muscular pain disorder. They cause local pain and referred pain to sites distant from the trigger points, as well as muscular stiffness and limited range of motion of the joints associated with the affected muscles. They also cause weakness of the involved muscle, as well as autonomic dysfunction such as salivation, sweating, localised vasoconstriction and lacrimation (Travell and Simons 1983: 15). When myofascial trigger points are treated correctly, the prognosis for recovery and pain relief is very good. Thus, physical therapists and health professionals need to offer an astute diagnosis of muscular pain and a known solution to patients suffering from myofascial trigger points (Auleciems 1995).

2.2 Prevalence

Gatterman (1990: 285) states that much bodily pain will occur in muscle, as skeletal muscle comrprises over forty percent of the total body mass.

Travell and Simons (1983 1: 13) write that, although patients of any age or gender can develop myofascial trigger points, middle-aged women who do little exercise are particularly prone to developing myofascial trigger points.

Travell and Simons (1983 1: 13) write that of a group of 200 subjects aged 17 to 35 years old, 54% of the females and 45% of the male subjects examined, had latent shoulder girdle trigger points. This study also found that 13% of the female and 12% of the male subjects experienced referred pain on compression of the trigger points, indicating that they suffered from active myofascial trigger points. This observation indicates that females would tend to suffer a higher incidence of muscular pain than males in this age group.

Hubbard (1998) states that 30% to 40% of muscular pain patients experience chronic, recurrent, daily muscle pain, thereby causing significant problems for the patient, employer and physician.

2.3 The aetiology, perpetuating factors and the pathomechanics of myofascial trigger points

Gatterman (1990: 285) suggests that due to postural strain and mechanical stresses, possibly due to an imbalance between agonist and antagonist muscles,

the most common sites for the formation of trigger points are the postural muscles of the back and neck and rotator muscles of the hips and shoulders.

Travell and Simons (1983 1: xi) state that the correct diagnosis of myofascial trigger points is important in order to administer appropriate treatment. Incorrect diagnosis or ineffectual treatment (of myofascial trigger points) could result in chronicity of the muscular problem. This would include problems such as restricted range of motion of the joints associated with the affected muscles, autonomic dysfunction (e.g. lacrimation and sweating), as well as further muscle dysfunction, muscular weakness and possibly an involvement of secondary sites in the pain syndrome.

Travell and Simons (1983 1: 103) discuss that mechanical stresses such as skeletal assymetry (e.g. short leg or hemipelvis) and body disproportion (e.g. Morton's foot or short upper arms) are the most common perpetuating factors for the formation of myofascial trigger points. These authors also comment that misfitting furniture, poor posture and prolonged immobility can also cause such mechanical stress. Nutrirional inadequacies (e.g. deficiencies of Vitamin C, Calcium, Potassium, Iron and Vitamin B 1,6, and 12) as well as metabolic and endocrine inadequacies (e.g. hypothyroidism, hyperuricaemia and hypoglycaemia) are also implicated in the formation of myofascial trigger points.

Psychological factors (e.g. depression, tension and anxiety), chronic infection (e.g. viral or bacterial disease, or parasitic infestations) and factors such as insomnia, allergy and radiculopathy and chronic visceral disease are also causative factors of myofascial trigger points.

Hubbard (1998) reiterates that emotional and physical stress, strenuous activity and prolonged immobilization can perpetuate myofascial trigger points.

Prolonged muscle spasm causes shortening of the muscle, with decreased aerobic oxidation and increased anaerobic oxidation occuring within the muscle causing further muscle spasm. Trigger points form in the presence of prolonged muscle spasm. They are also seen in people who have experienced direct or indirect injury that would cause prolonged abnormal muscle function. The result of these pathological processes would be production of cellular waste products such as lactic acid and, therefore, inflammation is likely to occur within the affected muscle. (Murphy 1989.)

Rosen (1993) summarizes that the correct treatment of myofascial trigger points is vital for the complete recovery of the patient suffering from myofascial trigger points. Included in the treatment must be restoration of the range of motion and

strength of the affected muscles and joints to as normal as possible. Failure to do so could result in chronicity of the muscular problem, with residual dysfunction of the muscles and overlying fascia, with recurring disability and pain.

2.4 Clinical presentation

According to guidlines by Murphy (1989), active myofascial trigger points are clinically detected and diagnosed in the following manner. The patient is asked to identify the painful area. The examiner then manually palpates the identified muscle to elicit local tenderness and concomittent referred pain. Whilst the examiner is palpating the trigger point, he/she may feel a local twitch response (a transient local muscle contraction) underneath his/her fingers, and also produce a jump sign from the subject (where the subject moves away from the examiner's palpating hand, and thus from the pain, and cries out in response to the pain). For the purpose of this study, the same procedure was followed.

2.5 Treatment of myofascial trigger points

Several therapies and treatments are used to offer relief to the patient suffering from myofascial trigger points. These include the application of cold, heat,

behavioral therapy, trigger point injection, manipulation and TENS (Transcutaneous Electrical Nerve Stimulation) (Hubbard 1998), stretch and spray and stretch and ice, deep massage or ischaemic compression, myofascial release, medication, as well as exercises to stretch and strengthen the affected muscles (Auleciems 1995). Dry needling (Han 1997) and laser (Khan 1994: 41) are also used commonly.

2.5.1 Dry needling of active myofascial trigger points

Lewit (1979) states that the use of acupuncture needles in the needling of active trigger points is commonplace and, that when a needle is appropriately inserted into an affected muscle or its fascia, that is, directly into the most painful site, the immediate analgesia felt by some patients in the muscle is called the 'needle effect'. Han (1997) states that dry needling can decrease or abolish myofascial pain by mechanically disrupting and directly stimulating trigger points. These mechanisms are described by Travell and Simons (1983: 79). They propose that mechanical disruption of muscle fibres by needle puncture causes an increase in extracellular pottasium, leading to the depolarisation of muscle fibres. This interupts the positive feedback mechanism which perpetuates the trigger point pain, thus relieving the pain caused by myofascial trigger points. Dry needling appears to be as effective as injection of medication into the trigger point (Han 1997).

Hubbard and Berkoff (1993) initiated a study to prove that myofascial trigger points showed spontaneous EMG (Electromyographic) activity. This study was unblinded and apparently random.

The subjects consisted of 29 patients (who were otherwise healthy and neurologically intact) suffering from chronic tension-type headaches and pericranial muscle tenderness, as well as 25 patients suffering from neck, shoulder, low back and buttock muscle tenderness. An additional 8 normal subjects with no history of head, neck or back pain, who were found to have latent (non-symptomatic) myofascial trigger points, were also chosen. The object of this selection was to ascertain the difference in EMG activity between active (symptomatic) trigger points, latent (non-symptomatic) and non-tender muscular tissue.

The results were measured by use of the EMG machine and by collection of subjective data. The subjective data required that the patients complete a tenderness rating (on a scale of 1-4) and identify their level of pain (on a scale of 1-4) prior to EMG testing.

TECA (TECA Corporation, White Plains, New York) EMG needles were inserted through the skin directly over the active trigger point. A second needle was placed into non-tender muscular tissue 1cm away from the first needle. The second needle indicated no electrical activity and caused no pain. The first needle was advanced into the trigger point area until similar symptoms were produced by the needle as by manual palpation of the trigger point (a deep ache and referred pain). Most often, EMG activity was detected at a depth of 2cm, and it was at this depth into the muscle that the patient experienced the trigger point symptoms. The needles were left in place for 15 - 50 minutes per patient. Results showed that spontaneous EMG activity was recorded from all the tested trigger points of both the normal subjects and patients. It was also noted that, as the needle was advanced or withdrawn within one millimeter of the trigger point, that all EMG activity disappeared. Pearson correlations between mean EMG and tenderness to palpation showed $p=0.0007$, which showed a statistically significant difference and, therefore, that EMG activity did exist within an active myofascial trigger point. The authors thus hypothesized that sympathetic stimulation of intrafusal muscle fibres caused low-grade, symptomatic muscle tension, possibly by distending, distorting and chemically sensitizing the spindle capsule by prolonged spindle tension.

This study appears to be a reasonable pilot study for future study into EMG

activity of active myofascial trigger points. However, the methodology could have been improved upon in the following manner:

- The ages of the patients ranged from 18 to 80 years old, with a mean age of 38,6 years. This is a very wide age range and should have been narrowed to limit the variables associated with advancing age and concommitant age-related diseases.
- Eighty percent of the sample was female. This is an unbalanced gender population which could have created a Type II error.

  The sample size of 54 patients was small and the reason for the distinction of the patients by presenting symptomatology was not made apparent in the study.The very small sample (n=8) of normal subjects should have been larger to create a more balanced statistical review. An equal sample of symptomatic and non-symptomatic patients would be suggested to improve statistical accuracy.
- The tenderness rating and pain rating before each testing (each on a scale of 1-4) were not referenced, and the accuracy, sensitivity and specificity of these tests is not known. These tests may be useful in creating an overall impression of the patient's perception of their pain at the time of the study but it cannot be said for certain that the tests gave a sound scientific review of the pain. Recognised measurements such as the Numerical Rating Scale (Jenson et al. 1986) could have been used instead.

In a prospective, randomised, double-blinded study by Garvey et al. (1989), sixty-three patients with low back strain were treated with one of four modalities: 1. (Group A: n=13) Injection of Lidocaine, 2. (Group B: n=14) Injection of Lidocaine and steroid, 3. (Group C: n=20) Acupuncture (single, dry needle stick into the trigger point) and 4. (Group D: n=16) Vapocoolant spray with Acupuncture (single, dry needle stick into the trigger point).

Results showed that Groups C and D showed a 63% improvement rate as opposed to a 42% improvement for Groups A and B. The authors concluded that direct stimulus to the trigger point using non-injection methods (single, dry needle-stick alone and in combination with vapocoolant spray), gave more symptomatic (subjective) relief than treatment using injection methods, although statistically these results were not significant. The authors therefore concluded that a larger sample size of 200 patients would have been more suitable for the study in order to get a statistically significant difference using the two-tailed t-test at 80% power, with a p value of 0.05.

- ◊ It is important to note that all prospective subjects in this trial were treated for four weeks prior to the study with non-steroidal anti-inflammatory drugs,hot showers twice a day and avoidance of strenuous activity. These treatments were thought to alleviate the subjects' pain. Although the non-

steroidal anti-inflammatory drugs were not given in conjunction with the treatment during the actual study, the hot showers twice daily and avoidance of strenuous activity was still recommended. These treatments may have increased the variables associated with the treatments given and thereby influenced the results of this study.

- As shown, the sampling, although random, did not equally allocate subjects to the four groups for study, which would render an unbalanced sample size per group with an added influence on the results.

  The sample also consisted of 41 males and 22 females with an average age of 38 years. This gender imbalance may also have influenced the results.

- The results show a short term (2 week) response to the treatment. It would have been useful to ascertain the long term effect of the treatments given in order to show the rate of recurrence of the trigger points that were treated. A follow-up consultation for data collection one month later is therefore recommended.

However, Murphy (1989) contradicts these findings. He states that in his clinical experience that he finds more consistent success in the treatment of active myofascial trigger points by using needle-puncture and anaesthetic than by dry needling alone.

2.5.2 Laser treatment of active myofascial trigger points

Laser is an acronym for Light Amplification by Stimulated Emmision of Radiation. Khan (1994: 39) writes that low intensity (or cold) laser such as the Helium-Neon (He-Ne) laser (used in this study) has a red light emission at a wavelength of 670nm. He-Ne laser operating at 1 W/square cm can penetrate human tissue 0,8mm directly, and 10 to 12 mm indirectly, following refraction, dispersion and reflection through the dermal tissues. Khan (1994: 41) suggests that for pain control, laser can be administered daily for 15 to 30 seconds, pulsed at 4 to 10 pulses per second. Snyder-Mackler et al. (1989) recommend that for pain control, laser be applied at 0,95 W/square cm . Laakso et al. (1994) suggest that laser doses above 4 W/square cm may inhibit cell processes, and that the therapeutic window of laser treatment therefore lies between 0,5 and 4,0 W/square cm.

In a double-blinded, placebo-controlled study by Laakso et al. (1994) to investigate the possible role for opioids in producing analgesia by means of laser stimulation, 56 human subjects, diagnosed with myofascial trigger points of the muscles of the neck, shoulders and upper thoracic region, were each given six laser treatments over a two week period. Blood samples were taken thirty minutes apart at the first visit, and no treatment was administered at this visit. Blood

samples were then taken before and after the fourth and sixth treatments. Blood serum levels of Beta-endorphin and Adrenocorticotropic Hormone (ACTH) were measured by blood assay. No subjective data was recorded. Results, (compared to the placebo group) showed a cumulative pre-treatment increase in plasma ACTH and a pre-treatment increase in plasma Beta-endorphin levels throughout the duration of the study, indicating that laser provided an analgesic response by activation of the central hormonal opioid pathways.

In an effort to show the efficacy of laser in the treatment of pain caused by myofascial trigger points, Snyder-Mackler et al. (1989) researched the effect of Helium-Neon (He-Ne) laser radiation on skin resistance in treating pain in patients with trigger points in the neck or back. Skin resistance refers to the resistance of the skin to the passage of a direct electrical current passed through it. A decreased skin resistance is seen to correlate with increased pain felt by the subject in the area underlying the skin being tested and an increased skin resistance is seen to correlate with decreased pain felt by the subject. (Snyder-Mackler et al. (1989)

In this double-blinded study, twenty-four subjects were equally and randomly divided into placebo and treatment groups of twelve subjects each. The treatment group received three laser treatments within five to nine days, at twenty seconds

The placebo group were treated with a laser unit which was switched off.
At all treatments the dermometer was used to measure pre- and post-treatment skin resistance over the active myofascial trigger point being treated. The Visual Analog Scale (VAS) was also completed by the patient prior to and after the treatment. VAS and dermometer measurements were only recorded before (pre-treatment) the first treatment and after (post-treatment) the third treatment.

The results showed that, on inter-group analysis, a statistically significant difference existed between the placebo (mean = 48.0%) and the laser groups (mean = 57.8%) at the pre-treatment skin resistance measurements. No mention was made of the inter-group, pre-treatment scores of the VAS. However, a statistically significant difference ($p<0.001$) was shown between the post-treatment skin resistances in the placebo and laser groups, with an associated reduction in pain by VAS ($p < 0.005$) over the trigger points in the treatment group.

This research may have a type II error on account of the following short-falls of the methodology used in this study.

- The sample size of twelve subjects per group was too small. A much larger sample (n=200) would have been suitable.
- No mention seems to have been made of the statistical analysis of the pre-

treatment scores and analyses of the VAS.

These researchers concluded that cold laser treatment of active myofascial trigger points did increase skin resistance of the skin overlying the trigger point and decrease the pain of that trigger point. They also commented that He-Ne laser may be a beneficial adjunct to other traditional therapeutic modalities.

2.6 Interpretation of the related literature

The data supplied suggests that both Helium-Neon laser and dry needling are effective in the treatment of active myofascial trigger points. The purpose of this study was to show which one of these techniques was more effective than the other in the treatment of active myofascial trigger points. This study was therefore a feasible, comparative, uncontrolled, unblinded pilot study that compared the relative effect of He-Ne laser as opposed to dry needling of active myofascial trigger points and will also provide suitable grounding for further laser, dry needling and myofascial research.

2.7 Literature Review of Muscles

According to the criteria laid out in this study, trigger points in the trapezius,

levator scapulae, supraspinatus, infraspinatus, rhomboid major and minor, and teres major and minor muscles were considered for treatment. This section describes the anatomy related to these muscles, trigger point location and characteristics and the needling techniques for the trigger points in these muscles.

2.7.1 Trapezius

The Trapezius muscle is a large, triangular muscle which traverses the posterior neck and upper aspect of the trunk. It originates at the medial third of the superior nuchal line, external occipital protuberance, ligamentum nuchae and spinous processes of C7 and T1 vertebra. The upper fibres of the trapezius insert into the lateral third of the clavicle, the middle fibres insert into the acromion and spine of the scapula and the lower fibres into the base of the scapular spine. It acts to elevate, retract and rotate the scapula in order to move the glenoid cavity superiorly and anteriorly. (Moore 1985: 662.)

Seven trigger points are commonly located in the trapezius muscle. Trigger points one (TP1) and two (TP2) are located in the upper fibres of trapezius. TP1 is located laterally in the upper free border of the muscle near the angle of the neck. TP1 refers pain unilaterally upwards along the posterolateral part of the

neck to the mastoid process. The pain may also be referred to the temple and posterior orbit, the angle of the jaw, the occiput and lower molar teeth. This trigger point is examined using a pincer grasp over the entire free margin of the upper border of trapezius. TP1 is needled with the patient supine, in an anterior to posterior direction, whilst the examiner holds the muscle belly away from the underlying structures. (Travell and Simons 1983: 183-196.)

TP2 is located inferior and posterior to the free border of trapezius. TP2 refers pain slightly posterior to the cervical reference zone of TP1. TP2 is examined using a pincer grasp or flat palpation of the fibres inferior and posterior to TP1. TP2 is needled with the patient supine, in an anterior to posterior direction, whilst the examiner holds the muscle belly away from the underlying structures. (Travell and Simons 1983: 183-196.)

TP3 and TP4 are located in the lower fibres of trapezius. TP3 is located medial to the scapular border inferiorly. TP3 refers pain to the upper paraspinal cervical muscles to the mastoid process, the acromion and a diffuse tenderness over the suprascapular region and medial border of the scapula. TP3 is examined using flat palpation whilst the muscle is placed on a stretch by rotating the scapula upward and forward. The button-like muscular nodule (TP3) is needled with the

patient lying on the side opposite to the painful trigger point, with the muscle stretched. The needle is directed toward an underlying rib, avoiding the intercostal space. (Travell and Simons 1983: 183-196.)

TP4 is located at the medial border of the infraspinatus muscle, just below the spine of the scapula. TP4 refers a burning pain downward and medial to the vertebral border of the scapula. TP4 is examined with the middle fibres of trapezius stretched, by elevating and abducting the scapula, with the patient seated. TP4 is needled with the muscle stretched. The needle is directed towards the shoulder and aligned with the lateral fibres of the muscle. (Travell and Simons 1983: 183-196.)

TP5, TP6 and TP7 are located in the middle fibres of the trapezius. TP5 is located in the superficial horizontal fibres of the middle trapezius, one centimetre medial to the scapular attachment of the levator scapulae muscle. TP5 refers a burning pain medially between the trigger point and the spinous processes of C7 and T1 vertebra. TP5 is examined with the patient seated using flat palpation over the stretched muscle with the scapula elevated and abducted. The trigger point is needled with the patient lying on their side opposite to the painful trigger point with their hand on their thigh to stabilise the scapula. This superficial trigger point is needled tangential to the skin. (Travell and Simons 1983: 183-196.)

TP6 is located near the acromion, lateral to the supraspinatus muscle. TP6 refers an aching pain to the tip of the shoulder. TP6 is examined using flat palpation with the patient seated and the scapula elevated and abducted, placing the muscle on a stretch. TP6 is needled with the patient lying on their side opposite to the painful trigger point with their hand on their thigh to stabilise the scapula. This superficial trigger point is needled tangential to the skin. (Travell and Simons 1983: 183-196.)

TP7 is located in the most superficial fibres of the middle trapezius where the fibres cross the levator scapulae muscle. TP7 refers a "shivery" sensation with pilomotor erection of the skin in the lateral aspect of the arm of the same side and sometimes of the thigh of the same side. TP7 is examined using flat palpation. TP7 is needled with the patient lying on their side opposite to the trigger point with their hand on their thigh to stabilise the scapula. This superficial trigger point is needled tangential to the skin to avoid penetration of the lungs and other underlying structures. (Travell and Simons 1983: 183-196.)

2.7.2 The Levator Scapulae muscle

The levator scapulae muscle is a strap-like muscle which lies deep to the sternocleidomastoid and trapezius muscles. It originates at the transverse

processes of the first three or four cervical vertebrae and inserts into the superior part of the medial border of the scapula. The levator scapulae muscle elevates and rotates the scapula, tilting the glenoid cavity inferiorly. (Moore 1985: 664.)

Two trigger points are located in this muscle. These trigger points refer pain to the angle of the neck, the vertebral border of the scapula and to the shoulder posteriorly, and cause limitation of neck rotation. The primary trigger point is found at the angle of the neck beneath the anterior border of the upper trapezius. The secondary trigger point is located above the attachment of the muscle to the superior angle of the scapula. The primary trigger point is examined using flat palpation, with the patient seated, leaning the weight of the upper torso against the chair's backrest and the elbows supported on the armrests in order to slacken the muscle. This trigger point is needled superficially, upward and medially toward the underlying vertebral transverse process. The secondary trigger point is examined seated or lying on the side opposite to the painful trigger point, using flat palpation across the fibres about 1,3cm above the superior angle of the scapula. The trigger point is trapped between the examiner's fingers and needled superficially, upward above the scapular border, in order to avoid entering the thoracic cage. (Travell and Simons 1983: 334-342.)

2.7.3 The Supraspinatus muscle

The supraspinatus muscle is a rounded muscle which lies deep to the trapezius muscle in the supraspinous fossa. It originates at the medial two thirds of the supraspinous fossa of the scapula and inserts into the superior facet on the greater tubercle of the humerus. This muscle acts to abduct the humerus and holds the head of the humerus in the glenoid cavity. (Moore 1985: 669.)

Three trigger points are located in this muscle. The medial trigger point is located deep to the upper fibres of the trapezius in the supraspinous fossa, just above the spine of the scapula, three centimetres lateral to the vertebral border of the scapula. The lateral trigger point is located in the space between the scapula and the clavicle just medial to the acromion. The third trigger point is located in the tendon of this muscle, under the acromion process. These trigger points refer a deep ache around the shoulder, the mid-deltoid region, down the arm and forearm, to the lateral epicondyle and the wrist. The trigger points are examined with the patient seated or lying on their side opposite the painful trigger point. The medial trigger point is located by flat palpation just above the scapular spine lateral to the vertebral border of the scapula. The lateral trigger point is palpated in the space between the scapula and the clavicle just medial to the acromion. The medial trigger point is needled with the patient lying on the opposite side to

the painful trigger point, and the needle is directed downward into the supraspinous fossa, below and behind the edge of the upper trapezius. The lateral trigger point is needled with the needle angled downward, deep into the supraclavicular fossa, parallel to and behind the rib cage. (Travell and Simons 1983: 368-375.)

2.7.4 The Infraspinatus muscle

The infraspinatus muscle is a triangular muscle which lies in the infraspinous fossa. It originates in the infraspinous fossa and inserts onto the middle facet on the greater tubercle of the humerus. It acts to laterally rotate the humerus and hold the head of the humerus in the glenoid fossa. (Moore 1985: 669.)

Three trigger points are found in this muscle. The main trigger point is located between the vertebral border and the spine of the scapula, inferior to the first quarter of the length of the scapular spine. The lateral trigger point is located inferior to the midpoint of the scapular spine. The third, and least common of these trigger points, is located mid-muscle along the vertebral border of the scapula. These trigger points refer intense pain to the front of the shoulder, deep within the shoulder joint and down the anterlolateral aspect of the arm, lateral forearm and radial side of the hand and fingers. These trigger points are

examined using flat palpation with the patient seated or lying on their side opposite to the painful trigger point. The trigger points are needled with the patient lying on the side opposite the painful trigger point, with their arm abducted to 90 degrees, with the elbow resting on a pillow. The trigger points are trapped between the palpating fingers and needled towards the most painful point, taking care not to puncture the scapular blade, thereby entering the thoracic cage. (Travell and Simons 1983: 376-386.)

2.7.5 The Rhomoid Major and Minor muscles

The rhomboid major and minor are two flat muscles which lie deep to the trapezius muscle. Rhomboid major originates at the spinous process of T2 to T5 and inserts into the medial border of the scapula, inferior to the scapula spine. Rhomboid minor originates at the ligamentum nuchae and spinous processes of C7 and T1 vertebrae and inserts at the medial border of the scapula at the root of the scapular spine. Both muscles act to retract and rotate the scapula and depress the glenoid cavity. (Moore 1985: 664-665.)

Three trigger points are located in these muscles. These trigger points present along the vertebral border and appear as "ropy" bands on palpation. They refer pain along the vertebral border of the scapula, between the scapula and the

paraspinal muscles, and over the supraspinous area of the scapula. The trigger points are examined with the patient seated and slumped with arms hanging forward in order to separate the scapulae. Once the ropy bands have been located and fixed against the chest wall by the examiner, the trigger point is needled directing the needle tangential to the surface, aiming the needle toward a rib to avoid entering an intercostal space. (Travell and Simons 1983: 425-429.)

2.7.6 The Teres Major and Minor muscles

The teres major muscle is a rounded muscle which originates on the dorsal surface of the inferior angle of the scapula and inserts onto the medial lip of the intertubercular groove of the humerus. This muscle acts to adduct and medially rotate the humerus. (Moore 1985: 668.)

Two trigger points are found in this muscle. The medial trigger point is located over the posterior surface of the scapula and the lateral trigger point is located in the posterior axillary fold where the latissimus dorsi wraps around the teres major muscle. Both trigger points refer pain to the posterior deltoid area, over the long head of triceps brachii, into the shoulder joint posteriorly and to the dorsal forearm. The medial trigger point is examined with the patient lying on their side opposite to the painful trigger point, with the upper arm resting on a pillow. Flat palpation is

used to locate the trigger point at the mid-scapular region laterally. The lateral trigger point is examined with the patient lying supine with their arm in 90 degrees abduction and externally rotated. This trigger point is located using pincer palpation over the free border of the posterior axillary fold. The medial trigger point is needled directly into the painful locus of the trigger point. The lateral trigger point is needled in the same position as the examination, and the needle is directed from anterior to posterior, whilst the trigger point is held by the examiner in a pincer grasp. (Travell and Simons 1983: 403-409.)

The teres minor is an elongated muscle which originates at the upper part of the dorsal surface of the lateral border of the scapula and inserts into the inferior facet of the greater tubercle of the humerus. This muscle acts to laterally rotate the humerus and hold the humerus in the glenoid cavity. (Moore 1985: 669.)

The trigger point of the teres minor muscle is located in the lateral edge of the scapula between the infraspinatus and teres major muscles. This trigger point refers pain to the posterior deltoid muscle, the posterior shoulder and arm. The trigger point is examined using flat and pincer palpation, with the patient lying on their side opposite to the painful trigger point with the upper arm resting on a pillow. The trigger point is needled with the patient lying in the same position as

for examination and the needle is directed toward the scapula, whilst the examiner fixes the trigger point between his/her fingers. (Travell and Simons 1983: 387-392.)

CHAPTER THREE

MATERIALS AND METHODS

CHAPTER 3: MATERIALS AND METHODS

3.1 OBJECTIVES OF THE STUDY

This study compared the relative effectiveness of low intensity laser therapy as opposed to dry needling in the treatment of active myofascial trigger points. The purpose of the study was to determine the more effective method of treating active myofascial trigger points, in terms of subjective and objective clinical findings.

The first objective was to evaluate the relative effectiveness of laser therapy as opposed to dry needling on active myofascial trigger points in terms of subjective measures.

The second objective was to evaluate the relative effectiveness of laser therapy as opposed to dry needling on active myofascial trigger points in terms of objective measures.

The third objective was to evaluate the relative effectiveness of laser therapy as opposed to dry needling on active myofascial trigger points in terms of both subjective and objective measures.

3.2 STUDY DESIGN AND PROTOCOL

The study was conducted at The Department of Chiropractic, Technikon Natal, Durban, South Africa.

This study was comparative, unblinded and uncontrolled. Two treatment groups of fifteen subjects each were used. The first group, group A, received dry needling of active myofascial trigger points and the second group, group B, received laser therapy to the active trigger points. The option of a third, placebo group was declined, as it was expected that both treatment groups would derive benefit from the treatments given (Han 1997 22: 1) and (Snyder-Mackler et al. 1989 5: 336).

3.2.1 THE SUBJECTS

A sample size of thirty subjects was selected. Each subject was chosen according to the criteria and delimitations set out in this study. All selected subjects were diagnosed before treatment as suffering from cervical and/or thoracic active myofascial trigger points. The upper thoracic muscles and the muscles of the shoulder girdle containing active myofascial trigger points were treated. Subjective and objective results were measured, analysed and compared.

Five treatments were given to each subject over a two week period, followed by a non-treatment follow-up consultation one month later. If the patient became asymptomatic before the end of the treatment time, no further treatments were given. However, the subjects were still required to present for the remaining treatment sessions for collection of the subjective and objective data. Data was collected from the subjects before the first, third and fifth consultations, as well as at the non-treatment follow-up consultation, one month later.

Human subjects required for this study were recruited by placing adverts in local newspapers. Subjects who presented at the Chiropractic Day Clinic at Technikon Natal, Durban, and who were willing to participate in this clinical trial, were also considered for the study.

3.2.2 CRITERIA AND DELIMITATIONS OF SUBJECT SELECTION

Only subjects between the ages of eighteen and fifty years old were considered for the study. The gender and race of the subject was not taken into account as part of the selection process.

Pregnant and diabetic patients, as well as those using a pacemaker, were excluded from the study. Non-compliant subjects, and those subjects who were

taking or began taking anti-inflammatories, analgesics or muscle relaxants during the study, were also rejected from the study.

Subjects with contra-indications to either treatment offered were excluded from the study. For each of the two treatment groups, their contra-indications were as follows:

a) Contra-indications to low intensity laser therapy include irradiation over an active neoplasm, areas of haemorrhage or hypoaesthesia, infected tissue, over the sympathetic ganglia, the vagus nerves and the cardiac region of the thorax in patients with heart disease and the treatment of patients with obtunded reflexes or cognitive difficulties (Baxter 1994: 58 - 62).

b) Contra-indications to dry needling include patients under the influence of alcohol at the time of the treatment, systemic illness, fever, high anxiety or emotional stress and syncopial reactions (Sola 1984). Potential subjects who indicated during the screening process that they were adverse to the thought of being dry needled were also not accepted onto the study.

3.2.3 DIAGNOSIS OF ACTIVE MYOFASCIAL TRIGGER POINTS

An initial consultation consisting of a full case history (see Appendix B), physical examination (see Appendix C) and cervico-thoracic orthopaedic and neurological examination (see Appendix D) was required to make an accurate diagnosis of active myofascial trigger points.

Myofascial trigger points were clinically detected and diagnosed according to the guidelines set out by Murphy (1989) as follows: The patient was asked to identify the painful area. Then, by manual palpation, the examiner found the area of local tenderness within the muscle (the trigger points). Upon manual compression of that tender area, the subject reported referred pain, and a local twitch response within the muscle was observed (seen by the examiner or felt by the subject or examiner). Whilst palpating the trigger point, the examiner produced a jump sign by the subject.

3.2.4 MUSCLE GROUPS THAT WERE TREATED

The study was limited to the treatment of active myofascial trigger points within the Trapezius, Levator Scapulae, Rhomboid Major, Rhomboid Minor, Supraspinatus,

Infraspinatus, Teres Major and Teres Minor muscles.

In the case where more than one active myofascial trigger point existed in a muscle, only the most symptomatic trigger point was treated. In the case where more than one muscle contained an active myofascial trigger point, the most symptomatic trigger points were assessed and a maximum of three of the most symptomatic trigger points were treated. The same trigger points located at the first consultation were treated at subsequent visits. No new active trigger points were treated, even if they became more symptomatic than the original trigger points chosen for treatment. This would prevent collection of false information from the subject by the author, as the objective of this study was to monitor the progression / regression of the original (presenting) trigger points as at the first consultation, and not a new complaint which may have arisen at a later date.

3.2.5 THE DATA

Primary and secondary data were collected for this study.

3.2.5.1 PRIMARY DATA

Primary data was collected by obtaining :

a) the subject's case history (Appendix B)

b) an objective examination of the subject, including physical examination (Appendix C) and cervical orthopaedic and neurological examinations (Appendix D)

c) the Numerical Rating Scale (NRS) (Appendix F)

d) the CMCC Neck Disability Index (Appendix E)

e) Algometer readings (Appendix G).

The primary data collected was used only if the subject under study satisfied all the criteria and delimitations set out in this study, completed the entire research program and if the questionnaires completed by the subject were completed correctly under supervision of the author.

3.2.5.2 SECONDARY DATA

Secondary data was obtained from relevant books, journals and periodicals. The secondary data was collected from the library at Technikon Natal and via inter-library loans.

3.2.6 THE SAMPLE

The sample size was limited to thirty subjects, as well as four additional subjects in case of subject drop-out or non-compliance of the subjects in this study. All subjects were given an "informed consent form" and "patient information sheet" (see Appendix A) which outlined the purposes and procedures of the study and possible hazards of the treatment. The subjects were asked to sign this form before treatment was administered. The sample was divided equally into two groups of fifteen subjects each by means of the random sampling method.

The random sampling method involves using thirty pieces of paper with fifteen having 'laser' written on them, and the remaining fifteen having 'needling' written on them. All thirty pieces were placed in a box. As subjects entered the study they were required to draw a piece of paper from the box. The piece of paper drawn indicated the type of treatment that that subject was to receive. Subjects were numbered according to the chronological order of presentation.

The subjects receiving dry needling were allocated to Group A. The subjects receiving laser therapy were allocated to Group B.

3.2.7 APPLICATION OF TREATMENTS

Provided that the subject fulfilled the research criteria and was diagnosed as having active myofascial trigger points, treatment was given at the initial consultation, followed by four treatments given within a two week period (Laakso et al. 1994). One month after the last treatment, a non-treatment follow-up consultation was held in order to assess the long term efficacy of the laser and dry needling treatments, in terms of the subjective and objective responses by the subjects.

Subjects in Group A were treated with dry needling by the author. This included pre-treatment sterilisation of the area of skin to be punctured by the needle by swabbing the skin with 90% ethanol solution. This was followed by the single insertion of a disposable acupuncture needle (stainless steel shaft with a copper coil finger grip superiorly) into the point of maximal tenderness of the identified active myofascial trigger point. (Lewit 1979.) The single insertion of the acupuncture needle was in accordance with the technique outlined by Hubbard and Berkoff (1993). One needle was used to treat the trigger points (maximum of three trigger points) found at the time of consultation, and then appropriately disposed of. (Techniques for the dry needling of individual trigger points are described in Chapter 2 (pages 21-30) of this study.)

Subjects in Group B were treated with application, by the author, of a continuous laser output for a duration of twenty seconds per trigger point, at a maximum intensity of 0,95 mW/sq.cm directly over each trigger point (Snyder-Mackler et al. 1989.) The stylus aperture of the laser unit was hand-held by the author and remained stationary between 0 and 1mm from the skin. No pressure was placed on the skin by the stylus aperture. (Snyder-Mackler et al. 1989.) The Laser unit used in this study was the Medilaser De Luxe supplied by Chris Engineering Industries cc, Cape Town, South Africa.
(Address: Chris Engineering Industries cc, P.O. Box 370, Howard Place, Cape Town, South Africa).

Subjects were expected to attend all consultations as set out in the research protocol even if they became asymptomatic; in which case, they did not receive treatment but continued to be assessed for subjective and objective clinical findings at the designated consultations.

3.2.8 DATA COLLECTION

3.2.8.1 SUBJECTIVE DATA

Subjective pain questionnaires were completed by the subject before the first, third and fifth treatments, as well as at the non-treatment follow-up consultation one month later. These questionnaires included the

a) Numerical Rating Scale (Jenson et al. 1986)(see Appendix F) and the

b) CMCC Neck Disability Index (Vernon and Moir 1991)(see Appendix E)

and were completed by the subject under the supervision of the author.

3.2.8.1.1 THE NUMERICAL RATING SCALE (NRS)

This is a subjective questionnaire (Jenson et al. 1986) whereby the subjects estimated their levels of pain prior to the first, third and fifth treatments and at the final follow-up consultation one month later. This data showed the progress or regress of the subjects' pain levels through the study.

The scale considers numbers between zero and one hundred. Zero indicates "no pain" and one hundred indicates "pain as bad as it could be". The patient was

asked to choose a number between zero and one hundred that best described their pain at the time of consultation. The NRS was chosen for its ease of application and scoring, with proven validity and practicality (Jenson et al. 1986.)

3.2.8.1.2 THE CMCC NECK DISABILITY INDEX

This questionnaire demonstrates the effect of the patient's cervical and/or thoracic pain on their everyday living abilities. The questionnaires were completed prior to the first, third and fifth treatments and at the final follow-up consultation one month later. The subjects were asked to complete the answers with regards to pain or disability suffered at the time of consultation.

Vernon and Moir (1991) demonstrate the reliability and validity of this questionnaire and show its impartiality to a wide range of age and gender.

3.2.8.2 OBJECTIVE DATA

The objective clinical findings (the algometer readings) were measured by the author before the first, third and fifth treatments, as well as at the non-treatment follow-up consultation one month later. This included the measurement of pain tolerance by the subject, to pressure exerted over an active myofascial trigger

point with the Pressure Algometer (Fischer 1987)(see Appendix G).

3.2.8.2.1 THE PRESSURE ALGOMETER

A pre-treatment measurement of the subjects' tolerance to pressure exerted by the algometer directly over the active myofascial trigger point, was recorded in order to assess the relative change of pressure tolerance by the subject over the treatment period. An increase in tolerance to pressure by the subject indicated an increased tolerance to pain and, therefore, an improvement in the subject's condition. A decrease in tolerance to pressure by the subject indicated a decreased tolerance to pain and, therefore, a worsening in the subject's condition.

Each active myofascial trigger point selected for treatment was measured for sensitivity to pressure before the first, third and fifth treatments and at the final consultation one month later (one measurement per trigger point, per consultation). Thus up to three algometer measurements were taken per consultation. These measurements were added together at the end of each consultation and an average score was calculated for that consultation. These results were used to compare inter- and intra group data for the first, third, fifth

and final consultations. The reliability of the algometer in detecting and assessing pain sensitivity by pressure threshold measurement is described by Fischer (1987).

The Pressure Algometer used in this study was the Wagner Force Dial FDK 20 (10kg x 100gr.) supplied by Wagner Instruments, Greenwich, CT 06836, U.S.A.

3.2.9 STATISTICAL ANALYSIS OF DATA

3.2.9.1 The sample size of the study

The sample size was thirty subjects and there were two groups used in this study. Group A consisted of fifteen subjects who were treated with dry needling. Group B consisted of fifteen subjects who were treated with laser.

Three clinical experiments were done: the CMCC Neck Disability Index (CMCC), the Numerical Rating Scale (NRS) and Algometer readings (Alg) were taken. For each clinical experiment, readings were taken four times (before the first, third and fifth consultations and at the final consultation).

The CMCC is a categorical variable as it is measured in an ordinal scale that varies from 1 to 7. The NRS and Algometer readings are continuous variables and are measured in percentages.

With the integration of the data obtained from the subjective and objective clinical findings, an indication was given to determine which of the two treatments was more effective in the treatment of active myofascial trigger points. This was an integration of objectives one, two and three as set out in the beginning of this chapter.

Demographic information was also collected from each subject in this study regarding age, sex, race and occupation.

The statistical package SPSS was used for data entry and analysis. The referenced text for statistics used in this study was that of Fisher (1993.)

3.2.9.2 The use of parametric and non-parametric tests for statistical analyses

The continuous variables (NRS and Alg) were analysed using parametric methods, while categorical variables (CMCC) were analysed using non-

parametric methods, regardless of the sample size per group.

Procedure 1.1 **Comparison between Groups A and B with respect to continuous variables**

The two-sample unpaired t-test was used to compare Groups A and B with respect to the NRS and Algometer readings. Included in this study were the following tests: Mean Scores, Standard Deviation Scores, Standard Error Mean Scores, comparison of group variances using Levene's test and the two-sample unpaired t-test for the equality of means.

The null hypothesis stated that there was no statistically significant difference between Groups A and B with respect to the variable of comparison at the $\alpha = 0.05$ level of significance. **The alternative hypothesis** stated that there was a statistically significant difference at the same level of significance.

The decision rule: The null hypothesis would be rejected if $p < \alpha$, where p is the observed significance level or probability value. Otherwise, the null hypothesis would be accepted at the same level.

Procedure 1.2 **Comparison between Groups A and B with respect to categorical variables**

The Mann-Whitney-U test was used to compare Groups A and B with respect to the CMCC.

the CMCC.

The null hypothesis stated that there was no statistically significant difference between Groups A and B with respect to the variable of comparison at the α = 0.05 level of significance. **The alternative hypothesis** stated that there was a statistically significant difference at the same level of significance.

The decision rule: The null hypothesis would be rejected at the a level of significance if $p < \alpha$, where p is the observed significance level or probability value. Otherwise, the null hypothesis would be accepted at the same level.

Procedure 2.1 Comparison between related samples within Group A with respect to continuous variables (NRS and Alg.)

The two-sample paired t-test was used to compare results from related samples with respect to the NRS and the Algometer readings. Included in this analysis was the two-sample paired t-test to compare two related samples.

In each test, **the null hypothesis** stated that there was no statistically significant improvement between the two related samples being compared, at the a level of significance. **The alternative hypothesis** stated there was a statistically

significant improvement.

The decision rule: The null hypothesis would be rejected at the a level of significance if $p < \alpha$, where p is the observed significance level or probability value. Otherwise, the null hypothesis would be accepted at the same level.

Procedure 2.2 **Comparison between related samples within Group A with respect to categorical variables (CMCC)**

The Wilcoxon signed-ranks test was used to compare results from related samples with respect to the CMCC.

In each test, **the null hypothesis** stated that there was no statistically significant improvement between two related samples being compared, at the $\alpha = 0.05$ level of significance. **The alternative hypothesis** stated there was a statistically significant improvement.

The decision rule: The null hypothesis would be rejected at the a level of significance if $p < \alpha$, where p is the observed significance level or probability value. Otherwise, the null hypothesis would be accepted at the same level.

Procedure 3.1 **Comparison between related samples within Group B with respect to categorical variables (NRS and Alg)**

Procedure 2.1 was repeated within Group B with the same decision rule.

Procedure 3.2 **Comparison between related samples within Group B with respect to categorical variables (CMCC)**

Procedure 2.2 was repeated within Group B with the same decision rule.

Procedure 4 **Averages and variances for continuous variables (NRS and Alg)**

Averages will be needed for construction of barcharts. Averages and variances will be used for power analysis. Included in this study are the summary statistics.

Procedure 5 **Comparison using barcharts**

Visual summaries of analytical findings will be given by use of barcharts to compare Groups A and B with respect to each variable of study. Average and median readings will be used to make barcharts.

Procedure 6 **Power analysis for continuous variables (NRS and Alg)**

Power analysis will be done for continuous variables only. Power analysis is a measure of how sensitive a test is. The power of a test depends on the size of the sample, the accuracy of the measurements involved in the study and the level of significance of the study, α. The smaller the power of the test, the larger becomes the likelihood of a Type II error (accepting a false null hypothesis). (Portney 1993.)

Procedure 7 **Frequencies, percentages and barcharts for demographic variables**

Frequencies, percentages and barcharts will be obtained for each of the two groups on the basis of the demographic variables of age, sex, race and occupation. Demographic data was collected at the time of taking the subjects' case history (Appendix B), before the first treatment.

CHAPTER FOUR

RESULTS

CHAPTER 4 : RESULTS

Objective and subjective primary data were collected in this study and analysed statistically.

The data is described under the following headings.

4.1 **The CMCC Neck Disability Index** (subjective data)

4.2 **The Numerical Rating Scale** (subjective data)

4.3 **The Algometer readings** (objective data)

4.4 **The Demographic data**

Statistical analyses included parametric tests for the continuous variables (NRS and Alg) and non-parametric tests for the catagorical variable (CMCC). The parametric tests included the two-sample unpaired t-test for intergroup analysis and the two-sample paired t-test for intra-group analysis. Non-parametric tests included the Wilcoxon signed-ranks test for intra-group comparisons and the Mann-Whitney-U test for inter-group comparisons. The tests were conducted at a 5% level of significance, with a 95% confidence interval ($p < 0.05$).

Abbreviations to be used in the presentation of data analysis

CMCC= The CMCC Neck Disability Index

NRS = The Numerical Rating Scale

Alg. = Algometer

NS = no significant difference

S = significant difference

l.o.s. = level of significance (5% in this study)

K1 = represents the reading obtained for CMCC at the first consultation

K2 = represents the reading obtained for CMCC at the third consultation

K3 = represents the reading obtained for CMCC at the fifth consultation

K4 = represents the reading obtained for CMCC at the final consultation

K5 = represents the reading obtained for NRS at the first consultation

K6 = represents the reading obtained for NRS at the third consultation

K7 = represents the reading obtained for NRS at the fifth consultation

K8 = represents the reading obtained for NRS at the final consultation

K9 = represents the reading obtained for Alg. at the first consultation

K10 = represents the reading obtained for Alg. at the third consultation

K11 = represents the reading obtained for Alg. at the fifth consultation

K12 = represents the reading obtained for Alg. at the final consultation

Where K1-12 is followed by an A or B this means that, of the K group mentioned, the group is either from the dry needling treatment (A) or the laser treatment (B). For example, K10A means that of the algometer readings obtained at the third consultation, the subjects were in the dry needling group.

4.1 THE CMCC NECK DISABILITY INDEX (CMCC)

The Mann-Whitney-U test was used to compare two independent (unpaired) groups with catagorical variables (for the CMCC). This is an inter-group comparison of the data.

The following procedures were explained in Chapter 3, Procedure 1.2 (page 48).

Table 4.1. A Results for the Mann-Whitney-U test for the CMCC (Procedure 1.2)

	K1 A & B	K2 A & B	K3 A & B	K4 A & B
Mann-Whitney -U test	77.000	90.500	100.500	91.000
p-value	0.418	0.367	0.624	0.389

When comparing Groups A and B for the first, third, fifth and final consultations, no statistically significant difference between any of the treatments was noted. This indicates that, for each treatment, the degree of change of the subjects' condition was relative in both groups A and B and, thus, the p-values showed no significant change with respect to the CMCC at the 5% level of significance.

The following procedure was explained in Chapter 3, Procedure 2.2 (Page 50)

The Wilcoxon Signed-Ranks test was used to compare two related (paired) groups with catagorical variables (for the CMCC). This is an intra-group comparison of the data.

Table 4.1 B The Wilcoxon signed-ranks test to compare related samples within Group A for the CMCC (Procedure 2.2)

Pairs	p-value	Improvement
Pair 1 K1A & K2A	0.002	improvement
Pair 2 K1A & K3A	0.001	improvement
Pair 3 K1A & K4A	0.003	improvement
Pair 4 K2A & K3A	0.006	improvement
Pair 5 K2A & K4A	0.026	improvement
Pair 6 K3A & K4A	0.725	no improvement

At the 5% level of significance, a statistically significant improvement was noted when comparing the first and third (K1A and K2A), the first and fifth (K1A and K3A), the first and final consultations (K1A and K4A), as well as the third and fifth (K2A and K3A) and third and final (K2A and K4A) consulations. However, no statistically significant improvement was seen between the fifth and final (K3A and K4A) consultations with respect to the CMCC. These results show a statistically significant, progressive improvement from the first through fifth treatments.

The following procedure was explained in Chapter 3, Procedure 3.2 (Page 51)

Table 4.1 C The Wilcoxon signed-ranks test to compare related samples within Group B for the CMCC (Procedure 3.2)

Pairs	p-value	Improvement
Pair 1 K1B & K2B	0.013	improvement
Pair 2 K1B & K3B	0.001	improvement
Pair 3 K1B & K4B	0.001	improvement
Pair 4 K2B & K3B	0.001	improvement
Pair 5 K2B & K4B	0.002	improvement
Pair 6 K3B & K4B	0.089	no improvement

At the 5% level of significance, a statistically significant improvement was noted when comparing the first and third (K1B and K2B), the first and fifth (K1B and K3B), the first and final consultations (K1B and K4B), as well as the third and fifth (K2B and K3B) and third and final (K2B and K4B) consulations. However, no significant improvement was seen between the fifth and final (K3B and K4B) consultations with respect to the CMCC. These results show a significant, progressive improvement from the first through fifth treatments.

4.2 THE NUMERICAL RATING SCALE (NRS)

Introduction: The two-sample unpaired t-test was used to compare two independent groups with continuous variables (NRS and Alg.). This was an inter-group comparison of the data. The two sample paired t-test was used to compare data within each group. This was an intra-group comparison of the data.

The following procedure was explained in Chapter 3, Procedure 1.1 (page 48).

Table 4.2. A NRS Mean Scores, Standard Deviations and Standard Mean Errors (Procedure 1.1)

Group	Mean	Standard Deviations	Standard Mean Errors
K5A	54.6667	23.7146	6.1231
K5B	54.5333	23.1235	5.9705
K6A	38.6667	23.2584	6.0053
K6B	41.6000	23.2496	6.0030
K7A	27.3333	24.2389	6.2585
K7B	30.2000	18.8914	4.8777
K8A	26.9667	28.2871	7.3037
K8B	23.1333	14.6183	3.7744

The mean scores showed that, at the first consultation (K5A and B), both groups were similar with respect to subjective pain as rated on the NRS. However, at the third consultation (K6A and B), the scores for both groups had decreased considerably, indicating that the rate of improvement by the subjects was greater

in Group A (dry needling). Again, at the fifth consultation (K7A and B), further improvement in subjective pain was seen, with a relatively greater improvement in Group A. At the final consultation (K8A and B) one month later, scores reflected that a further improvement was seen in Group A. However, Group B (Laser) showed greater overall improvement over Group A. Comparison of the scores of the first and final consultations, showed that the subjective pain of the patient had decreased by almost 50%

.

The results of the standard deviation for the NRS showed that for the first and third consultations, the standard deviation for Groups A and B were similar. However, at the fifth and final consultations, the standard deviation of Group A was considerably greater than Group B. The latter results indicate that Group B had a more uniform response to the treatment than did Group A.

The standard error mean scores of the NRS reflect that the scores remained fairly constant from first through final treatments in Group A. In Group B the scores varied, with an overall decrease in the mean standard error. There was also a difference between the fifth (K7) and final (K8) scores between Groups A and B. Group B showed less standard mean error. This indicated that the subjects in Group B had a more consistant response to treatment than those in

Group A. The responses of the subjects in Group A appeared more eratic than Group B despite showing great improvement when considering the means for both groups.

Table 4.2 B NRS : Comparison of group variances using Levene's test (Procedure 1.1)

Levene's test was conducted to test the equality of variances and is shown in this section for interest only. These test were conducted at the 5% level of significance (95% Confidence Interval).

	p-value	Equality of variances
K5	0.601	equal variances assumed
K6	0.725	equal variances assumed
K7	0.137	equal variances assumed
K8	0.005	equal variances not assumed

Levene's test showed that, on comparison of Groups A and B at the first (K5), third (K6) and fifth (K7) consultations, the two groups showed no statistically significant difference. However, at the final consultation (K8), a statistically significant difference was shown and equal variances were not assumed with respect to the NRS. Thus it was concluded that, at the first, third and fifth consultations, the rate of progression was not at the same rate; but that at the final consultation, the progression of treatments was at the same rate for Groups A and B.

Table 4.2 C NRS : The two sample unpaired t-test for the equality of means (Procedure 1.1)

The two sample unpaired t-test was used to test the equality of means and to show inter-group comparisons between Groups A and B. These tests were conducted at a 5% level of significance.

Groups	K5A and B	K6A and B	K7A and B	K8A and B
p-values	0.988	0.732	0.721	0.645
Equality of variances	equal variances assumed	equal variances assumed	equal variances assumed	equal variances not assumed

The two sample unpaired t-test for the NRS showed no statisically significant difference between Groups A and B at the first (K5), third (K6), fifth (K7) and final (K8) consultations. At the final consultation (K8), equal variances were not assumed for Groups A and B. (See table 4.2 B, where Levene's test showed that for K8, equal variances were not assumed and the p-value was 0.005). In conclusion, there is no statisically significant difference between Groups A and B with respect to the NRS at the 5% level of significance (α=0.05).

The following procedure was explained in Chapter 3, Procedure 2.1 (page 49).

Table 4.2 D The two sample paired t-test to compare two related samples within Group A for the NRS (Procedure 2.1)

Pairs	p-value	Significance
Pair 1 K5A & K6A	0.031	S
Pair 2 K5A & K7A	0.001	S
Pair 3 K5A & K8A	0.011	S
Pair 4 K6A & K7A	0.041	S
Pair 5 K6A & K8A	0.137	NS
Pair 6 K7A & K8A	0.952	NS

The two sample paired t-test for Group A showed a statistically significant improvement between the first and third (K5A and K6A), the first and fifth (K5A and K7A), the first and final (K5A and 8A) and the third and fifth (K6A and K7A) consultations. However, there was no statistically significant difference between the third and fifth (K6A and K7A) and the fifth and final (K7A and K8A) consultations. Thus it was concluded that a statistically significant improvement (See table 4.2A: Mean scores for the NRS) was shown by the NRS at the third and fifth consultations, but that no further statistically significant improvement was shown at the final consultation one month after the last treatment.

The following procedure was explained in Chapter 3, Procedure 3.1 (Page 51)

Table 4.2 E The two sample paired t-test to compare two related samples within Group B for the NRS (Procedure 3.1)

Pairs	p-value	Significance
Pair 1 K5B & K6B	0.027	S
Pair 2 K5B & K7B	0.000	S
Pair 3 K5B & K8B	0.000	S
Pair 4 K6B & K7B	0.003	S
Pair 5 K6B & K8B	0.002	S
Pair 6 K7B & K8B	0.054	NS

The two sample paired t-test for Group B showed a statistically significant improvement between the first and third (K5B and K6B), the first and fifth (K5B and K7B), the first and final (K5B and K8B), as well as between the third and fifth (K6B and K7B) and the third and final (K6B and K8B) consultations. However, no statistically significant difference was shown between the fifth and final (K7 and K8) consultations. Thus it can be concluded that, for Group B, a statistically significant improvement in the NRS scores was noted from the first to the fifth consultations. However, there was no statistically significant change between the fifth and final consultations, indicating no further improvement (or regression) of the subjects NRS scores from the fifth to the final consultations.

The following summary statistics were explained in Chapter 3, Procedure 4 (Page 51)

Table 4.2 F Summary statistics for NRS readings (Procedure 4)

	Average (mean)	Variance
K5A	54.6667	562.381
K5B	54.5333	534.695
K6A	38.6667	540.952
K6B	41.6000	540.543
K7A	27.3333	587.524
K7B	30.2000	356.886
K8A	26.9667	800.160
K8B	23.1333	213.695

The summary statistics included the averages (mean) and the variances. The means were discussed in Table 4.2 A and are shown here for convenience only.

Comparison between Groups A and B, showed similar means for each group at commencement of the study with respect to the NRS and, that by the fifth and final consultations, the mean had decreased by almost 50%, indicating an improvement in the subjects' condition from the first through final consultations.

At the first consultation, Group A showed a greater variance than Group B. At the third consultation, Groups A and B showed equal variances. The variance for Group A was greater at the fifth consultation relative to the first consultation, and greater still at the final consultation. The variance for Group B was lower at the fifth consultation relative to the first consultation, and lower still at the final consultation.

The results of the final consultation indicated a significant improvement in the subjects' condition with respect to the NRS and showed that Group B had an overall lower mean than group A. A great increase in the variance of Group A was shown, while a more modest, yet very significant fall in the variance of Group B was noted, showing a more constant improvement in the condition of the subjects' in response to the laser treatment. Thus group B had a better response to treatment.

The following procedure was explained in Chapter 3, Procedure 6 (Page 52).

Table 4.2 G Power analysis for NRS statistics (Procedure 6)

	Power of test
K5A vs K5B	0.0500
K6A vs K6B	0.0616
K7A vs K7B	0.0578
K8A vs K8B	0.3516

Power analysis tests the probability of falsely accepting the null hypothesis when the null hypothesis is, in fact, false.

The results of the power analysis comparing Groups A and B at the first, third, fifth and final consultations showed relatively weak values. The results of these

statistics should therefore not be considered absolute, and it must be considered that a Type II error may have been made in this study. A lesser confidence interval or a much greater sample size might be used in order to strengthen the power of these tests.

4.3 The Algometer Readings (Alg)

Introduction: The two sample unpaired t-test was used to compare two independent groups with continuous variables (NRS and Alg.) This was an inter-group comparison of the data. The two sample paired t-test was used to compare data within each group. This was an intra-group comparison.

The following procedures were explained in Chapter 3, Procedure 1.1 (page 48).

Table 4.2. A Algometer Mean Scores, Standard Deviations and Standard Mean Errors (Procedure 1.1)

Group	Mean	Standard Deviations	Standard Mean Errors
K9A	2.4120	0.9219	0.2380
K9B	2.5987	1.0614	0.2741
K10A	3.0853	1.5530	0.4010
K10B	2.8747	0.9550	0.2466
K11A	3.5713	1.6708	0.4314
K11B	3.0787	0.9988	0.2579
K12A	4.3673	2.2581	0.5830
K12B	3.4600	0.9404	0.2428

The mean scores show that, at the first consultation (K9 A and B), both were similar in terms of subjective pain as measured with the pressure algometer. At the third consultation (K10 A and B), the scores for both groups had increased slightly (more so for group A than B), indicating that there was an improvement in the subjects' condition. Again, at the fifth consultation (K11 A and B), another improvement in subjective pain is shown, with a relatively greater improvement in Group A. At the final consultation (K12 A and B) one month later, scores reflected further improvement in Groups A and B. The readings show that Group A (dry needling) showed a better response to treatment than Group B with respect to the pressure algometer reading scores. It is also shown that the objective tolerance to pressure over the trigger points by the patient had increased by almost 50% from the first through final consultations.

The results of the standard deviation for the algometer readings show an increasing value for Group A from first through final consultations. The standard deviation for Group B showed a more consistant pattern and remained fairly similar throughout the study. The latter results indicate that the subjects in Group B had a more uniform response to the treatment than did Group A.

The standard error mean scores of the Algometer readings reflect that the scores remained fairly constant from first through final treatments in Group B, and,

that in Group A, the scores varied, with an overall decrease in the mean standard error. There was also a relatively notable difference between the third (K10A) and fifth (K11A) scores. Group B showed less standard mean error. This indicated that the subjects in Group B had a more consistant response to treatment than those in Group A. The responses of the subjects in Group A appeared more erratic than Group B despite showing great improvement when considering the means for both groups.

Table 4.3 B Comparison of group variances using Levene's test for the Algometer readings (Procedure 1.1)

Levene's test was conducted to test the equality of variances and is shown in this section for interest only.

	p-value (at 5% l.o.s)	Equality of variances
K9 A & B	0.118	equal variances assumed
K10 A & B	0.177	equal variances assumed
K11 A & B	0.171	equal variances assumed
K12 A & B	0.043	equal variances not assumed

Levene's test showed that a comparison of Groups A and B at the first (K9A & B), third (K10A & B) and fifth (K11A & B) consultations showed no statistically significant difference. However, at the final consultation (K12A & B), there was a statistically significant difference between the two groups and equal variances

were not assumed with respect to the algometer readings. Thus, it can be concluded that at the first, third and fifth consultations the rate of progression was at the same rate, but, that at the final consultation, there was a statistically significant difference in the rate of progression of treatments for Groups A and B.

Table 4.3 C The two sample unpaired t-test for the equality of means for the Algometer readings (Procedure 1.1)

The two sample unpaired t-test was used to test the equality of means and to show inter-group comparisons between Groups A and B. These test were conducted at a 5% level of significance.

Groups	K9 A and B	K10 A and B	K11 A and B	K12 A and B
p-values	0.611	0.658	0.335	0.162
Equality of variances	equal variances assumed	equal variances assumed	equal variances assumed	equal variances not assumed

The two sample unpaired t-test for the algometer readings showed no statisically significant difference between Groups A and B at the first (K9A &B), third (K10A & B), fifth (K11A & B) and final (K12A & B) consultations. At the final consultation (K12A & B), equal variances were not assumed for Groups A and B (See table 4.3 B where Levene's test showed that for K12A and B equal variances were not

assumed and the p-value was 0.043). In conclusion, there is no statisically significant differrence between Groups A and B with respect to the Algometer readings, at the 5% level of significance (α=0.05).

The following procedures were explained in Chapter 3, Procedure 2.1 (Page 49)

Table 4.3 D The two-sample t-test to compare two related samples within Group A for the Algometer (Procedure 2.1)

Pairs	p-value	Significance
Pair 1 K9A & K10A	0.045	S
Pair 2 K9A & K11A	0.003	S
Pair 3 K9A & K12A	0.001	S
Pair 4 K10A & K11A	0.040	S
Pair 5 K10A & K12A	0.007	S
Pair 6 K11A & K12A	0.047	S

The two sample paired t-test for Group A showed a statistically significant improvement between all consultations. (The improvement is shown in Table 4.3A: Mean scores for the Algometer readings.)

The following procedure was explained in Chapter 3, Procedure 3.1 (Page 51)

Table 4.3 E The two sample paired t-test to compare two related samples within Group B for the Algometer readings (Procedure 3.1)

Pairs	p-value	Significance
Pair 1 K9B & K10B	0.323	NS
Pair 2 K9B & K11B	0.068	NS
Pair 3 K9B & K12B	0.002	S
Pair 4 K10B & K11B	0.275	NS
Pair 5 K10B & K12B	0.005	S
Pair 6 K11B & K12B	0.051	NS

The paired samples test for Group B showed that a statistically significant improvement was seen between the first and final (K9B and K12B) and the third and final (K10B and K12B) consultations. However, no significant difference was shown between the first and third (K9B and K10B), the first and fifth (K9B and K11B), the third and fifth (K10B and K11B) and between the fifth and final (K11B and K12B) consultations. This indicated that the treatment response was best (statistically significant) between the first and final (K9B) and between the third and final (K10B) consultations, with respect to the algometer readings.

The following summary statistics were explained in Chapter 3, Procedure 4 (Page 51)

Table 4.3 F Summary statistics for Algometer readings

(Procedure 4)

	Average (mean)	Variance
K9A	2.4120	0.850
K9B	2.5987	1.127
K10A	3.0853	2.412
K10B	2.8747	0.912
K11A	3.5713	2.791
K11B	3.0787	0.998
K12A	4.3673	5.099
K12B	3.4600	0.884

The summary statistics included the averages (mean) and the variances. The means were discussed in Table 4.3 A and are shown here for convenience only.

Comparison between Groups A and B, showed similar means for each group at commencement of the study with respect to the algometer readings and that, by the fifth and final consultations, the mean had decreased by almost 50%, indicating an improvement in the subjects' condition from the first through final consultations.

Comparison between Groups A and B showed that the variances for the first consultations were greater in Group B than in Group A. The variance for Group A increased at every consultation thereafter, indicating an increased variation from the mean and that the results varied considerably from the average readings. The

variance for Group B showed an overall decrease throughout the treatment and follow-up periods. This indicated that Group B showed a much more consistant and uniform response to treatment with respect to the algometer readings.

The following summary statistics were explained in Chapter 3, Procedure 6 (Page 52)

Table 4.3 G Power analysis for Algometer statistics (Procedure 6)

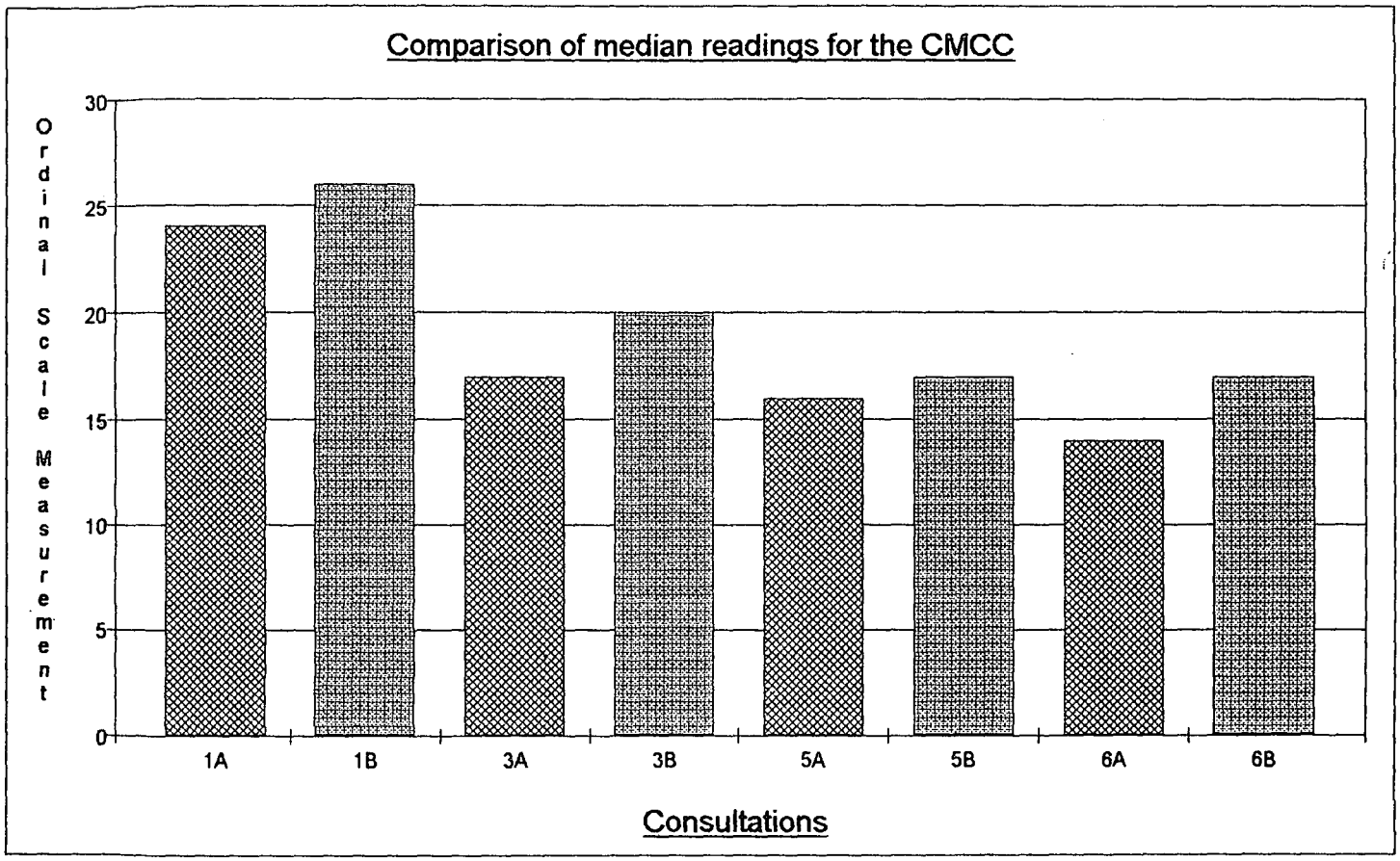
	Power of test
K9A vs K9B	0.0764
K10A vs K10B	0.0696
K11A vs K11B	0.1493
K12A vs K12B	0.2735

Power analysis tests the probability of falsely accepting the null hypothesis when the null hypothesis is, in fact, false.

The results of these tests comparing Groups A and B at the first, third, fifth and final consultations show an increased probability of a Type II error for this study. The results of these statistics should not be considered absolute, and that either a lesser confidence interval be employed in future analyses or a much greater sample size be used in future studies in order to strengthen the power of these tests.

Graph 4.1

Barchart to show the comparison of median readings with respect to the CMCC (Procedure 5)

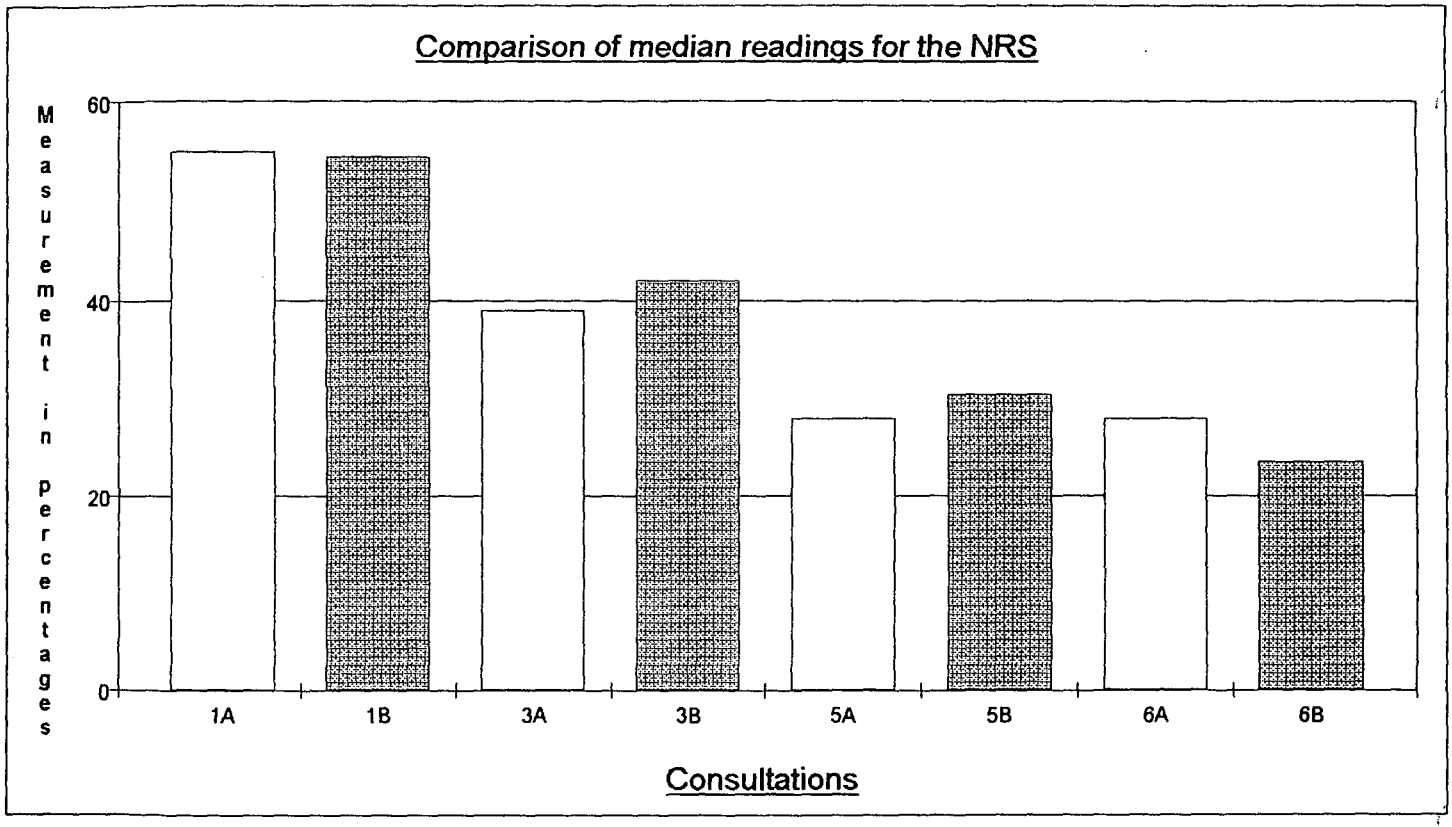


Key used on the X-axis

1A = Group A: first consultation
1B = Group B: first consultation
3A = Group A: third consultation
3B = Group B: third consultation
5A = Group A: fifth consultation
5B = Group B: fifth consultation
6A = Group A: final consultation
6B = Group B: final consultation

Graph 4.2

Barchart to show the comparison of median readings with respect to the NRS (Procedure 5)

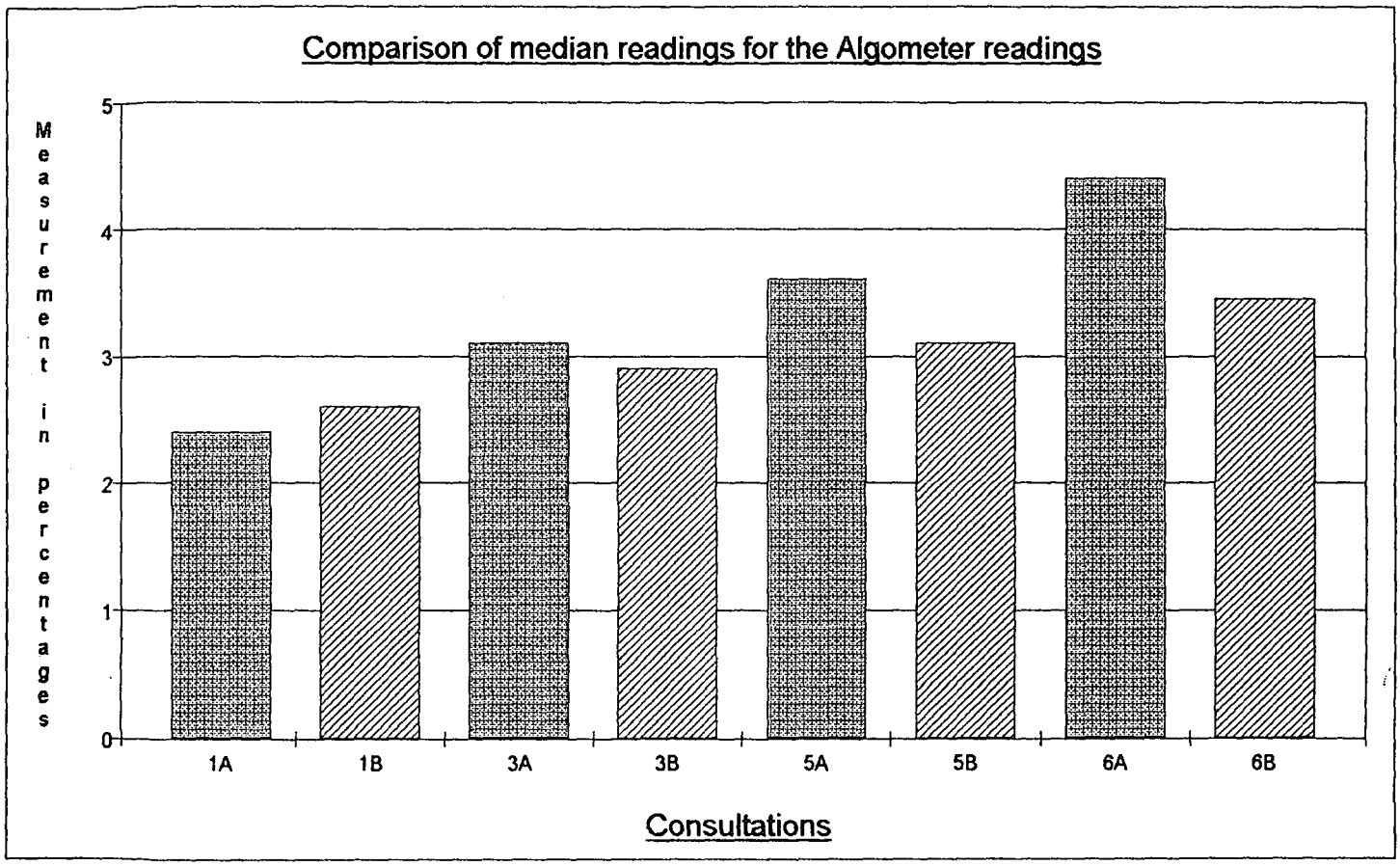


Key used on the X-axis

1A = Group A: first consultation
1B = Group B: first consultation
3A = Group A: third consultation
3B = Group B: third consultation
5A = Group A: fifth consultation
5B = Group B: fifth consultation
6A = Group A: final consultation
6B = Group B: final consultation

Graph 4.3

Barchart to show the comparison of median readings with respect to the Algometer readings (Procedure 5)



Key used on the X-axis

1A = Group A: first consultation
1B = Group B: first consultation
3A = Group A: third consultation
3B = Group B: third consultation
5A = Group A: fifth consultation
5B = Group B: fifth consultation
6A = Group A: final consultation
6B = Group B: final consultation

4.4 THE DEMOGRAPHIC DATA OF THE SUBJECTS

Table 4.4. A: Age group ranges of subjects

Range	20-29	30-39	40-49	50
Number of patients	15	9	5	1
n = 30				

Subjects were aged from 20 to 50. The average age was 31 years old, and most of the subjects were in the 20 to 29 age group range (50%).

Table 4.4. B: Gender groups of the subjects

	Male	Female
Group A	9	6
Group B	2	13
Total	11	19

Of a sample size of thirty patients, 11 (36.7%) of the subjects were male and the majority, 19 (63.3%) of the subjects were female.

Table 4.4. C: Race groups of the subjects

	Group A	Group B	Total
White	8	8	16 (53.3%)
Black	0	1	1 (3.3%)
Coloured	1	0	1 (3.3%)
Indian	5	6	11 (36.7%)
Chinese	1	0	1 (3.3%)

Subjects were from five different race groups. Most of the patients were White (53,3%), followed by Indian (36,7%). These subjects were randomly allocated into Groups A and B, and show to have been equally distributed among the two groups.

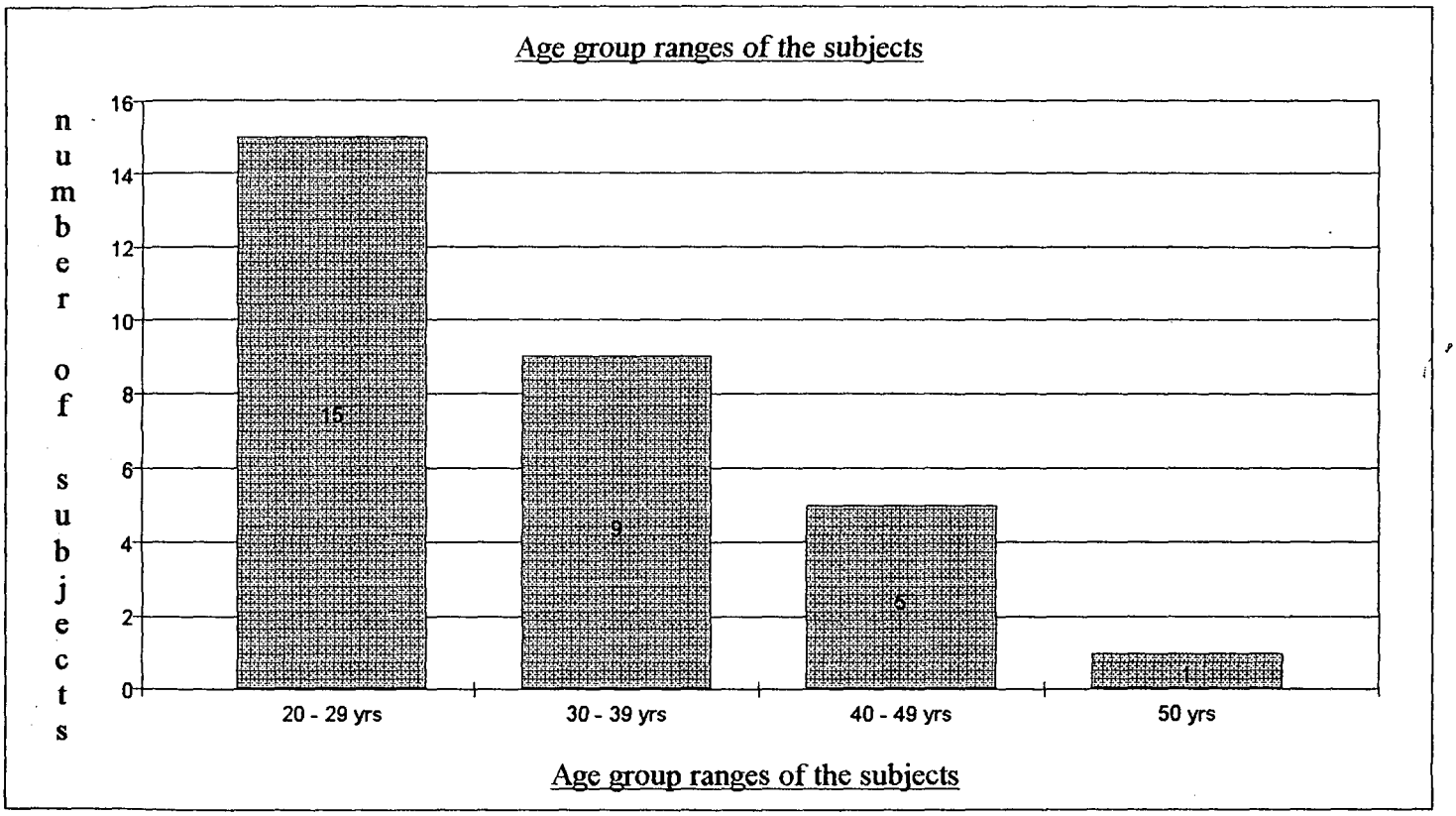
Table 4.4. D: Occupation groups of the subjects

Occupation	Number of subjects	n = 30
Employed	15	50.0%
Student	7	23.3%
Housewives	0	00.0%
Self-employed	4	13.3%
Unemployed	4	13.3%

Of the sample group of thirty subjects, the majority (15 (50.0%)) were employed, 4 (13.3%) were self-employed, 7 (23.3%) were students and 3 (13.3%) were unemployed.

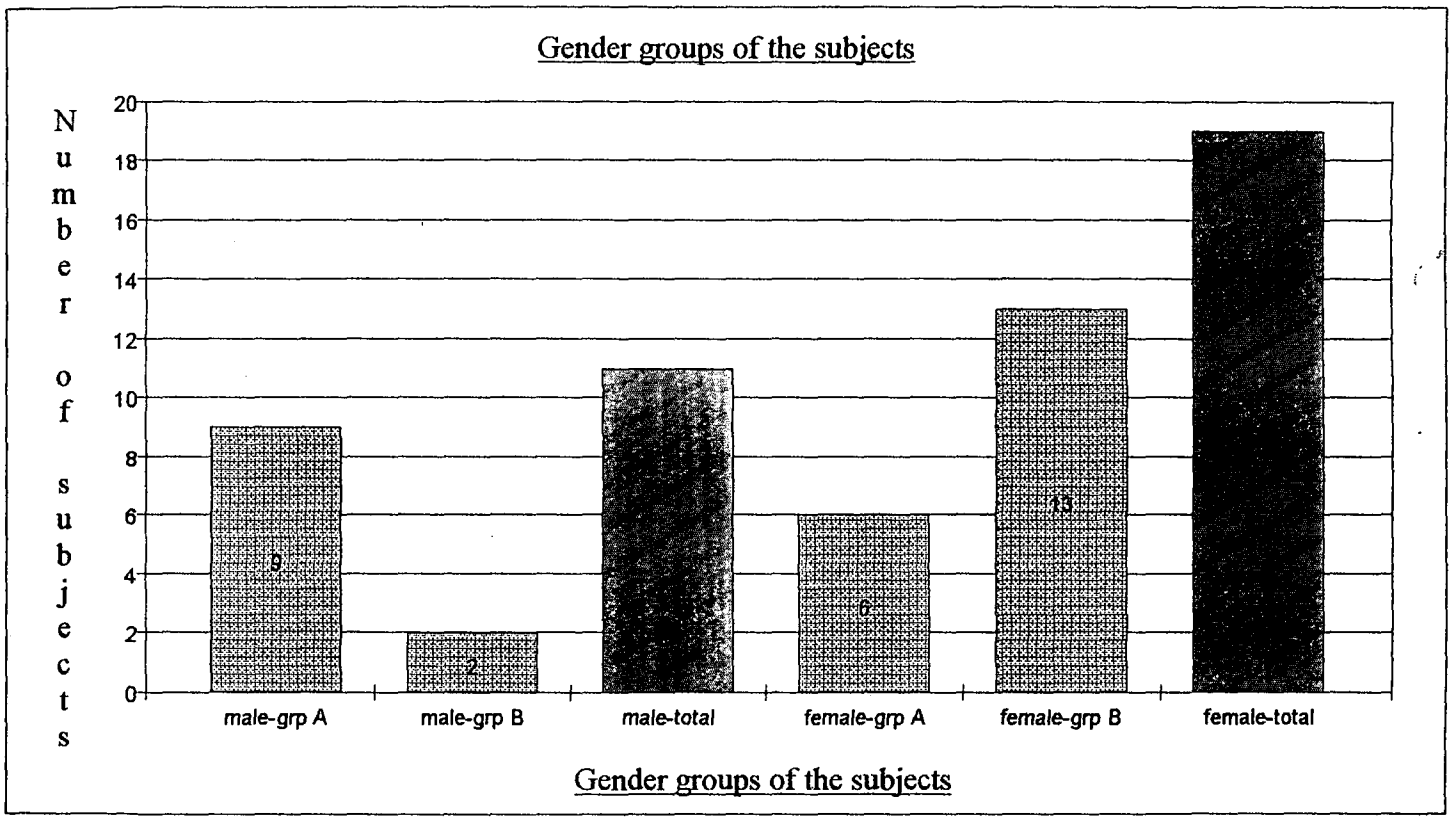
Graph 4.4

Barchart to show the age group ranges of the subjects



Graph 4.5

Barchart to show the gender groups of the subjects



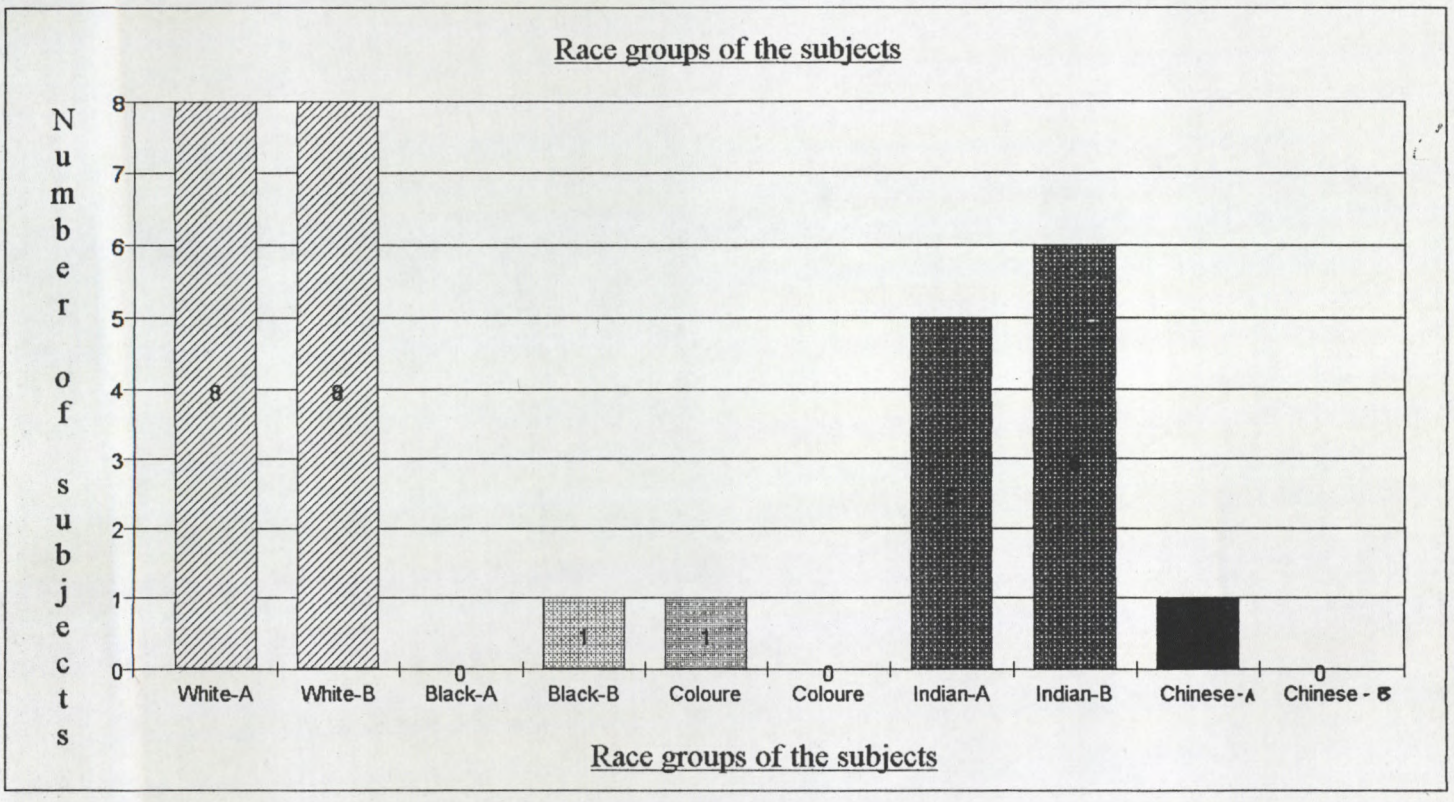
Key used on the X-axis

Male-grp A= the number of male subjects in Group A
Male-grp B= the number of male subjects in Group B
Male-total = the total number of male subjects in this study

Female-grp A= the number of female subjects in Group A
Female-grp B= the number of female subjects in Group B
Female-total = the total number of female subjects in this study

Graph 4.6

Barchart to show the race groups of the subjects

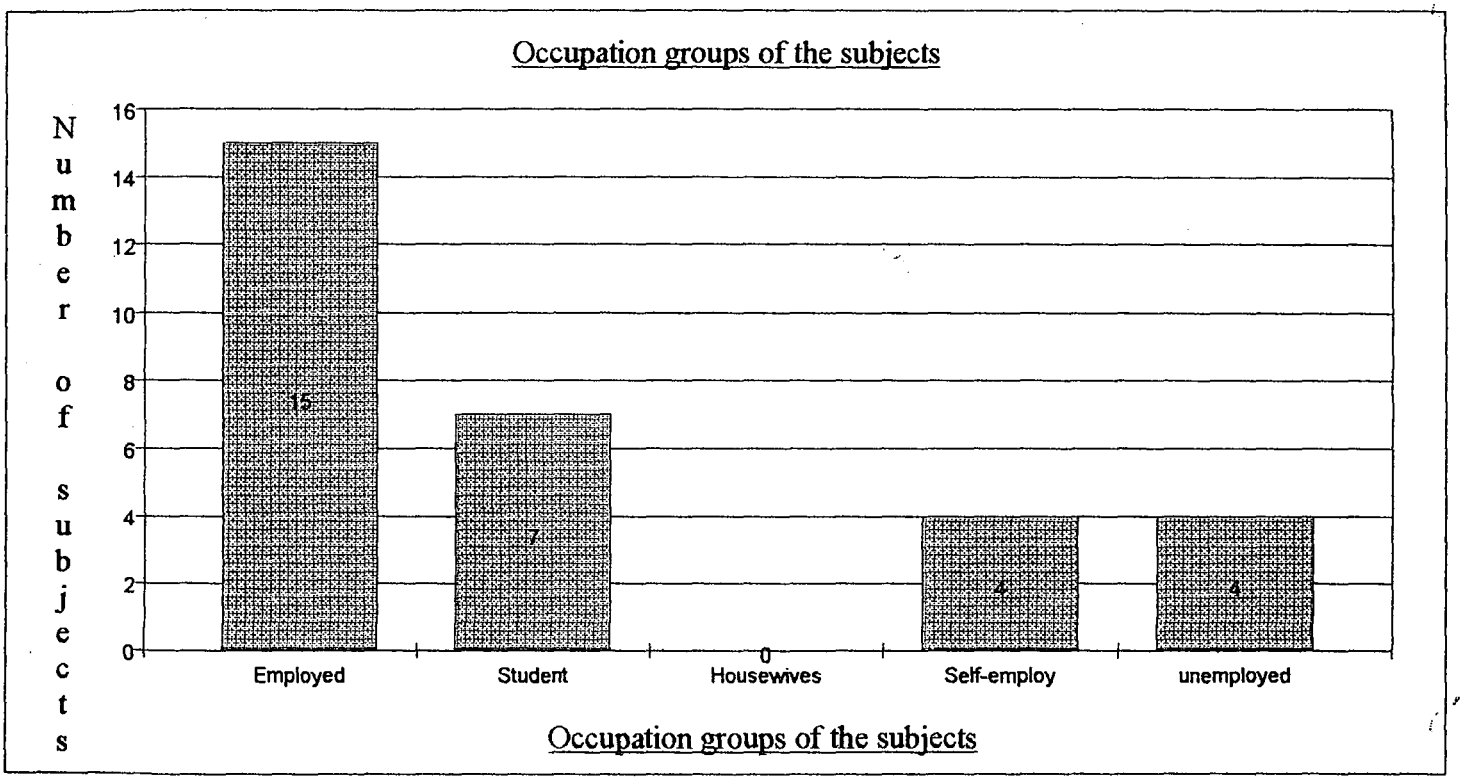


Key used on the X-axis

White-A = the number of white subjects in Group A
White-B = the number of white subjects in Group A
Black-A = the number of white subjects in Group A
Black-B = the number of white subjects in Group A
Coloure-A= the number of white subjects in Group A
Coloure-B= the number of white subjects in Group A
Indian-A = the number of white subjects in Group A
Indian-B = the number of white subjects in Group A
Chinese-A= the number of white subjects in Group A
Chinese-B= the number of white subjects in Group A

Graph 4.7

Barchart to show the occupation groups of the subjects



Key used on the X-axis

Employed = the number of subjects who are employed
Student = the number of subjects who are students
Housewives= the number of subjects who are housewives
Self-employ= the number of subjects who are self-employed
Unemployed= the number of subjects who are unemployed

CHAPTER FIVE

DISCUSSION

CHAPTER 5 : DISCUSSION OF THE RESULTS

Introduction: The results shown in Chapter 4 of this study will be discussed in this chapter. Following on from this, problems in the construction, data collection and execution of this study shall be discussed. Chapter 6 will contain the conclusions drawn from this study, as well as the author's recommendations for future research which will improve on this study.

The level of significance (α) used in this study was 0.05 (=5%). The null hypothesis stated that there was no statistically significant difference between Groups A and B with respect to the variable of comparison at the $\alpha = 0.05$ level of significance. The alternative hypothesis stated that there was a statistically significant difference at the same level of significance. The null hypothesis would be rejected if $p < \alpha = 0.05$, and the alternative hypothesis accepted. The alternative hypothesis would be rejected if $p \geq \alpha = 0.05$, and the null hypothesis would be accepted.

5.1 The CMCC Neck Disability Index

(The following results are extrapolated from Chapter 4, Procedure 1.2, page 56) The **Mann-Whitney-U test** was used for inter-group comparison of Groups A and B with respect to the CMCC.

Results showed that when comparing Groups A and B at the first ($p = 0.148$), third ($p = 0.367$), fifth ($p = 0.624$) and final ($p = 0.389$) consultations, $p \geq \alpha$. The null hypothesis was accepted, and it was concluded that there was no statistically significant difference in response to treatment between Groups A and B.

(The following results were extrapolated from Chapter 4, Procedure 2.2, page 57) The **Wilcoxon Signed-Ranks test** was used for intra-group comparison of related samples from within Group A with respect to the CMCC.

Results showed a statistically significant difference between the first and third ($p=0.002$), first and fifth ($p=0.001$), first and final consultations ($p=0.003$), as well as at the third and fifth ($p=0.006$) and third and final ($p=0.026$) consultations. However, no statistically significant difference between the fifth and final consultations ($p=0.725$) was shown.

These results indicated a progressive improvement from the first through fifth consultations with respect to dry needling of active myofascial trigger points. However, no difference in the subject's condition was shown between the fifth and final consulations, with respect to the CMCC Neck Disability Index.

(The following results were extrapolated from Chapter 4, Procedure 3.2, page 58) The **Wilcoxon Signed-Ranks** test of related samples from within Group B showed a significant improvement between the first and third ($p=0.013$), first and fifth ($p=0.001$), first and final consultations ($p=0.001$), as well as at the third and fifth ($p=0.001$) and third and final ($p=0.002$) consultations. However, no statistically significant difference between the fifth and final consultation ($p=0.089$) was shown.

These results indicate that progressive improvement by the subjects from the first throuh fifth consultations with respect to laser treatment of active myofascial trigger points. However, no difference in the subject's condition was shown between the fifth and final consulations with respect to the CMCC Neck Disability Index.

Summary: Integration of the results of the inter- and intra-group comparisons for the CMCC show progressive subjective improvement by the subjects in both

groups at a similar rate from the first through fifth consultations. No difference was shown in either group between the fifth and final consultations. Neither group proved better than the other for the treatment of active myofascial trigger points.

5.2 The Numerical Rating Scale (NRS)

(The following results were extrapolated from Chapter 4, Procedure 1.1 page 62) The **two sample unpaired t-test** was used for inter-group comparison of Groups A and B with respect to the NRS.

Comparison of Groups A and B at the first ($p=0.998$), third ($p=0.732$), fifth ($p=0.721$) and final ($p=0.645$) consultations showed no statistically significant difference between the groups. It was concluded that there was no subjective difference between the dry needling and laser groups with respect to the inter-group comparisons of the NRS.

(The following results were extrapolated from Chapter 4, Procedure 2.1, page 63) The **two-sample paired t-test** was used to compare two related samples within Group A. Statistically significant differences were shown between the first and

third (p=0.031), first and fifth (p=0.001), first and final (p=0.011) consultations as well as between the third and fifth (p=0.041) consultations. However, no statistically significant difference was shown between the third and final (p=0.137) and fifth and final (p = 0.952) consultations.

It can therefore be concluded that for the dry needling group, subjective improvement was shown between the first and fifth and first and final consultations. However there was no statistically significant difference between the fifth and final consultations with respect to the NRS.

(The following results were extrapolated from Chapter 4, Procedure 3.1, page 64) The two-sample paired t-test was used to compare two related samples within Group B with respect the the NRS. Statistically significant differences were shown between the first and third (p=0.027), first and fifth (p=0.000), first and final (p=0.000) consultations, as well as between the third and fifth (p=0.003) and third and final (p=0.002) consultations. However, no statistically significant difference was seen between the fifth and final consultations (p=0.054).

It can therefore be concluded that for the laser group, subjective improvement was shown between the first and fifth and first and final consultations. However there was no statistically significant difference between the fifth and final consultations

with respect to the NRS.

Summary: Integration of the results of the inter- and intra-group comparisons for the NRS show progressive subjective improvement by the subjects in both groups at a similar rate from the first through fifth consultations. Neither group proved better than the other for the treatment of active myofascial trigger points with respect to the NRS.

(The following results were extrapolated from Chapter 4, Procedure 4 and 6, page 65-66) The averages (means), variances and standard deviations (tested for in Procedure 1.1) were used for power analysis (Procedure 6) of the results obtained for the NRS. The results of the power analyses showed that the power of these non-parametric tests (small sample size) were low, thereby indicating that the results of this study are not necessarily reliable as a decision-making tool. Thus there is a high probability of Type II error for this study (accepting a false null hypothesis).

It can be concluded that the results of the NRS show that the dry needling and laser groups responded favourably to treatment. However, neither treatment proved to be better than the other. The null hypothesis is therefore accepted for the NRS as there was no statistically significant difference between the dry needling and laser treatment groups.

5.3 The Algometer readings

(The following results were extrapolated from Chapter 3, Procedure 1.1 page 67) The **two sample unpaired t-test** was used for inter-group comparisons of Groups A and B with respect to the Algometer readings.

Comparison of Groups A and B at the first ($p=0.611$), third ($p=0.658$), fifth ($p=0.335$) and final ($p=0.162$) consultations showed no statistically significant difference between the groups. It was concluded that there was no objective difference between the dry needling and laser groups with respect to the inter-group comparisons of the Algometer readings.

(The following results were extrapolated from Chapter 4, Procedure 2.1, page 71) The **two-sample paired t-test** was used for intra-group comparisons of related samples from within Group A. Statistically significant differences were shown between the first and third ($p=0.045$), first and fifth ($p=0.003$) and first and final consultations ($p=0.001$), as well as between the third and fifth ($p=0.040$), the third and final ($p=0.007$) and fifth and final ($p=0.047$) consultations.

It was therefore concluded that for the dry needling group, objective improvement was shown between the first and fifth, first and final and the fifth and final

consultations with respect to the Algometer readings.

(The following results were extrapolated from Chapter 4, Procedure 3.1, page 72) The **two-sample paired t-test** was used for intra-group comparisons within Group B. No statistically significant difference was shown between the first and third ($p=0.323$), first and fifth ($p=0.068$), third and fifth ($p=0.275$) and fifth and final ($p=0.051$) consultations. However, statistically significant differences were shown between the first and final ($p=0.002$) and the third and final ($p=0.005$) consultations.

It can be concluded that for the laser group, objective improvement was shown between the first and final consultations. However, there was no statistically significant difference between the first and fifth and fifth and final consultations with respect to the Algometer readings.

Summary: Inter-group comparisons for the Algometer readings showed no statistically significant difference from the first through final consultations. Intra-group analysis of the dry needling group showed progressive objective improvement by the subjects from the first through fifth consultations. Intra-group analysis of the laser group showed objective improvement between the first and final consultations, but no objective, statistically significant difference between the

first and fifth and fifth and final consultations. It can be concluded that neither group proved better than the other for the treatment of active myofascial trigger points with respect to the Algometer readings.

(The following results were extrapolated from Chapter 4, Procedure 4 and 6, page 73-74.) The average (means), variances and standard deviations (tested for in Procedure 1.1) were used for power analysis (Procedure 6) of the results obtained for the Algometer readings. The results of the power analyses showed that the power of these non-parametric tests (small sample size) were low, thereby indicating that the results of this study are not necessarily reliable as a decision-making tool. Thus there is a high probability of Type II error for this study (accepting a false null hypothesis).

It can be concluded that the results of the Algometer readings show that the dry needling and laser groups responded favourably to treatment. However, neither treatment proved to be significantly better than the other. The null hypothesis is therefore accepted for the Algometer readings as there was no statistically significant difference between the dry needling and laser treatment groups.

5.4 The Demographic Data of the Subjects

Travell and Simons (1983 1 : 13) write that patients of any age or gender can develop myofascial trigger points.

In this study, the subjects were aged from 20 to 50 years old. The average age was 31 years old, and 50% of the subjects were aged between 20 and 29 years old (Table 4.4A).

Table 4.4B showed that 36,7% of the subjects were male, and 63.3% of the subjects used in this study were female.

These subjects were selected in order of presentation to the Chiropractic Day Clinic following diagnosis of active myofascial trigger points. This study therefore, cannot indicate the prevalence of gender or of age distribution in the sample population used.

53.3% of the subjects used in this study were White, 3.3% were Black, 3.3% were Coloured, 36.7% were Indian and 3.3% were Chinese.

Again, this study does not endeavour to indicate the prevalence of active myofascial trigger points among the various race groups of the Greater Durban Area. The high percentages of White and Indian subjects could be due to the newspaper advertisements place to acquire patients for this study. The newspapers for the Greater Durban Area were used and the readership of these newspapers is predominantly White and Indian.

Occupation groups of this study included the following (Table 4.4D): Employed (50.0%), Students (23.3%), Housewives (0.0%), Self-Employed (13.3%) and Unemployed (13.3%). The prevalence of these occupations are of little consequence to this study, and were included for interest only.

5.5 SUMMARY OF THE DISCUSSION OF THE RESULTS

Results of the inter-group comparisons (Mann-Whitney-U test for the CMCC and the two-sample unpaired t-test for the NRS and Algometer readings) showed that there were no significant differences between the Groups A and B at the initial consultation. This finding optimises data collection by ensuring a similar base-line recording of the subjects' subjective and objective data between the two groups, and that results obtained following treatment would indicate a realistic change in the subjects' condition relative to the other group.

Inter-group comparisons for the CMCC showed no statistically significant difference between the first, third, fifth and final consultations. Intra-group comparisons for the CMCC showed that for the dry needling and laser groups, progressive improvement occured from the first through fifth consultations, but that there was no subjective difference between the fifth and final consultations.

Inter-group comparisons for the NRS showed no statistically significant difference between the first, third, fifth and final consultations. Intra-group comparisons for the NRS showed that for the dry needling and laser groups, progressive improvement occured from the first through fifth consultations, but that there was no subjective difference between the fifth and final consultations.

Inter-group comparisons for the Algometer readings showed no statistically significant difference between the first, third, fifth and final consultations. Intra-group comparisons for the Algometer readings showed that for the dry needling group, progressive, objective improvement occured from the first through final consultations, and that for the laser group an objective improvement occured between the first and final consultations, but that there was no objective difference between the first and fifth and the fifth and final consultations. It was therefore concluded for the Algometer readings, that there was no objective, statistically significant difference between the dry needling and laser groups.

When considering the results of inter- and intra-group comparisons for the CMCC, NRS and Algometer readings, it can be concluded that there is no statistically significant difference between the dry needling and laser treatments on active myofascial trigger points, at the 5% level of significance. The null hypothesis for this study is therefore accepted.

5.6 PROBLEMS AND POINTS FOR DISCUSSION IN THE CONSTRUCTION, DATA COLLECTION AND EXECUTION OF THIS STUDY

5.6.1 The sample size used in this study was small. A larger group for study would have decreased the likelihood of a Type II error occuring in this study, as indicated by the results of the power analysis.

5.6.2 This study was uncontrolled and unblinded. Researcher bias cannot be excluded from such a study. This study could have included a control group (placebo group). The author could have been blinded as to which was the controlled and the experimental treatment, for example, the use of unmarked laser units which were functional (experimental treatment) and dysfunctional (controlled treatment). Blinding the author would minimise any bias towards the study (Haldeman, 1992 : 418). An independent examiner could have been employed to ensure that the readings were taken correctly and without bias. Human error and incorrect calibration of equipment cannot be excluded as causes of research error when collecting data.

5.6.3 The selection of subjects for this study was random. Subjects from all races, aged between 18 and 50 years old and of either genders were considered. This selection process would enhance the accuracy of statistical analysis.

5.6.4 Research criteria and delimitations excluded from this study potential subjects who suffered from other illness, febrile disease or who were pregnant. These criteria would further enhance the accuracy of statistical analysis by excluding the possibility of another cause of the subjects' pain or aggravation of the myofascial trigger points.

5.6.5 Subjects were requested not to begin a new lifestyle (for example, starting a new sport) to which the patient was not accustomed before the start of the study. This method would prevent an undue change in the subject's condition during treatment. Out-patient compliance cannot however, be guaranteed.

5.6.6 Misinterpretation by the subjects may have affected their responses to the questions and thus could have affected the results.

5.7 Conclusions of this study

Intra-group data analyses of the CMCC, NRS and Algometer readings, showed that both the dry needling and laser groups showed significant improvement between the first and fifth and first and final treatments. No statistically significant difference was shown between the fifth and final consultations. Inter-group data analyses showed no statistically signifant difference between the dry needling and laser groups in terms of the CMCC, NRS and Algometer readings.

The first objective of this study was to evaluate the relative effectiveness of dry needling as opposed to laser therapy on active myofascial trigger points in terms of subjective measures. In terms of the CMCC Neck Disability Index (catagorical variable) and the NRS (continuous variable), neither treatment was more effective and both treatments showed similar results.

The second objective of this study was to evaluate the relative effectiveness of dry needling as opposed to laser therapy on active myofascial trigger points in terms of objective measures. In terms of the Algometer readings (continuous variable) neither treatment was more effective and both treatments showed similar results.

The third objective of this study was to evaluate the relative effectiveness of dry needling as opposed to laser therapy on active myofascial trigger points in terms of subjective and objective measures. In terms of the subjective (CMCC and NRS) and the objective (Algometer readings) findings, neither treatment was more effective and both treatments showed similar results. Results showed statistically significant improvement in response to both dry needling and laser groups with respect to subjective and objective data.

It can therefore be concluded within the parameters of this study, that both dry needling and laser have beneficial effects on, and are equally effective in the treatment of active myofascial trigger points with respect to the subjective and objective measures.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 6 : CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions of this study

Both dry needling and laser treatment showed statistically significant beneficial effects on active myofascial trigger points with respect to subjective and objective findings.

Inter- and intra-group analyses of the subjective and objective data showed that neither dry needling nor laser proved to be the more effective treatment of active myofascial trigger points.

6.2 Recommendations for further studies

6.2.1 A larger sample size (>30 patients per group) is suggested in repeat studies in order to improve the quality and quantity of statistics available for data analysis.

6.2.2 A large selection of muscles was used in this study. It is advised that fewer muscles be treated in repeat studies. It would be of interest to record the relative

frequency with which active myofascial trigger points manifest in different muscles. This information would contribute to statistical interpretation of the frequency and prevalence of active myofascial trigger points in particular muscles.

6.2.3 It would be of interest to compare the relative effect of laser/dry needling to other forms of treatment of myofascial trigger points. Such treatments mentioned in Chapter 2 were cold, heat, trigger point injection, manipulation, ultrasound, stretch and spray, stretch and ice, exercise and massage.

6.2.4 It would also be of interest to compare the relative effect of dry needling and laser as a treatment versus dry needling and laser combined with stretch, as recommended by Travel and Simons (1983).

6.2.5 Research into the treatment of active myofascial trigger points using combined dry needling and laser, would indicate whether the combined treatment is more beneficial than each treatment on its own.

6.2.6 Caution should also be observed when using students or scholars as subjects. An increase in emotional/postural stress was noted for the end of year exams and during class tests. These changes were noted by the author at

individual consultations, although these results do not appear to reflect in the overall statistical analysis of data.

6.2.7 The use of a placebo group to assess the extent of the placebo effect on the change of the subjects' condition is recommended. Placebo effects of any treatment cannot be ignored when considering the results.

REFERENCES

References

Auleciems, L.M. 1995. Myofascial Pain Syndrome: A Multidisciplinary Approach. Nurse Practitioner, 20(4): 18-28.

Baxter, D.G. 1994. Therapeutic Lasers Theory and Practice. UK: Churchill Livingstone. 259p. ISBN 0-443-04393-0.

Bruce, E. 1995. Myofascial Pain Syndrome: Early Recognition and Comprehensive Management. AAOHN Journal, 43(9): 469-474.

Fischer, A.A. 1987. Pressure Threshold Measurement for Diagnosis of Myofascial Pain and Evaluation of Treatment Results. Clinical Journal of Pain, 2(4): 207-214.

Fisher, L.D. 1993. Biostatistics: A Methodology for the Health Sciences. New York: John Wiley and Sons. 991p. ISBN 0-471-58465-7.

Garvey, T.A., Marks, M.R. and Wiesel, S.W. 1989. A Prospective, Randomised, Double-Blind Evaluation of Trigger Point Injection Therapy for Low Back Pain. Spine, 14 (9): 962-964.

Gatterman, M. I. 1990. Chiropractic Management of Spine Related Disorders. USA: Williams and Wilkins. 437p. ISBN 0-683-03438-3.

Haldeman, S. 1992. Principles and Practice of Chiropractic. 2nd ed. USA: Appleton & Lange. 641p. ISBN 0-8385-6360-0.

Han, S.C. and Harrison, P. 1997. Myofascial Pain Syndrome and Trigger Point Management. Regional Anaesthesia, 22(1): 89-101.

Hubbard, D. R. and Berkoff, G. M. 1993. Myofascial Trigger Points Show Spontaneous Needle EMG Activity. Spine, 18(13): 1803-1807.

Hubbard, D.R. 1998. Persistant muscular pain: Approaches to relieving trigger points. The Journal of Musculoskeletal Medicine, May: 16-27.

Jenson, M.P., Karoly, P. and Braver, S. 1986. The Measurement of Clinical Pain Intensity: a Comparison of Six Methods. Pain, 27: 117-126.

Khan, J. 1994. Principles and Practice of Electrotherapy. 3rd ed. New York: Churchill Livingstone. 194 p. ISBN 0-443-08919-1.

Laakso, E.L., Cramond, T., Richardson, C. and Galligan, J.P. 1994. Plasma ACTH and Beta-Endorphin Levels in Response to Low Level Laser Therapy (LLLT) for Myofascial Trigger Points. Laser Therapy, 6: 133-142.

Lewit, K. 1979. The Needle Effect in the relief of Myofascial Pain. Pain, 6: 93 - 90.

Moore, K.L. 1985. Clinically Oriented Anatomy. 3rd ed. Baltimore, U.S.A.: Williams and Wilkins. P1101. ISBN 0-683-06132-1.

Murphy, G.J. 1989. Myofascial Trigger Points. JCO, 23: 627-631.

Rosen, N. B. 1993. Myofascial Pain: The Great Mimicker and Potentiator of other diseases in the performing artist. Maryland Medical Journal, 42(3): 261-266.

Portney, L. G. And Watkins, M. P. 1993. Foundation of Clinical Research: Applications to Practice. Norwalk, Conneticut, U.S.A.: Appleton and Lange. 663p. ISBN 0-8385-1065-5.

Snyder-Mackler, L., Barry, A.J., Perkins, A.I. and Soucek, M.D. 1989. Effects of Helium-Neon Laser Irradiation on Skin Resistance and Pain in Patients with Trigger Points in the Neck or Back. Physical Therapy, 69(5): 336-341.

Sola, S.E. 1984. Treatment of Myofascial Pain Syndromes. Advances in Pain Research and Therapy, 7: 467-485.

Travell, G.J. , and Simons, D.G. 1983. Background and Principles. In Travell, G.J. and Simons, D.G. Myofascial Pain and Dysfunction The Trigger Point Manual. The Upper Extremities Volume 1. pp. 5-45. USA, Williams and Wilkins. 713 p. ISBN 0-683-08366-X.

Vernon, H. and Moir, S. 1991. The Neck Disability Index: A Study of Reliability and Validity. Journal of Manipulative and Physiological Therapeutics, 14(7) : 409-415.

APPENDICES

PATIENT INFORMATION SHEET

APPENDIX A

This is a research study, and will be investigated by a sixth year resident. The aim of this study is to compare the relative effect of laser and dry needling of active Myofascial Trigger Points, involved in causing muscular pain.

You will be required to attend the Chiropractic Day Clinic, Technikon Natal, for five treatment sessions within a two week period, as well as a non-treatment follow-up consultation, one month following the date of the last treatment.

Should you become pain-free during the treatment period, treatment will be stopped, but consultations will continue as scheduled, in order to complete the questionnaires and objective measurements. The one-month follow-up consultation will be held one month after the date after the last (non-treatment) consultation.

Depending on the group to which you are allocated, you will receive either laser treatment, or dry needling of the appropriate muscle groups.

You will be required to complete pain questionnaires, and the researcher will take objective measurements of your tolerance to pressure exerted by a pressure algometer over a tender muscle, as well as measurements of neck range of motion.

You will be required not to begin or continue taking analgesic or antiinflammatory medication or muscle relaxants for the duration of the study. Should you begin taking such medication during the study, you will be excluded from this study. You are also requested not to accept any other treatment during the time of your treatment, as these may affect the results obtained for this research.

I have understood and am willing to comply with the above treatment protocol.

_____ _____

Name Date

INFORMED CONSENT FORM

Appendix A

TITLE OF RESEARCH PROJECT

THE RELATIVE EFFECTIVENESS OF LOW INTENSITY LASER VERSUS DRY NEEDLING IN THE TREATMENT OF MYOFASCIITIS

NAME OF SUPERVISOR: Dr Heidi Marise Kretzman M.DipC (SA)

NAME OF RESEARCH STUDENT: Karen Miller

Please circle the appropriate answer

1. Have you read the research information sheet? Yes/No
2. Have you had an opportunity to ask questions regarding this study? Yes/No
3. Have you received satisfactory answers to your questions? Yes/No
4. Have you had an opportunity to discuss this study? Yes/No
5. Have you received enought information about this study? Yes/No
6. Who have you spoken to? _____
7. Do you understand the implications of your involvement in this study? Yes/No
8. Do you understand that you are free to withdraw from this study? Yes/No

a) At any time
b) without having to give a reason for withdrawing, and
c) without affecting your future health care.

9. Do you agree to voluntarily participate in this study? Yes/No

PATIENT/SUBJECT*
NAME_____SIGNATURE_____
(in block letters)
PARENT/GUARDIAN*
NAME_____SIGNATURE_____
(in block letters)
WITNESS
NAME_____SIGNATURE_____
(in block letters)
RESEARCH STUDENT
NAME_____SIGNATURE_____
(in block letters)

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

Appendix B

Patient:_____ Date: _____
file #:_____ X-Ray#:_____
Age:_____ Sex:_____ Occupation:_____
Intern:_____ Signature:_____

FOR CLINICIAN'S USE ONLY
Initial visit clinician:_____Signature:_____

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

Case Status:

PTT: Conditional: Signed Off: Final Sign out:

Recommendations:

Intern's Case History

1. Source of History:

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

3. Present Illness:

- Location
- Onset
- Duration
- Frequency
- Pain (Character)
- Progression
- Aggravating Factors
- Relieving Factors
- Associated S & S
- Previous Occurrences
- Past Treatment and Outcome

4. Other Complaints:

5. Past Medical History:

- General Health Status
- Childhood Illnesses
- Adult Illnesses
- Psychiatric Illnesses
- Accidents/Injuries
- Surgery
- Hospitalizations

6. Current health status and life-style:

- Allergies
- Immunizations
- Screening Tests
- Environmental Hazards (Home, School, Work)
- Safety Measures (seat belts, condoms)
- Exercise and Leisure
- Sleep Patterns
- Diet
- Current Medication
- Tobacco
- Alcohol
- Social Drugs

7. Immediate Family Medical History:

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

8. Psychosocial history:

- Home Situation and daily life
- Important experiences
- Religious Beliefs

9. Review of Systems:

- General
- Skin
- Head
- Eyes
- Ears
- Nose/Sinuses
- Mouth/Throat
- Neck
- Breasts
- Respiratory
- Cardiac
- Gastro-intestinal
- Urinary
- Genital
- Vascular
- Musculoskeletal
- Neurologic
- Haematologic
- Endocrine
- Psychiatric

TECHNIKON NATAL

Appendix C

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Patient:_____File#: _____Date:_____
Clinician:_____Signature:_____
Intern:_____Signature:_____

1. VITALS

Pulse rate:
Respiratory rate:
Blood pressure: R L
Temperature:
Height:
Weight:

2. GENERAL EXAMINATION

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

Urinalysis:

3. CARDIOVASCULAR EXAMINATION

1) Is this patient in **Cardiac Failure** ?
2) Does this patient have signs of **Infective Endocarditis** ?
3) Does this patient have **Rheumatic Heart Disease ?**

Inspection - Scars
- Chest deformity:
- Precordial bulge:
- Neck -JVP:

Palpation: - Apex Beat (character + location):
- Right or left ventricular heave:
- Epigastric Pulsations:
- Palpable P2:
- Palpable A2:

Pulses:
- General Impression:
- Radio-femoral delay:
- Carotid:
- Radial:
- Dorsalis pedis:
- Posterior tibial:
- Popliteal:
- Femoral:

Percussion: - borders of heart

Auscultation:
- heart valves (mitral, aortic, tricuspid, pulmonary)
- Murmurs (timing,systolic/diastolic, site, radiation, grade).

4. RESPIRATORY EXAMINATION

1) Is this patient in **Respiratory Distress** ?

Inspection
- Barrel chest:
- Pectus carinatum/cavinatum:
- Left precordial bulge:
- Symmetry of movement:
- Scars:

Palpation
- Tracheal symmetry:
- Tracheal tug:
- Thyroid Gland:
- Symmetry of movement (ant + post)
- Tactile fremitus:

Percussion
- Percussion note:
- Cardiac dullness:
- Liver dullness:

Auscultation
- Normal breath sounds bilat.:
- Adventitious sounds (crackles, wheezes, crepitations)
- Pleural frictional rub:
- Vocal resonance
  - Whispering pectoriloquy:
  - Bronchophony:
  - Egophony:

5. ABDOMINAL EXAMINATION

1) Is this patient in **Liver Failure** ?

Inspection
- Shape:
- Scars:
- Hernias:

Palpation
- Superficial:
- Deep = Organomegally:

- Masses (intra- or extramural)
- Aorta:

Percussion - Rebound tenderness:
- Ascites:
- Masses:

Auscultation - Bowel sounds:
- Arteries (aortic, renal, iliac, femoral, hepatic)

Rectal Examination
- Perianal skin:
- Sphincter tone & S4 Dermatome:
- Obvious masses:
- Prostate:
- Appendix:

6. G.U.T EXAMINATION

External genitalia:
Hernias:
Masses:
Discharges:

7. NEUROLOGICAL EXAMINATION

Gait and Posture
- Abnormalities in gait:
- Walking on heels (L4-L5):
- Walking on toes (S1-S2):
- Rombergs test (Pronator Drift):

Higher Mental Function
- Information and Vocabulary:
- Calculating ability:
- Abstract Thinking:

G.C.S.:
- Eyes:
- Motor:
- Verbal:

Evidence of head trauma:

Evidence of Meningism:
- Neck mobility and Brudzinski's sign:
- Kernigs sign:

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

II External examination of eye:
- Visual Acuity:
- Visual fields by confrontation:

- Pupillary light reflexes = Direct:
  = Consensual:
- Fundoscopy findings:

III Ocular Muscles:
Eye opening strength:

IV Inferior and Medial movement of eye:

V
a. Sensory - Ophthalmic:
- Maxillary:
- Mandibular:

b. Motor - Masseter:
- Jaw lateral movement:

c. Reflexes - Corneal reflex
- Jaw jerk

VI Lateral movement of eyes

VII
a. Motor - Raise eyebrows:
- Frown:
- Close eyes against resistance:
- Show teeth:
- Blow out cheeks:

b. Taste - Anterior two-thirds of tongue:

VIII General Hearing:
Rinnes = L: R:
Webers lateralisation:
Vestibular function - Nystagmus:
- Rombergs:
- Wallenbergs:
Otoscope examination:

IX & X Gag reflex:
Uvula deviation:
Speech quality:

XI Shoulder lift:
S.C.M. strength:

XII Inspection of tongue (deviation):

Motor System:

a. Power

- Shoulder = Abduction & Adduction:
  = Flexion & Extension:
- Elbow = Flexion & Extension:
- Wrist = Flexion & Extension:

- Forearm = Supination & Pronation:
- Fingers = Extension (Interphalangeals & M.C.P's):
- Thumb = Opposition:
- Hip = Flexion & Extension:
  = Adduction & Abduction:
- Knee = Flexion & Extension:
- Foot = Dorsiflexion & Plantar flexion:
  = Inversion & Eversion:
  = Toe (Plantarflexion & Dorsiflexion):

b. Tone
- Shoulder:
- Elbow:
- Wrist:
- Lower limb - Int. & Ext. rotation:
- Knee clonus:
- ankle clonus:

c. Reflexes
- Biceps:
- Triceps:
- Supinator:
- Knee:
- Ankle:
- Abdominal:
- Plantar:

Sensory System:

a. Dermatomes
- Light touch:
- Crude touch:
- Pain:
- Temperature:
- Two point discrimination:

b. Joint position sense
- Finger:
- Toe:

c. Vibration:
- Big toe:
- Tibial tuberosity:
- ASIS:
- Interphalangeal Joint:
- Sternum:

Cerebellar function:

Obvious signs of cerebellar dysfunction:
= Intention Tremor:
= Nystagmus:
= Truncal Ataxia:

Finger-nose test (Dysmetria):
Rapid alternating movements (Dysdiadochokinesia):
Heel-shin test:
Heel-toe gait:
Reflexes:
Signs of Parkinsons:

8. SPINAL EXAMINATION:(See Regional examination)

Obvious Abnormalities:
Spinous Percussion:
R.O.M:
Other:

9. BREAST EXAMINATION:

Summon female chaperon.

Inspection
- Hands rested in lap:
- Hands pressed on hips:
- Arms above head:
- Leaning forward:

Palpation
- masses:
- tenderness:
- axillary tail:
- nipple:
- regional lymph nodes:

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
REGIONAL EXAMINATION - *CERVICAL SPINE* Appendix D

Patient: _____ File: _____

Date: _____ Intern/Resident: _____

Clinician: _____ Sign: _____

OBSERVATION:

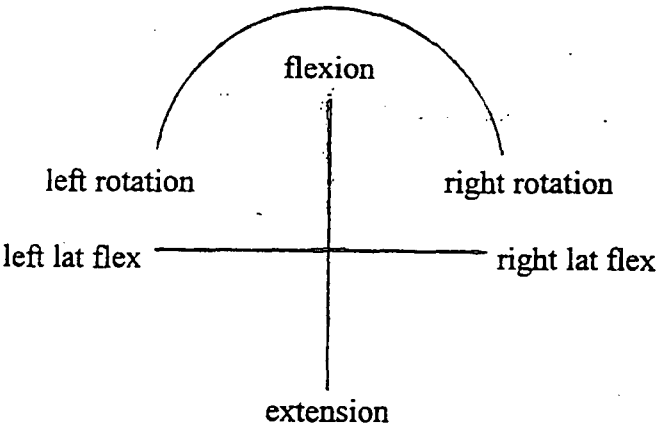
Posture
Swellings
Scars
Discolouration
Hair Line
Bony & Soft Tissue Contours

Shoulder position:
Left:
Right:
Muscle spasm
Facial expression

RANGE OF MOTION:

Flexion (45'):
L/R Rotation (70'):

Extension (70'):
L/R Lat Flex (45'):



PALPATION:

Lymph Nodes
Thyroid Gland

Trachea

ORTHOPAEDIC EXAMINATION:

Tenderness
Trigger Points: SCM, Scalenii, Post Cervicals, Trapezius, Lev Scap

Doorbell sign
Kemp's test
Cervical distraction
Halstead's test
Hyperabduction test
Shoulder abduction test

Cervical compression
Lateral compression
Adson's test
Costoclavicular test
Eden's test
Shoulder depression test

Dizziness rotation test
Brachial plexus tension

Lhermitte's sign

Appendix D

NEUROLOGICAL EXAMINATION:

Dermatomes	Left	Right	**Myotomes**	Left	Right	**Reflexes**	Left	Right
C2			C1			C5		
C3			C2			C6		
C4			C3			C7		
C5			C4					
C6			C5					
C7			C6					
C8			C7					
T1			C8					
			T1					

VASCULAR:

	Left	Right
Blood Pressure		
Carotid arts.		
Subclavian arts.		
Wallenberg's test		

MOTION PALPATION & JOINT PLAY:

Left: Motion Palpation:
Joint Play:

Right: Motion palpation:
Joint Play:

Basic Exam: Shoulder:
Case History:

ROM: Active:
Passive:
RIM:
Orthopaedic/Neuro/
Vascular:
Observ/Palpation:

Upper T horacics:
Motion Palpation:
Joint Play:

Basic Exam: Thoracic Spine:
Case History:

ROM: Motion Palp:
Active:
Passive:
Orthopaedic/Neuro/
Vascular:
Observ/Palpation:

CMCC NECK DISABILITY INDEX

Patient Name:_____ File no.:_____ Date:_____

Appendix E

This questionnaire has been designed to give the doctor information as to how your back pain has affected your ability to manage everyday life. Please answer every section and mark in each section only ONE box as it applies to you. We realize you may consider that two of the statements in any one section could relate to you, but please just mark the box which most closely describes your problem.

Section 1 - Pain Intensity

- ☐ I have no pain at the moment.
- ☐ The pain is very mild at the moment.
- ☐ The pain is moderate at the moment.
- ☐ The pain is fairly severe at the moment.
- ☐ The pain is very severe at the moment.
- ☐ The pain is the worst imaginable at the moment.

Section 2 - Personal Care (Washing, Dressing ...)

- ☐ I can look after myself normally without causing extra pain.
- ☐ I can look after myself normally but it causes extra pain..
- ☐ It is painful to look after myself and I am slow and careful.
- ☐ I need some help but manage most of my personal care.
- ☐ I need help every day in most aspects of self care.
- ☐ I do not get dressed, I wash with difficulty and stay in bed.

Section 3 - Lifting

- ☐ I can lift heavy weights without extra pain.
- ☐ I can lift heavy weights but it gives extra pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example on a table.
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned .
- ☐ I can lift only very light weights.
- ☐ I cannot lift or carry anything at all.

Section 4 - Reading

- ☐ I can read as much as I want to without pain in my neck.
- ☐ I can read as much as I want to with slight pain in my neck.
- ☐ I can read as much as I want with moderate pain in my neck.
- ☐ I cannot read as much as I want because of moderate pain in my neck.
- ☐ I can hardly read at all because of severe pain in my neck.
- ☐ I cannot read at all.

Section 5 - Headaches

- ☐ I have no headaches at all.
- ☐ I have slight headaches which come infrequently.
- ☐ I have moderate headaches which come infrequently.
- ☐ I have moderate headaches which come frequently.
- ☐ I have severe headaches which come frequently.
- ☐ I have headaches almost all the time.

Section 6 - Concentration

- ☐ I can concentrate fully when I want to with no difficulty.
- ☐ I can concentrate fully when I want to with slight difficulty.
- ☐ I have fair degree of difficulty in concentrating when I want to.
- ☐ I have a lot of difficulty in concentrating when I want to.
- ☐ I have a great deal of difficulty in concentrating when I want to.
- ☐ I cannot concentrate at all.
- ☐

Section 7 - Work

- ☐ I can do as much work as I want to .
- ☐ I can do only my usual work, but no more.
- ☐ I can do most of my usual work, but no more.
- ☐ I cannot do my usual work.
- ☐ I can hardly do any work at all.
- ☐ I cannot do any work at all.
- ☐

Section 8 - Driving

- ☐ I can drive my car without any neck pain.
- ☐ I can drive my car as long as I want with slight pain in my neck.
- ☐ I can drive my car as long as I like with moderate pain in my neck.
- ☐ I cannot drive my car as long as I want because of moderate pain in my neck.
- ☐ I can hardly drive at all because of severe pain in my neck..
- ☐ I cannot drive at all.

Section 9 - Sleeping

- ☐ I have no trouble sleeping.
- ☐ My sleep is slightly disturbed (<1 hour sleep loss).
- ☐ My sleep is mildly disturbed (1-2 hours sleep loss).
- ☐ My sleep is moderately disturbed (2-3 hours sleep loss).
- ☐ My sleep is greatly disturbed (3-5 hours sleep loss).
- ☐ My sleep is completely disturbed (5-7 hours sleep loss).

Section 10 - Recreation

- ☐ I am able to engage in all my recreation activities with no neck pain at all.
- ☐ I am able to engage in all my recreation activities, with some pain in my neck.
- ☐ I am able to engage in most, but not all of my usual recreation activities because of pain in my neck.
- ☐ I am able to engage in a few of my usual recreation activities because of pain in my neck.
- ☐ I can hardly do any recreation activities because of pain in my neck.
- ☐ I cannot do any recreation activities at all.

Vernon/Hagino, modified from Foubister et al.,Physiotherapy, 1980

Appendix F

Patient Name: _____

File no. : _____

The Numerical Rating Scale (NRS)

(for completetion by the patient)

Please indicate on the line below the number between zero (0) and 100 that best describes your pain. A zero (0) would mean "no pain", and a 100 would mean "pain as bad as it could be".

Please write one number only.

0 _____ 100

(For researcher's use only)

Consultation	Date	Number
1		
3		
5		
6		

Patient Name: _____

File no. : _____

The Algometer Readings Sheet

(for completetion by the author)

Consultation 1 : Date _____

Muscle affected	Trigger point affected	Reading
1		
2		
3		

Consultation 3 : Date _____

Muscle affected	Trigger point affected	Reading
1		
2		
3		

Consultation 5 : Date _____

Muscle affected	Trigger point affected	Reading
1		
2		
3		

Consultation 6 : Date _____

Muscle affected	Trigger point affected	Reading
1		
2		
3		