THE RELATIVE EFFECTIVENESS OF THE FOUR-ELECTRODE AS OPPOSED TO THE PEN-ELECTRODE INTERFERENTIAL CURRENT METHOD IN THE TREATMENT OF MYOFASCIAL PAIN SYNDROMES.

by

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I, Alan Clifford Corin,
do hereby declare
that this dissertation
represents my own work
in both conception and execution

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Approved for final submission

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DEDICATION

This dissertation is dedicated to my parents, Rodney and Olive Corin, who have given me their continued support and encouragement and have been my inspiration in me giving my all to the profession of chiropractic.

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ABSTRACT

The purpose of this investigation was to determine the relative effect of the four-electrode as opposed to the pen-electrode interferential current method in the treatment of myofascial pain syndromes.

This was a randomised clinical trial consisting of two groups. Group A received four-electrode interferential current therapy, while Group B received pen-electrode interferential current therapy. Each group consisted of 15 subjects, between the ages of 18 and 55 years, selected from the general population. Subjects diagnosed with active myofascial trigger points in any of the following muscles: trapezius, levator scapulae, supraspinatus, infraspinatus and rhomboid major and minor, were admitted into the study.

Each subject received five treatments over a period of three weeks followed by a one-month follow-up consultation.

Each subject was assessed by means of the CMCC Neck Disability Index, short-form McGill Pain Questionnaire and the Numerical Pain Questionnaire; as well as pain threshold readings by means of an algometer and cervical spine ranges of motion measurements by means of a cervical goniometer. Readings were taken at the first, fifth and follow-up consultations for all subjective and objective measurements.

Statistical analysis was completed using the non-parametric Wilcoxon signed-rank test and the Mann Whitney unpaired test comparing intra-group and inter-group data respectively, at a 95% confidence level.

It was evident from the data that patients in both groups responded favourably to their respective treatments. Significant improvement in all subjective and objective measurements was noted between the first and fifth, and first and follow-up consultations in both groups ($p<0.05$). No improvement was noted between the fifth and follow-up consultations in either group ($p<0.05$).

The comparison of both subjective and objective data between both groups showed no significant difference except for algometer readings taken at the fifth consultation ($p<0.05$). A statistically significant difference was evident here, and thus from the comparison of mean values it was concluded that pen-electrode interferential current therapy results in a significantly greater increase in pain threshold levels when compared to four-electrode interferential current therapy. A more favourable long term clinical response was noted in the pen-electrode group.

It is suggested that both four-electrode and pen-electrode interferential current therapies are effective in the treatment of myofascial pain syndromes. It may be said that pen-electrode interferential current therapy is more effective than four-electrode interferential current therapy, as it displayed a more favourable statistical and clinical response to treatment. Further studies with a larger sample size are needed to clearly evaluate the use of interferential current in the treatment of active myofascial trigger points.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

DEFINITION OF TERMS

Active myofascial trigger points: A focus of hyperirritability in a muscle or it's fascia that is symptomatic with respect to pain. It refers a pain pattern at rest and /or in motion that is specific for the muscle involved. It is always tender and prevents full lengthening of the muscle, weakens the muscle , refers pain on direct compression, mediates a local twitch response of muscle fibers when adequately stimulated and often produces specific referred autonomic phenomena in it's pain reference zone. (Travell and Simons, 1983:1.)

Latent myofascial trigger point: A focus of hyperirritability in a muscle or it's fascia that is clinically quiet with respect to spontaneous pain, it is painful only when palpated. It may have all the characteristics of an active trigger point from which it may be distinguished. (Travell and Simons, 1983:2.)

Reference zone: A specific region of the body at the distance from the trigger point where phenomena that it causes are observed (Travell and Simons, 1983:4).

Interferential current: Electrical stimulation that utilises two medium-frequency currents that are identical in frequency but differ in amplitude (Gatterman, 1990:351).

Four-electrode interferential current: Interferential therapy that uses four electrodes to deliver two currents, one current with a constant frequency and the other current with a variable frequency (Dynatronics Operators Manual, 1996:58).

Pen-electrode interferential current: Interferential current that uses an active probe and a ground probe to produce a composite wave form identical to the four-electrode wave, by the internal mixing of two sine waves within the interferential current unit prior to output (Dynatronics Operators Manual, 1996:58).

Sweep feature: A function which moves the point of interference inward and outward in a spiral pattern, bathing about 80% of the area within the electrodes with the interferential current (Dynatronics Operators Manual, 1996:60).

CHAPTER ONE

INTRODUCTION

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Chronic myofascial pain, identified by palpation of trigger points, has been described in various terms in the medical and dental literature for well over a century (Wreje and Brorsson, 1995). The myofascial pain syndrome is one of the most common painful muscular dysfunctions found in patients (Hong et al., 1993). According to Travell and Simons (1983:5) myofascial trigger points are extremely common and become a distressing part of nearly everyone's life at one time or another. Goldenberg (1987) estimated the number of people in the USA suffering from myofasciitis to be between 3 and 6 million.

Sola (1981) stated that the most common muscles affected by the myofascial pain syndrome are the trapezius, the levator scapulae and the infraspinatus. Rubin (1981) described myofasciitis of the trapezius as the most common cause of craniofacial referred pain.

Travell and Simons (1983:3) describe a myofascial trigger point as being a hyperirritable locus within a taut-band of skeletal muscle, located in the muscular tissue and/or its associated fascia. Myofascial pain is pain of muscular origin but trigger points can also be found in skin, tendon, ligament and periosteum (Gerwin, 1994). Trigger points are microscopic lesions resulting from overuse, disuse or misuse of a muscle or group of muscles (Auleciems, 1995).

Myofascial pain syndrome often goes unrecognised or misdiagnosed and is often mistreated resulting in the patient suffering unnecessary pain and disability. Myofascial trigger points have been misdiagnosed as tendinitis, bursitis and entrapment neuropathies. It is as a result of clinicians failure to recognise and understand myofascial pain syndromes, and to correct underlying dysfunction's, that treatment programs are often prolonged or unsuccessful. (Skootsky et al., 1989, Rosen, 1993 and Auleciems, 1995.)

Several groups of investigators have reported results from treatments directed at myofascial pain syndromes (Wreje and Brorsson, 1995). According to Bruce (1995) despite the remarkable advances in modern healthcare, a void exists in understanding, evaluating and managing the common musculoskeletal aches and pains. The need for an effective treatment of this common and debilitating disorder has been recognised and various techniques of treatment have been administered, each rendering varying degrees of effectiveness (Travell and Simons, 1983:6).

Various techniques described in the literature include stretching, ischaemic compression, various needling techniques as well as heat therapy, cryotherapy and electrotherapeutic modalities (Fricton, 1994, Rosen, 1994, Auleciems, 1995 and Bruce, 1995).

Electrotherapeutic modalities include interferential current therapy, transcutaneous electrical nerve stimulation (TENS), microcurrent and ultrasound (Murphy, 1983). Airkasinen and Pontinen (1992) conducted a randomised study, involving 14 patients with active trigger points, to evaluate the effect of TENS on myofascial trigger points. From their results they suggest that electrical stimulation treatment may have a beneficial effect on low pain threshold. Pain relief and reduction in muscle spasm are

two common clinical uses of interferential current discussed in the literature (De Demonico, 1982, De Demonico and Strauss, 1985, Low, 1988:164 and Goats, 1990.)

Most studies done using low frequency current therapy for treatment of active myofascial trigger points have been done using TENS.

Graff-Radford et al. (1987) concluded, from a double-blind study where he used TENS in the treatment of active trigger points of 60 subjects, that high frequency and high intensity electrical stimulation was effective in decreasing myofascial pain sensitivity. Various authors (Lehman et al., 1983, Frampton, 1985 and Airkasinen and Pontinen, 1992) have shown in studies conducted, that low frequency electrical stimulation results in an increase in the pain threshold of myofascial trigger points.

In 1995 Christie concluded from his findings of a randomised controlled study, involving 30 subjects with myofascial trigger points, that no difference exists between the results obtained when treating trigger points with an interferential current pen-electrode to those obtained when treating trigger points with the dry needling method.

Delivery of current through a pen-electrode or probe allows for treatment of a very small area. The pen-electrode therapy utilises an active probe and a ground electrode. The active probe delivers the current to the patient and the ground electrode completes the circuit. The active probe is placed on the patient's skin over the myofascial trigger point and the ground electrode is placed at any location on the patient's skin away from the treatment site.(Dynatronics Manual 1996:16.) When using the four-electrode method a very large but still specific area is subjected to the interferential current. With twin-current quadripolar interferential current application,

stimulation occurs in a cloverleaf pattern around the electrodes due to the nature of the interfering electromagnetic currents. (Gatterman 1990:352.) In the past the rotating vector was the only interferential current treatment available. The rotating vector rotates the cloverleaf pattern within the tissues to get a more generalised effect. The disadvantage with this method is that the centre of interference does not move and the depth of the beat is reduced thus decreasing strength of treatment. (Dynatronics Manual 1996:59.)

A more advanced method is the Sweep which is described in the Dynatronics Operators Manual (1996:60). The Sweep feature literally moves the point of interference inward and outward in a spiral pattern, bathing about 80 percent of the area within the electrodes with the interferential current.

Treating a large percentage of the muscle, as when using this method with the sweep function, would be thought to be more effective, as it is the entire muscle that has been subjected to abnormal stress and not only the part of the muscle that contains the trigger point, as was suggested by Auleciems (1995). The Sweep feature was used in this study. No clinical trials assessing the efficacy of the Sweep feature have been published to date.

The purpose of this investigation was to compare the effectiveness of four-electrode interferential current therapy versus pen-electrode interferential current therapy in the treatment of myofascial trigger points. This was done in terms of the patients' subjective and objective clinical findings in order to determine which was the more effective treatment. The subjective findings were analysed using the CMCC Neck Disability Index, the Short Form McGill Pain Questionnaire and the Numerical Pain Rating Scale-101 while the objective measurements included the use of the Cervical

Range of Motion goniometer (C.R.O.M) and the algometer. These measurements were then compared to statistically determine the more effective of the two treatments.

This research will hopefully aid in the process of clarifying the role of interferential current in the treatment of myofascial pain syndromes. The primary research is this, does the four-electrode interferential method using the sweep feature which treats a whole muscle or region increase patients' pain threshold more effectively than treating each individual trigger point in a patients' myofascial pain syndrome using the pen-electrode method.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

CHAPTER TWO

2.0 REVIEW OF THE RELATED LITERATURE

2.1 PREVALENCE AND INCIDENCE OF TRIGGER POINTS

It is the opinion of Fricton (1994) that myofascial pain is the most common cause of persistent regional pain such as back pain, shoulder pain, tension-type headaches and facial pain. In a study by Sola et al. (1954) which involved 200 unselected, asymptomatic basic airmen (100 men and 100 women) with a median age of 19, 99 (49,5%) were found to have one or more trigger points (active or latent) in the shoulder-girdle muscles. The female group showed somewhat of a higher incidence, with 54% of the female patients having positive findings compared to 45% of the male patients. Of the 99 subjects having trigger points 62 had multiple trigger points, with a slightly higher incidence in the male patients. Of the trigger points occurring in the positive subjects (253 trigger points in total), 84,7% occurred in the following four muscles: the trapezius, levator scapula, infraspinatus and scalenes.

Travell and Simons (1983:13) claim that individuals of either sex and of any age can develop trigger points; sedentary, middle aged women are apparently very vulnerable. Except in later years, women are more likely than men to develop myofascial pain syndromes. Trigger points are less common in labourers involved with heavy work every day compared to sedentary labourers who indulge in occasional episodes of vigorous activity (Travell and Simons, 1983:13).

Skootsky et al. (1989) studied myofascial pain in a general internal medicine practice and found that among those patients that present with pain, 29.6% were found to have myofascial pain as the cause of the pain.

2.2 AETIOLOGY OF TRIGGER POINTS

Gatterman (1990:291) states that many factors interact to create trigger points. Usually, one stress activates the trigger point, then other factors perpetuate it. Both acute events and chronic stresses tend to activate trigger points (Travell and Simons, 1983:55).

The types of activation have been discussed by Travell and Simons (1983:55) and include the following: mechanical stresses, such as an episode of excessive or unusual exercise; sudden overuse of a muscle; direct cooling of a fatigued muscle, as by a cold draft; sustained postural overload, as in poor work habits; inactivity; viral diseases; acute emotional stress and psychological tension.

2.3 PERPETUATING FACTORS

According to Graff-Radford et al. (1987) pain associated with myofascial trigger points is perpetuated by factors that affect or stress the muscle containing the trigger point (TP).

Rubin (1981) states that injuries , viral or bacterial infections, immobilisation, psychogenic stress and other environmental factors can perpetuate trigger points, which may occur in any of the voluntary muscles of the human body and thus lead to a multitude of myofascial pain syndromes.

Travell and Simons (1983:104-156) present a concise description of the perpetuating factors of myofascial trigger points. A summary of this description follows:

1. Mechanical stresses: Common sources include skeletal asymmetry and disproportion. Skeletal asymmetry may include a short leg or small hemipelvis where as disproportion includes a long second metatarsal and short upper arms. Other significant contributing factors include: misfitting furniture, poor posture and prolonged immobility.

2. Nutritional inadequacies: This includes abnormally low levels of the B vitamins (especially B1, B6, B12 and Folic acid), and of vitamin C. Adequate calcium, potassium, iron and several trace minerals are essential for normal muscle functioning.

3. Metabolic and endocrine inadequacies: This includes hypothyroidism, hypoglycaemia, hyperuricemia, hypoxia and anaemia. These impair muscle metabolism and perpetuate the symptoms of the trigger points.

4. Psychological factors: These include depression, sick behaviour, secondary gain, anxiety and tension. Travell and Simons (1983:149) state that physicians must not assume that psychological factors are the primary cause.

5. Chronic infection and infestations: These include bacterial and viral infections and parasitic infestations. Viral infections, particularly herpes simplex, result in an increase in symptoms. Bacterial infections such as, an abscessed or impacted tooth, sinusitis and chronic urinary tract infection are implicated.

6. Other factors: Travell and Simons list allergic rhinitis, impaired sleep and nerve impingement as other factors that may perpetuate trigger points.

Graff-Radford et al. (1987), Rosen (1993) and Fricton (1994) all agree on the common perpetuating factors, these being of a behavioural, cognitive, physical, emotional, social and environmental nature.

According to Rosen (1994) pain in the tissues and tissue dysfunction are two processes that may exist independently and act separately or exist as part of one process. Musculoskeletal dysfunction may exist in a dormant pain free state without interfering with the normal activities of daily living. When an individual attempts to stress his tissues beyond the normal, clinical dysfunction occurs and symptoms develop.

Rosen (1994) hypothesizes that trauma, lack of exercise and stress force a decrease in activity of the individual, resulting in dysfunction and symptoms occurring at lower levels of physical demand, but they may only manifest if the loaded or stressed activities are performed. The most common cause for recurring pain and dysfunction according to Rosen (1994) is the inadequate or incomplete rehabilitation of a previously painful process which has presumably resolved without the patient having achieved a normal range of motion or normal strength.

It is the opinion of Bruce (1995) that persistent perpetuating factors such as poor posture, repetitive muscle irritation, or exercise related muscular injuries, may result in an acute myofascial pain syndrome becoming chronic.

2.4 PATHOPHYSIOLOGY OF MYOFASCIAL TRIGGER POINTS

The nature of the myofascial trigger point and the central nervous system changes associated with the regional pain are still not fully understood. The histological and biochemical studies that have been completed on biopsies of trigger points have demonstrated non-specific anatomical changes in the muscle but may shed light on metabolic changes occurring in trigger points. (Fricton, 1994.)

Simons (1981) lists the following mechanisms that account for the initial neuromuscular dysfunction phase of trigger points. If the initial trauma locally tears the sarcoplasmic reticulum and releases its calcium, the calcium acts together with the available adenosine triphosphate to continuously activate local contractile activity, this results in a high level of uncontrolled, localised metabolic activity. The final outcome being a shortened bundle of affected muscle fibers due to the physiologic contracture. The sustained high level of metabolic activity produces substances that sensitise sensory nerve endings, causing local sensory hyperirritability. Local tenderness, referred pain and localised vasoconstriction occurs. Impairment of blood circulation to the muscle occurs due to the sustained maximal contraction. Decrease in the energy supply, due to a lack in blood supply, results in a depletion of available adenosine triphosphate, converting the local physiological contracture of the muscle fibers into an energy-deficient contracture. Eventually, the sarcoplasmic reticulum should be repaired. If this fails to occur, as has been postulated for McArdle's disease, the excess calcium would sustain contraction, maintaining energy depletion.

This hypothesis that active trigger points are a series of self-sustaining malfunctions of muscle contraction initiated by reparable structural injury, needs testing.

Auleciems (1995) points out that although a number of causes are speculated, there is no widely accepted neurophysical or pathological explanation for Myofascial Pain Syndrome. Deficient in energy, trigger points are regions of metabolic distress. Microtrauma and overload may result in trigger point formation. Microtrauma leads to calcium release from the sarcoplasmic reticulum. High calcium levels cause continued contraction of the sarcomeres and increased energy demands for adenosine triphosphate, resulting in local hypoxia. (Auleciems 1995.)

Fricton (1994) hypothesises a comparable theory to those of Simons (1981) and Auleciems (1995). It is as follows: He states that the characteristics of myofascial pain may long outlast the initiating events, resulting in a self-generating pain cycle that is perpetuated through lack of proper treatment, sustained muscle tension, distorted muscle posture, pain-reinforcing behaviour, and failure to reduce other contributing factors such as inactivity or sleep disturbance. The initiating events, including macrotrauma and microtrauma, disrupt the weakened or normal muscle through sustained contraction or through injury. Disruption of the sarcoplasmic reticulum transpires, releasing free calcium within the muscle, which along with adenosine triphosphate stimulates actin and myosin interaction and local contractile and metabolic activity, resulting in increases in noxious by-products. Substances such as serotonin, histamine, kinins and prostoglandins sensitise and fire type III and type IV muscle nociceptors, the central nervous system and motor units.

These afferent inputs converge with other somatic and visceral inputs in lamina I or V of the dorsal horn resulting in perception of local and referred pain.

With sustained contractile activity, local blood flow is decreased, resulting in low oxygen tension, depleted adenosine triphosphate reserves and diminished activity of the calcium pump. Free calcium and adenosine triphosphate interact to trigger contractile activity and a self-perpetuating cycle is established. Sustained increases in local noxious by-products of oxidative metabolism sensitise nociceptors within the interstitial connective tissue at the trigger point and cause further disruption of the calcium pump.(Fricton 1994.)

Bengtsson et al. (1986a) reported on 77 biopsies from 57 patients with primary fibromyalgia and 17 biopsies from 9 healthy controls. 42 biopsies from patients were deemed normal , while 35 showed discrete pathological changes (degeneration, regeneration, inflammatory infiltrates, ragged-red fibres and 'moth-eaten' fibres). Moth-eaten fibres were found in 35 and ragged-red fibres in 15 of 41 trapezius biopsies. They concluded that the minor pathological changes found in the biopsies were not in themselves of diagnostic significance, but that they did indicate the presence of muscle pathology in trigger points.

In another study, Bengtsson et al. (1986b) studied muscle energy metabolism by chemical analysis of biopsy samples, from trigger points in the trapezius muscle, from 15 patients. They found a decrease in the levels of adenosine triphosphate (ATP), adenosine diphosphate (ADP) and phosphocreatinine, and an increase in the levels of adenosine monophosphate (AMP) and creatinine. They concluded that a marked change in muscle energy metabolism exists in painful muscles with trigger points, compared to that of normal muscle. They state that the reason for

the change is unknown, but that hypoxia is probably present in the painful muscle and that it may contribute to the deficiency of energy-rich compounds.

Lund et al. (1986) completed a study which intended to elucidate whether or not muscle hypoxia exists in primary fibromyalgia patients. They compared the results with the results from a group of healthy volunteers. The Mehrdraht Dortmund Oberflache (MDO) oxygen electrode was used to evaluate oxygenation in the trigger points of the trapezius and brachioradialis muscles. Ten patients and eight controls were studied. The results in the patients were abnormal, with scattered histograms, indicating low tissue oxygenation. The controls were normal, except in one case.

The findings in the trapezius and brachioradialis muscles of the patients indicated an abnormal oxygenation, possibly due to morphological or functional changes affecting the microvessels in the trigger points. Thus the authors concluded that abnormal oxygenation exists in muscle with trigger points.(Lund et al.,1986.)

2.5 ELECTROMYOGRAPHY OF MYOFASCIAL TRIGGER POINTS

Hubbard and Berkoff (1993) conducted a study in which a monopolar needle electromyogram (EMG) was recorded simultaneously from trapezius myofascial trigger points and adjacent nontender fibres (non-trigger points) of the same muscle in 8 normal subjects and in two patient groups, tension headaches (29 subjects) and fibromyalgia (25 subjects).

Sustained spontaneous EMG activity was found in the 1-2mm nidus of all trigger points, and was absent in non-trigger points. Mean EMG amplitude in the patient groups was significantly greater than in normals.

Hubbard and Berkoff (1993) hypothesise that sympathetically stimulated intrafusal contraction causes an involuntary low-grade but symptomatic muscle tension. They state that the sympathetic nervous system innervates not extrafusal fibers but intrafusal fibers. Hubbard and Berkoff (1993) mention an electron microscopy study in cats, where 5-hydroxydopamine, which accumulates in vesicles of the terminals of postganglionic sympathetic axons, was used. The study demonstrated sympathetic endings in close proximity (a few microns) to intrafusal neuromuscular junctions and muscle fiber membranes. Prolonged or chronic spindle tension becomes painful by distending, distorting, or chemically sensitising the spindle capsule. Sympathetic activity explains the autonomic symptoms associated with trigger points and provides a mechanism by which local injury and nociception causes widespread tension and pain. For chronic muscular pain, this theory offers a mechanism of pathogenesis, an objective method of diagnosis and evaluation, and the potential for improved treatment.

2.6 CLINICAL CHARACTERISTICS OF MYOFASCIAL TRIGGER POINTS

Travell and Simons (1983:12) define an active trigger point as "a hyperirratable locus within a taut band of skeletal muscle, located within the muscular tissue and/or its associated fascia. The spot is painful on compression and can evoke characteristic referred pain and autonomic phenomena."

According to Rosen (1994) a trigger point hierarchy may exist, with primary trigger points possibly having secondary, tertiary and satellite trigger points.

Travell and Simons (1983:12-13) classify myofascial trigger points as either active or latent. An active trigger point causes the patient pain. A latent trigger point is clinically silent with respect to pain, but may cause restriction of movement and weakness of the affected muscle. A latent trigger point may persist for years; it predisposes to acute attacks of pain, since minor overstretching, overuse, or chilling of the muscle may suffice to reactivate it.

Myofascial pain is pain of muscle origin, although the central feature, a painful trigger point, can also be found in skin, tendons, periosteum and ligaments. Central to the concept of the trigger point is its extraordinary tenderness and its characteristic referral of pain to sites distant to the trigger point. Neurophysiologically, the trigger point is hypersensitive and has an expanded receptive field that includes areas distal to the primary trigger point. (Gerwin, 1994.)

Authors such as Sola et al. (1954), Graff-Radford et al. (1987) and Rosen (1993), all agree on a number of signs and symptoms of active trigger points. Included are the following: pain, stiffness, limitation of motion, weakness and autonomic phenomena, such as increased vasomotor activity, lacrimation and coryza, increased sudomotor activity, increased pilomotor activity (gooseflesh) or proprioceptive disturbances.

The main complaint of an active trigger point is pain, both localised and referred pain, the pain may vary in both intensity and quality from a low grade discomfort to a severe deep, burning, aching, incapacitating pain (Sola et al.,1954 and Graff-Radford et al., 1993). Rosen (1993) and Auleciems (1995) both agree that trigger points have a specific and characteristic pattern of referred pain.

According to Fricton (1994) patients complain of fatigue, anxiety, sleep disorders, depression and morning stiffness in chronic cases of myofascial pain syndrome.

Travell and Simons (1983:16) summarize the findings on examination of active trigger points as follows:

1. Active or passive stretching of the affected muscle causes an increase in pain.
2. The stretch range of motion of the muscle is restricted.
3. Pain is increased when the affected muscle is strongly contracted against fixed resistance.
4. The maximum contractile force of the muscle is weakened.
5. Dysesthesia may be referred to the zone of referred pain by the active trigger point.
6. Autonomic phenomena e.g. increased vasomotor, sudomotor and pilomotor activity may be referred to the pain referral zone of the affected muscle.
7. Muscle in the immediate vicinity of a trigger point feels tense to palpation.
8. The trigger point is found as a sharply circumscribed spot of exquisite tenderness in a taut palpable band.

9. Digital pressure applied on an active trigger point elicits a "jump sign," which is a general pain response of the patient, who winces, may cry out, and may withdraw in response to pressure applied on a trigger point (Travell and Simons,1983:2.)
10. Snapping palpation of the trigger point evokes a local twitch response in the muscle.
11. Moderate, sustained pressure on a sufficiently irritable trigger point causes or intensifies pain in the reference zone of that trigger point.
12. Dermographia or panniculosis may be evident on the skin of some patients.

2.7 DIAGNOSIS OF MYOFASCIAL PAIN SYNDROMES

According to Fricton (1994) the diagnostic criteria for myofascial pain syndromes needs to be broad enough to allow application to different muscle groups and to distinguish myofascial pain from systemic disorders affecting muscle.

Myofascial pain syndromes can mimic a wide variety of conditions and syndromes. Proper diagnosis is essential in the correct treatment of the condition. (Auleciems, 1995.) Auleciems (1995) states that diagnosing myofascial pain syndrome involves obtaining a careful history and performing a meticulous physical examination.

According to Travell and Simons (1983:155) and Auleciems (1995) laboratory and imaging studies are useful in identifying perpetuating factors and for ruling out other aetiologies. When trigger points are not responding to treatment, serum

vitamin levels, erythrocytic sedimentation rates, blood chemistry, full blood counts and thyroid function studies may help determine underlying perpetuating factors.

Fricton (1994) found blood and urine studies to be normal unless abnormalities were caused by other concomitant disorders and that radiographs and magnetic resonance imaging did not reveal any pathological changes in the muscle or connective tissue. He also mentions that no neurological deficit exists with the myofascial pain syndrome.

Gerwin (1994) states that no consistent anatomical change has been identified using light microscopy, electron microscopy or histochemistry. He discusses the limited role of non-steroidal anti-inflammatory drugs in the treatment of myofascial trigger points due to the lack of an inflammatory response and the lack of firm evidence that prostoglandins play a role in the development of trigger point pain.

Fischer (1987) discusses the reliability of the algometer in the objective assessment of pressure threshold of tender areas. He states that this method has been proven to be useful in diagnosing tender spots and trigger points.

Kemp (1994) proposes a comprehensive method for diagnosing myofascial pain syndrome. According to Kemp (1994) a diagnosis of myofascial pain syndrome can be made if 5 major criteria and at least 1 of 3 minor criteria are satisfied.

Major criteria

1. Localised spontaneous pain
2. Spontaneous pain or altered sensations in expected referred pain area for given trigger point.

3. Taut, palpable band in accessible muscle.
4. Exquisite, localised tenderness in precise point along taut band.
5. Some measurable degree of reduced range of movement

Minor criteria

1. Reproduction of spontaneously perceived pain and altered sensations by pressure on trigger point.
2. Elicitation of a local twitch response of muscular fibers by transverse "snapping" palpation or by needle insertion into trigger point.
3. Pain relief obtained by muscle stretching or injection of trigger point.

2.8 OVERVIEW OF MUSCLES

An overview of the muscles used in this study follows:

2.8.1 The Trapezius Muscle (Travell and Simons 1993:183)

The trapezius muscle also known as the "coat hanger" consists of three parts, the upper, middle and lower fibers. The three sections can function independently. Trigger points in the upper fibers refer pain along the posterolateral aspect of the neck, behind the ear and to the temple. Middle fibers refer pain toward the vertebra and to the interscapular region.

Referred pain from the lower trigger points are mainly to the neck, suprascapular and interscapular regions. Symptoms include referred pain with little weakness or limitation of motion. Active rotation of the head and neck to the opposite side is painful at full range and lateral flexion is slightly restricted.

2.8.2 The Levator Scapulae Muscle (Travell and Simons,1983:334)

Patients with levator scapulae trigger points usually present with a "stiff neck." Referred pain is mainly in the angle of the neck and along the vertebral border of the scapula. Activation of the trigger points is usually due to sustained elevation of the shoulders or due to cramping of the muscle, when fatigued or exposed to cold. Neck rotation is primarily affected.

2.8.3 The Supraspinatus Muscle (Travell and Simons,1983:368)

The characteristic referred pain of this muscle is felt as a deep ache in the mid-deltoid region of the shoulder and pain down the arm, mainly to the lateral epicondyle but rarely to the wrist. Referred pain is aggravated by forceful abduction of the arm and passive adduction of the arm behind the back.
The pain may disturb the patients sleep. Limitation of motion is evident with the Hand-to-shoulder blade and Mouth-wrap-around tests.

2.8.4 The Infraspinatus Muscle (Travell and Simons,1983:377)

Referred pain from the trigger point locations in the infraspinatus muscle concentrates deeply in the anterior deltoid region and in the glenohumeral joint, the pain may extend down the anterior and lateral aspects of the arm and forearm and the radial aspect of the hand. Suboccipital and posterior cervical areas may also be areas of referred pain. Overload of the muscle while reaching backward and up may activate these trigger points.
Internal and external rotation at the shoulder may is usually restricted. Sleeping on ones side, brushing hair or teeth and reaching into back pocket or for bra hooks is painful.

2.8.5 The Rhomboideus Major and Minor Muscles

(Travell and Simons,1983:425)

Characteristic referred pain patterns for these muscles are medially to the vertebral border of the scapula and over the supraspinous area of the scapula. Poor posture is the main cause of activation. Restriction of arm range of motion at the shoulder is minimal. Patients often present with a round shoulders appearance due to latent trigger points in the pectoralis major muscle,which cause the shoulders to be pulled forward and weaken the interscapular muscles.

2.9 TREATMENT OF MYOFASCIAL PAIN SYNDROMES

Many authors have found success in the treatment of myofascial pain syndromes using a wide variety of treatment methods and techniques (Fricton, 1994.) Auleciems (1995) comments that an excellent prognosis can be expected if the myofascial pain syndrome is effectively managed. According to Rosen (1993) treatment programs and protocols may prove unsuccessful if clinicians fail to understand the condition, misdiagnose the pain syndrome or fail to correct co-existing conditions, perpetuating factors and underlying dysfunction's.

A variety of hands-on skills, such as stretching, massage, manipulation, mobilisation and strengthening; and a wide variety of modalities namely, heat, ice, ultrasound, electrical stimulation, mechanical pressure and light energy, are available to physicians and therapists for the treatment of trigger points (Rosen, 1994; Fricton, 1994; Auleciems,1995 and Bruce, 1995.)

It is the opinion of Fricton (1994) that the two most common treatment methods for myofascial pain syndromes are trigger point injection and the spray and stretch technique.

2.9.1 Spray and Stretch Technique

The spray and stretch technique is described by Travell and Simons (1983:63) as being the "workhorse" of myofascial therapy. It is their opinion that this technique is the one technique that inactivates myofascial trigger points more quickly and with less discomfort than local injection or ischaemic compression.

Travell and Simons (1983:64) state that the spray is the "distraction" and the stretch the "action". They found the best results with spraying, then stretching and then spraying again. The commonly used vapocoolant sprays used are flouromethane and ethyl chloride (Travell and Simons, 1983:67; Bruce, 1995).

According to Auleciems (1995) this technique is useful in simultaneously treating multiple trigger points in a muscle or group of muscles and is also useful after trigger point injection therapy.

Hong et al. (1993) found in a study of 56 patients, with active myofascial trigger points, that pain threshold increased significantly after the application of the spray and stretch technique. When compared to the two control groups; control group 1-patients received no therapy (n=21), control group 2-placebo (n=16), the increase in the experimental group (n=19) was significantly more.

2.9.2 Needling Therapy

Three variations of the needling technique are found in the literature, these include dry needling, injection of saline and injection of local anaesthetic.

Lidocaine, procaine and bupivicaine are some local anaesthetics that have been used in the treatment of trigger points (Travell and Simons, 1983:75; Auleciems, 1995 and Bruce, 1995). Murphy (1983) has experienced more consistent success with local anaesthetic than with dry needling. Rosen (1994) has also found, through his experience, local anaesthetic to be more beneficial than dry needling in trigger point therapy. He found the onset of relief to be more instantaneous and the discomfort after the treatment to be significantly less when using local anaesthetic, when compared to dry needling.

Wreje and Brorsson (1995) conducted a randomised controlled clinical trial, of 116 subjects, in which they compared the effectiveness of saline injection (n=61) to that of sterile water injection (n=55) in the treatment of myofascial trigger points. They found neither method to be more effective than the other, but they mention that the injection of sterile water caused greater patient discomfort.

Broome (1996:92) found, in a controlled study of 30 patients, both saline injection therapy and dry needling therapy to be equally effective in the treatment of myofascial trigger points . He found the dry needling caused less patient discomfort compared to the saline.

2.9.3 Ischaemic Compression

Ischaemic Compression is a technique in which digital pressure is sustained to a trigger point with sufficient force and for a long enough duration to inactivate it (Travell and Simons, 1983:86). Travell and Simons (1983:86) named the technique "Ischaemic Compression" because, on release of pressure the blanched skin shows a reactive hyperaemia.

Travell and Simons' (1983:87) application of Ischaemic Compression is as follows: The relaxed muscle is stretched to the verge of discomfort. The thumb (or a strong finger) is pressed directly on the trigger point to create tolerably painful, sustained pressure. As the discomfort abates pressure is gradually increased. The process is continued for approximately one minute. If trigger point tenderness persists, the procedure can be repeated after application of a hot pack and active range of motion exercises.

According to Gatterman (1990:296) pressure can be applied using a thumb, finger, knuckle or elbow depending on the size, depth and thickness of the muscle being compressed. She states that mechanical devices can be used but that they do not give the necessary feedback as the trigger point releases.

2.9.4 Chiropractic Treatment

Gatterman (1990:286) states that chiropractic therapy has proved to be among one of the most effective treatment of myofascial pain syndromes. Chiropractic care along with life style changes including stretching and light aerobic exercise, adequate rest, relaxation, and changes in attitude can bring much relief to

myofascial pain syndrome sufferers. This author gives no mention of what "chiropractic therapy" involves.

2.9.5 Electrotherapeutic Modalities

Murphy (1983) states that trigger points can be treated with various electrotherapeutic devices, these include high-voltage electrical stimulation, such as interferential current therapy, transcutaneous electrical nerve stimulation (TENS), microcurrent and ultrasound. He experienced best results with a combination of electrotherapeutic modalities and the spray and stretch technique.

According to Rosen (1994) modalities are beneficial in the treatment of myofascial trigger points in terms of achieving muscle relaxation, improved circulation, pain relief and relief of muscle hypertonicity. He also mentions that modalities should be used as an adjunct to other treatment rather than as the primary treatment of myofascial pain syndrome trigger points.

Electrical stimulation, electroacupuncture, TENS and ultrasound act at tissue level and are helpful in stimulating muscles and trigger points (Fricton, 1994; Rosen, 1994; Bruce, 1995).

According to Travell and Simons (1983:92) electrical stimulation that causes muscular contraction tends to aggravate trigger point symptoms.

2.10 INTERFERENTIAL CURRENT THERAPY

2.10.1 A Historical Overview of Interferential Current Therapy

Dr. Hans Nemec of Austria originally developed frequency-difference interferential current therapy in the late 1940's to overcome the skin resistance created by the introduction of low-frequency currents through the skin (Gatterman 1990:351). Medium frequency currents pass much more readily through the skin, with only mild sensory stimulation. Interferential current excited only little interest when it was first introduced due to the fact that its development coincided with that of powerful anti-inflammatory medications such as the corticosteroids and phenylbutazone. (Ganne et al. 1979.) Following the publication of Melzack and Wall's theories on pain in 1965 neurophysiologists and surgeons made use of low frequency currents to stimulate large afferent fibres to inhibit pain, this prompted a resurgence of the old physiotherapeutic technique (Ganne 1976).

2.10.2 Mechanism of Action of Interferential Current

Interferential current utilises two medium-frequency alternating currents that differ in frequency by 0-150 Hz. One circuit is set at 4000 Hz while the other oscillates between 4000 Hz and 4150 Hz. When the two circuits interfere with one another, a beat frequency is created, which is the difference in frequency between the two circuits. The beat frequency acts as a low frequency alternating current. With twin-current quadripolar application, stimulation occurs in a cloverleaf pattern around the electrodes due to the nature of the interfering electromagnetic currents. (Gatterman 1990:352.)

Initially the rotating vector was used, which rotates the cloverleaf pattern within the tissues, to get a more generalised effect. The disadvantage with this method is that the centre of interference does not move and the depth of the beat is reduced thus decreasing strength of treatment. (Dynatronics Manual, 1994:59.)

A more advanced method is the Sweep which is described in the Dynatronics Operators Manual (1994:60). The Sweep feature literally moves the point of interference inward and outward in a spiral pattern, bathing about 80 percent of the area within the electrodes with the interferential current.

Delivery of current through a pen-electrode or probe allows for treatment of very small areas (Dynatronics Manual 1994:64). The pen-electrode therapy utilizes an active probe and a ground electrode. The active probe delivers the current to the patient and the ground electrode completes the circuit. The active probe is placed on the patient's skin over the myofascial trigger point and the ground electrode is placed at any location on the patient's skin away from the treatment site. (Dynatronics Manual 1996:16). Goats (1990) also describes some units that incorporate four electrodes into a single small applicator which facilitates the effective treatment of superficial or localised lesions.

2.10.3 Effects of Interferential Current

According to Low (1988:162) different beat frequencies result in different effects. Higher beat frequencies, around 100Hz, are used for their analgesic effect whereas lower beat frequencies, around 10Hz, produce innervated muscle contraction (Low 1988:162.)

Goats (1990) states that the optimum frequency of stimulation for voluntary muscle appears to be 40-80 Hz, whereas visceral muscle, supplied by the autonomic nervous system, is stimulated optimally at 10-50 Hz.

Most authors agree on the hypothesis that all the effects are due to stimulation of nervous tissue which leads to various secondary effects, such as pain relief and muscle contraction (Ganne, 1976; Low, 1988:162 and Goats, 1990).

2.10.3.1 Control of Pain

A summary of the mechanisms thought to be involved in pain relief follows:

a) Activation of the pain gate control mechanism

Stimulation of the large diameter cutaneous fibres results in closure of the "pain gate" in the dorsal horn of the spinal cord. The closure impedes transmission of nociceptive impulses in the second order neuronal pathway for pain. Interferential current at a frequency of 100Hz would stimulate these large diameter nerve fibres.(De Demonico, 1982.)

b) Activation of nociceptive fibres

Direct stimulation of the pain nerve endings (A delta and C fibres) can diminish pain by means of the descending pain suppresser system. Nociceptive impulses pass up to the mid-brain, particularly to the periaqueductal grey matter and raphe nuclei. Cells from the raphe nuclei send impulses back down the spinal cord to the level of origin of the pain. At this point an inhibition of the second order

nociceptor neuron occurs, via an inhibitory interneuron. In other words, nociceptive stimuli produce an autoinhibition via a complex negative feedback system operating within the central nervous system. Interferential current, at a frequency of 10-25 Hz, can stimulate these pain nerve endings directly. (De Demonico, 1982.)

c) Physiological block

A high frequency stimulus of above 50 Hz could possibly cause a temporary physiological block in the pain nerve endings (A delta and C fibres). The pain gate closure and the physiological block would occur at a beat frequency of 80-100 Hz. (De Demonico,1982.)

d) Increased blood flow

Increased local blood flow and tissue fluid exchange will hasten the removal of chemical irritants acting on nociceptive nerve endings and reduce pressure due to local exudate, resulting in a reduction of pain. Regular mild muscle contraction has a pumping effect on vessels and stimulation of the autonomic nervous system may result in vasodilation. (Low, 1988:163.)

e) The placebo effect

According to Low (1988:163) the placebo effect could contribute to the pain relief achieved when using interferential current therapy, due to the machine being technically impressive and the sensation of the current, being unfamiliar to most patients.

2.10.3.2 Muscle Contraction

Any beat frequency within the biological range can produce muscle contraction. A lower beat frequency of 40-80 Hz is optimal in achieving a tetanic contraction whereas isolated twitch contractions occur with beat frequencies less than 5 Hz. (De Demonico and Strauss, 1985.)

Interferential current can produce strong, efficient and comfortable muscle contraction (De Demonico and Strauss, 1985; Low 1988:164).

De Demonico and Strauss (1985) summarise the clinical response to muscle contraction as follows:

- muscle re-education
- prevention of disuse atrophy
- increased muscle strength and endurance
- reduction of muscle spasm
- modulation of spasticity

2.10.4 Conditions Treated with Interferential Current

2.10.4.1. Pain

According to Low (1988:164) interferential current is widely used for pain relief and it is his opinion that it is effective in the management of neurogenic and chronic pain.

Walsh et al. (1995) conducted a study on 88 patients in which they investigated the effect of four combinations of low frequency electrical stimulation pulse durations and frequencies on nerve conductance and mechanical pain threshold. Results showed that the TENS parameters of 110 Hz and 200 ms produced the most beneficial effects. These parameters decreased the conductance velocity of the nerve and increased the mechanical pain threshold, measured over the sensory distribution of the same nerve, more effectively than the other three groups of parameters.

They concluded by stating that the combinations of TENS parameters are important to the peripheral neurophysiological and hypoalgesic effects. Both TENS and the beat frequency of interferential current are forms of low frequency electrical stimulation, hence a TENS study being discussed above.

2.10.4.2. Muscular Pathology

Low (1988:164) states that muscle spasm would be decreased with any reduction in pain.

Willie (1969) concluded a study in which he compared interferential current therapy (n=10) to ice therapy (n=10) in the treatment of pulled muscles and haematomas, in participants of body contact sports. In the interferential current therapy group, 100 Hz was used for the first 24 hours after injury, then a frequency of 0-100 Hz was started once the bleeding had ceased. The relief of pain and the absorption rate was considerably faster when compared to that of the 10 subjects who received ice therapy.

2.10.4.3. Ligamentous Lesions

Willie (1969) treated a series of 10 strained lateral ligaments of the ankle with interferential current. The pattern of treatment was as follows:

100 Hz for 10 minutes - 1st treatment

0-100 Hz for 10 minutes - 2nd treatment

0-100 Hz for 10 minutes - 3rd treatment

7 patients were symptom free after the three treatments. 1 patient needed a course of another three treatments before being symptom free. 2 patients showed no improvement

2.10.4.4. Tissue Healing

According to Goats (1990) interferential current therapy alters the intracellular concentration of enzymes and other molecules involved in many metabolic processes. Goats (1990) lists acceleration of bone healing, repair of nerves, tendons and ligaments and improved regeneration of the liver as some factors influenced by interferential current therapy.

Ganne et al. (1979) conducted a study in which 150 patients had fractures of the mandible, with factors known to predispose to non-union. Nine patients received interferential current during the fixation period. All nine fractures united satisfactorily.

They compared the results with a retrospective study of 150 consecutive mandibular fractures previously treated by the same surgeons without interferential current, 3 fractures resulted in non-union requiring grafting. Thus the incidence of non-union was 0% when interferential current was used as compared to 2% in the control group.

2.10.4.5 Myofascial Trigger Points

Most studies done using low frequency current therapy for the treatment of active myofascial trigger points has been done using transcutaneous electrical nerve stimulation (TENS).

Graff-Radford et al. (1987) conducted a double-blind study involving 60 patients with active myofascial trigger points. The effect of TENS on myofascial pain and trigger point sensitivity was evaluated. One of five treatment modalities was applied to the patient for 10 minutes, the treatment modalities were as follows:

1. TENS at 2 Hz, pulse width 250 m.sec, asymmetrical rectangular biphasic waveform, strongest intensity tolerable (10-40 Ma).
2. TENS at 100 Hz, pulse width 250 m.sec, identical waveform as above with intensity of < 39 Ma.
3. TENS at 100 Hz, pulse width 50 m.sec, identical wavefrom as above with intensity of <39 Ma.
4. TENS at 1200-20 000 Hz, pulse width 15 m.sec, identical waveform as above with intensity of 1-4 Ma.
5. The placebo group, no battery was used in the unit.

The greatest reduction in pain (50%) occurred in patients who were in group 4. The study demonstrated that high frequency and high intensity electrical stimulation was effective in decreasing myofascial pain sensitivity. They concluded from their study that high frequency electrical stimulation may reduce myofascial pain without affecting the trigger point sensitivity.

Frampton (1985) conducted a study to evaluate the effect of electroacupuncture (a combination of needling and low frequency stimulation) in the treatment of trigger points in muscles of the neck and back. An unselected group of 28 consecutive subjects (12 had back pain and 16 had neck pain) were involved in the study. Impulses were delivered over the sites of palpable tenderness via an Asah El-acupuncture search probe. Patients completed the Visual Analogue Scale (VAS) before and after the treatment. In the patients with neck pain there was an improvement of 1.57 cm in the VAS and the α-value was 2.06, indicating improvement at the 5% level of confidence. In the patients with back pain there was an improvement of 0.58 cm in the VAS and the α-value was 0.43, indicating no significant improvement. The results from this study show this treatment to be effective in the treatment of neck pain but not in the treatment of back pain.

Airaksinen and Pontinen (1992) conducted a study in which they evaluated the effects of low frequency electrical stimulation on myofascial trigger points. The subjects were 14 female patients who suffered from chronic tension headaches. 76 trigger points on the right side were accepted for the study. The left side acted as the control. The algometer was used to assess trigger point pain threshold before and after treatment. Each trigger point was treated for 30 seconds at two different consultations. The Acuhealth device was used in the negative output mode of 3.5 volts rms at 2.5 Hz.

The results showed an immediate increase in the pain threshold in the experimental group following treatment. They concluded by suggesting that electrical stimulation treatment may have a beneficial effect on pain threshold. No differentiation was made between active and latent trigger points in this study.

Lehmann et al. (1983) compared TENS of high frequency, high amplitude with electroacupuncture of low frequency, high amplitude stimulation and found the electroacupuncture to have a slower induction time.

Christie (1995) conducted a controlled study involving 30 patients with myofascial trigger points of the trapezius, levator scapulae, rhomboid major and minor, supraspinatus and infraspinatus muscles. The aim of the study was to determine whether the use of interferential current provided a non-invasive alternative to dry needling agitation in the treatment of myofascial pain syndromes.

The interferential current used was the pen-electrode type. Both treatment groups were treated between four and six times, treatments were within three days of the previous treatment, and then re-evaluated after a three week follow-up period.

The Psychological Well Being Schedule, CMCC Neck Disability Index and Numerical Pain Rating scales were used as subjective measurements and the algometer was used as the objective measurement. The comparison of subjective and objective data between the interferential current group and the dry needling group showed no significantly statistical difference at any time. Comparison of subjective and objective data within each group showed a significant improvement in both groups.

Thus Christie concluded that interferential current, using the pen electrode, is an effective and viable alternative treatment to dry needling in the treatment of myofascial pain syndromes.

2.11 CONCLUSION

Travell and Simons (1983) and others (Skootsky et al., 1989; Auleciems, 1995; Bruce, 1995 and Wreje et al., 1995) have shown in previous studies myofascial pain syndrome to be a debilitating, unrecognised and undertreated condition.

As is evident from the available literature many methods of management and treatment exist for myofascial trigger points (Travell and Simons,1983; Rosen, 1994; Fricton, 1994; Auleciems, 1995 and Bruce,1995) but there remains the need for assessment into the most effective form of treatment of this condition.

There is a limited amount of literature available on the treatment of myofascial pain syndrome using interferential current. Christie (1995) concluded that interferential current, in the form of the pen-electrode, is an effective treatment of myofascial trigger points. Although the four-electrode method of interferential current application has been studied (Willie, 1969; Lehmann et al.,1983 and Goats,1990), its role, long term effects and advantages/disadvantages over the pen-electrode method still remains unclear. One debatable aspect of the pen-electrode method, used in Christies study, is that only a small area of the affected muscle is treated, that being the trigger point.

Therefore a study comparing this method to the four-electrode method using the sweep function, which penetrates 80 percent of the affected muscle, would

demonstrate how specific the application of interferential current needs to be for the treatment of trigger points and which method of current application is more effective in the treatment of myofascial pain syndromes.

CHAPTER THREE

MATERIALS AND METHODS

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 INTRODUCTION

The details of the research study undertaken are discussed in this chapter. This includes a detailed description of the study design, the subjects used and the interventions utilized. Measurements obtained and the statistical analysis for evaluation of data are also discussed.

This study was designed as a comparitive, randomised clinical trial. The objective of this study was to assess for intra-group improvement within the two treatment groups (namely, four-electrode interferential current and pen-electrode interferential current). Then an inter-group statistical analysis was performed to determine which treatment of myofascial pain syndrome had more effect.

3.2 THE SUBJECTS

Patients were obtained by means of advertisements placed on local noticeboards, around Technikon campus and on local radiostations. No restrictions were placed on the patient's racial group, sex, area of residence, income bracket or occupation.

Any patient presenting to the Technikon Natal Chiropractic Day Clinic with neck pain, upper back or shoulder pain was briefly screened to assess whether they could be considered for the study.

Screening consisted of questions concerning location of pain, character of pain and presence of referred pain as well as a brief examination, by means of palpation, for the presence of active trigger points.

If, in the opinion of the researcher, the patient was likely to comply with the criteria necessary for acceptance into the study, then the patient underwent further examination by the researcher.

3.3 INCLUSION AND EXCLUSION CRITERIA OF PATIENTS

1. Patients had to be between the ages of eighteen and fifty-five.
2. Only patients diagnosed by the researcher as having active myofascial trigger points of the trapezius, levator scapulae, supraspinatus, infraspinatus and rhomboid major and minor muscles were considered.
3. Any patient suffering from systemic or local pathology were not be eligible for the study.e.g.heart disease, danger of hemorrhage, potentially malignant lesions, multiple sclerosis, bacterial infections, skin diseases and epilepsy.
4. Patients were not allowed to take analgesics, nor receive any manual therapy for the duration of the participation in the study. Manual therapy included chiropractic adjustments, any electrotherapies other than the treatment interventions of the study, any other myofascial therapy or soft tissue therapies.
5. The patient's condition had to comply with all eight criteria for the diagnosis of active myofascial trigger points of the trapezius, levator scapulae, supraspinatus, infraspinatus and rhomboid major and minor muscles as described by Travell and Simons (1983:18-19):

- Either a history of rapid onset during, or shortly following acute overload stress, or a history of gradual onset with chronic overload of the affected muscle.
- A pattern of pain referred from the trigger point that is characteristic for that muscle in which it is located.
- Weakness of the affected muscle with associated restriction in its stretch range of motion.
- A taut palpable band in the affected muscle.
- Intense focal tenderness of the taut band to applied pressure.
- A local twitch response produced by needling or snapping palpation of the trigger point.
- Reproduction of the characteristic pain patterns by needling or palpating the trigger point.
- Elimination of the clinical presentation by specific trigger point therapy.

6. If, from the medical case history, physical examination or cervical/upper back regional examination there were indications for a radiographic examination then patients were excluded from the study.
7. Patients with concomitant facet syndrome were included in the study but were not treated for the facet syndrome.
8. Any patient for whom Interferential Current Therapy was contraindicated, as described by Low (1988:166), was excluded from the study:
   - Interferential current should not be used in the case of haemorrhage in a region, because stimulaiton may cause further haemorrhaging.
   - Neoplastic tissue should not be treated directly in case the interferential current stimulates growth or encourages metastasis.
   - Acute infections should be avoided because the current may provoke the further spread of the infection.

- Patients with cardiac pacemakers should not be treated with interferential current.

9. The patient had to sign a consent form (appendix E), this gave the researcher permission to use the patient in the study.

3.4 THE SAMPLE GROUP

The sample group of thirty patients was randomly divided into two groups of fifteen according to the process of randomisation as described by Scott-Dawkins (1995). Fifteen papers were inscribed with the letter P (representing the pen-electrode group) and fifteen were inscribed with the number 4 (representing the four-electrode group). The identical labels were then folded to prevent the letters being seen, and then placed in a box. After the box had been sufficiently agitated, the labels were drawn out one at a time. The sequence of letters drawn was then recorded next to a list numbering one to thirty (appendix A). Depending at what point in the list the patient joined the study, the patient would be allocated a treatment group correlating to the same number in the list.

There was no patient blinding involved in this study as each patient was informed of the two treatment groups and to which group they had been allocated.

The methodology followed was similar in execution to that used by Christie (1995) and Broome (1996). The procedure for the study was as follows: Each patient that passed the initial screening test and inclusion criteria underwent a detailed case history (appendix B), a physical examination (appendix C) and a cervical spine regional examination (appendix D).

Once this was completed and the patient's condition had satisfied the diagnostic criteria, a series of five treatments within a maximum of three weeks were booked. A follow-up appointment was then booked for one month after the fifth consultation.

3.5 INTERVENTIONS

Patients in group A received four-electrode interferential current as their treatment while patients in group B received pen-electrode interferential current over the affected muscle. The patients in group A had the procedure explained to them and were instructed to lie prone. Interferential current was applied to the active trigger points through four small adhesive POLYS™ electrodes (1-3/4" x 1-3/4") placed on the skin at the periphery of the muscle or muscles, containing the active trigger points. The electrodes were placed in such a way that they formed a square. The electrodes were sprayed with Dyna Mist™ , a conductivity enhancing material, before they were placed onto the skin. The interferential feature (quadpolar) , the sweep feature and the high frequency range was selected on the unit. The high frequency range is 80 to 150 Hz. This frequency was the frequency delivered to the patient. In the interferential mode, two output jacks are utilized with four electrode pads placed in a criss-cross fashion. Output from Channel 1 is a constant 4000 Hz wave, while the output of Channel 2 is the variable 4000 to 4150 Hz sine wave. These particular parameters were chosen as it is recommended in the Dynatron 550 Operator's Manual (1996:58) and by Guffey (1996:5). The intensity of the current was determined by the patient, under the guidance of the researcher.

The patients in group B also had the procedure explained to them and were instructed to lie prone. Interferential current was applied to the active trigger point through the pen-shaped point electrode. Current was delivered by the pen-electrode to the skin

through a cotton ear bud. The cotton ear bud was sprayed with the Dyna Mist ™ before being applied to the patient's skin. The ground electrode, a small adhesive POLYS™ electrode (1-3/4" x 1-3/4"), was also sprayed with the Dyna Mist ™ before being placed onto the skin close to the active trigger point.

The premodulated feature (bipolar) and the high frequency range were selected on the unit. Premodulated therapy utilizes one output jack and produces a composite wave form identical to that of the four-electrode interferential current while using only two electrodes. The Dynatron 550 achieves this by mixing the two sine waves within the unit. The intensity of the current was determined by the patient, under the guidance of the researcher.

Treatment time for both groups was 10 minutes, as recommended by Gatterman (1990:355). All active trigger points in the relevant muscles were treated in both groups.

The Interferential equipment used was the Dynatron 550 manufactured at the Dynatronics Corporation, 7030 Park Centre Drive, Salt Lake City, Utah, USA, 84121. This equipment was used in the treatment of both groups A and B.

3.6 MEASUREMENTS

The active trigger points were recorded on the Algometer/Goniometer form (appendix F). This form served as a record to indicate the active trigger points in the trapezius, levator scapulae, supraspinatus, infraspinatus and rhomboid major and minor muscles and made the relocation of trigger points on subsequent visits more accurate.

The subjective and objective measurements were taken at the first consultation and were repeated at treatment five and at the one month follow-up consultation. This allowed for assessment of any improvement during the treatment period and after the one month following cessation of treatment.

No objective or subjective data was collected at treatments two, three and four. Only the allocated research intervention was performed on the patient.

3.6.1 Subjective Measures

The primary data was collected via the written communications method. The patient completed the Short-Form McGill Pain Questionnaire (appendix G), the Numerical Pain Rating Scale-101 (appendix H) and the CMCC Neck Disability Index (appendix I). These three forms subjectively assess various aspects of the patient's pain.

3.6.1.1 The short-form McGill Pain Questionnaire (appendix G)

The data obtained with the short-form McGill Pain Questionnaire provides information on the sensory, affective and overall intensity of pain (Melzack, 1987). Melzack (1987) conducted two studies at the Montreal General Hospital. In the first study both the long form and short form of the McGill Pain Questionnaire was presented to the following patients, post-surgical (n=40), obstetrical (n=20) and musculoskeletal (n=13), before and 30 minutes after medication or other therapy for pain was administered. A second study was carried out due to the order of presentation of the long and short forms in the first study. 31 post-surgical and 31 dental patients participated in this study. In both groups, patients were assigned an order, long form followed by short form or vice versa, on the basis of a computer-generated list of random orders. The

short-form McGill Pain Questionnaire was developed for use in specific research settings when time, for the capture of patient information regarding the sensory dimension of pain, was limited. This questionnaire correlates highly with the major pain rating indices (sensory, affective and total) of the long-form McGill Pain Questionnaire and is sensitive to traditional therapies, analgesic drugs, epidural blocks and transcutaneous electrical nerve stimulation. (Melzack, 1987.)

The short-form McGill Pain Questionnaire consists of fifteen words from the sensory and affective categories of the long-form McGill Pain Questionnaire. The Present Pain Intensity and the Visual Analogue Scale are also included to provide overall pain intensity. Each pain descriptor is ranked by the patient on an intensity scale of 0 = none, 1 = mild, 2 = moderate, 3 = severe.

3.6.1.2 Numerical Pain Rating Scale (101 Scale) (appendix G)

The Numerical Pain Rating Scale assesses the perceived level of pain intensity of a patient (Jensen et al.,1986).

The questionnaire consists of a numerical scale from 0 to 100, with the 0 representing one extreme (e.g. 'no pain'), and the 100 representing the other extreme (e.g. 'pain at its worst). The patient indicates by means of a percentage the intensity of their pain, both at its best and at its worst.

Jensen et al. (1986) completed a consecutive clinical trial which consisted of 75 patients (31 males and 44 females) who had had pain for at least six months. The study examined the usefulness of six different pain intensity measures in a group of chronic pain patients. The study found the Numerical Pain Rating Scale to be the

superior measure. This questionnaire has several practical advantages over the other measures. It can be administered in written or verbal form and is extremely simple to score. In addition, it has 101 response categories and thus is more likely to be accepted by researchers concerned with the limited response options of the other measures. The Numerical Pain Rating Scale does not appear to be associated with incorrect responding more than any other scale and the difficulty of the scale is not associated with age.

This questionnaire is a wise choice for use in a study in which a standard measure of pain intensity is needed to facilitate comparisons of treatment outcome and to index chronic patients' pain intensity levels at different times in their lives (Jensen et al., 1986).

3.6.1.3 CMCC Neck Disability Index (appendix I)

The Neck Disability Index is a revised form of the Oswestry Low Back Pain Index and is a self-reporting instrument used for the assessment of how the activities of daily living of sufferers of disabling neck pain are affected. Features of this comprehensible, relevant instrument is the ease of use, scoring and the general format of presentation. (Vernon & Mior,1991.)

Vernon and Mior (1991) completed a clinical trial which consisted of 48 patients (17 males and 31 females) who presented with neck pain (70% of the patients had sustained a whiplash-type injury within six weeks of the study while 30% presented with more chronic non-traumatic neck complaints). The study, which assessed the validity of the Neck Disability Index, demonstrated that it achieved a high degree of test-retest reliability and internal consistency, unaffected by age or gender, and that it

appeared to have an acceptable level of validity, being sensitive to the level of severity and to changes in the severity over time.

The CMCC Neck Disability Index is a 10-item ordinal scale questionnaire. The patient has to answer 10 questions, each with a maximum score of 5 and a minimum of 0. The total score is out of 50 and is represented as a percentage.

3.6.2 Objective Measurements

An objective assessment of the changes in the patient's condition during the treatment period and after one month also formed part of this study. The algometer and goniometer were used to obtain this objective data. At the initial consultation algometer readings were carried out on the active trigger points in the relevant muscles while the goniometer was used to evaluate cervical spine range of motion. These two instruments gave an objective assessment of the patient. Immediately following the treatment of the first consultation algometer and goniometer readings were retaken so that the immediate reaction to treatment could be objectively assessed.

3.6.2.1 The Algometer

According to Fischer (1987), evaluation of the therapeutic efficacy in myofascial pain syndromes is based primarily on the subjective assessment of local tenderness, but there are certain methods, such as pressure threshold measurement that are particularly useful in the objective assessment of treatment results. Pressure threshold is the maximum pressure inducing pain or discomfort (Fischer, 1986). Fischer (1987) performed a study on the pressure threshold measurement for diagnosis and

evaluation of treatment results of trigger points. Twenty-four males and twenty-six females participated in the study. Pressure threshold measurement values were established at nine different sites, frequently affected by trigger points, including the trapezius, supraspinatus and infraspinatus muscles. The deltoid was used as the reference for normal muscle sensitivity. He concluded that algometry is a useful method for diagnosis of tender spots and trigger points and particularly useful in their clinical management and assessment of treatment results.

Reeves et al. (1986) presented three studies pertaining to the reliability of the Algometer. Fifteen patients (11 female and 4 male) diagnosed with active myofascial trigger points contributing to head and neck pain participated in the first study. Two experimenters independently measured the pressure threshold of five specifically marked trigger points on two seperate occasions. The first study, a randomised, controlled clinical trial, showed both inter and intra-examiner reliability when measuring marked trigger point locations. Twelve patients (10 females and 2 males) with myofascial pain of the head and neck participated in the second study. The second study was identical to the first except that the trigger points, in the involved muscles, were not marked. In the second study, inter and intra-examiner reliability was shown when locating and measuring unmarked trigger points. Nine patients (7 females and 2 males) volunteered for the third study. The procedure was identical to study 1 except in addition to measuring the trigger points the experimenters also measured an adjacent non-trigger point location,within 2cm diameter from the trigger point. In the third study, Reeves et al. (1986) concluded that trigger points are discrete points of focal tenderness.

The algometer used in this study was the FDK20 force-dial made by Wagner Instruments (P.O Box 1217, Greenwich, CT, 06836 USA, Tel.:203 869 9861) and supplied by Activator Methods Inc.

The algometer was used as follows:

- The dial on the guage was set to zero.
- The 1cm rubber disc was applied to the point of maximum tenderness by placing the gauge perpendicular to the surface.
- The patient was told to say "now" at the point at which they first perceived pain.
- The pressure was gradually increased at a rate of 1kg/second, as recommended by Fischer (1986).
- The researcher stopped applying pressure as soon as the patient indicated discomfort.
- The reading on the dial was immediately recorded on the Algometer/Goniometer form (appendix F).
- This procedure was repeated for all active trigger points in the relevant muscles.

3.6.2.2 The CROM Goniometer

Disorders of the cervical spine often alter the normal active range of motion of the neck. The response of a patient with neck pain to therapeutic intervention is clinically evaluated by measuring changes in the cervical spine active range of motion. (Youdas et al.,1991.) Based on a clinical study of 60 patients with orthopaedic disorders in a physiotherapy department it was concluded that the CROM device had good to high intra-examiner reliability. The CROM device also proved to have a high interexaminer reliability. (Youdas et al.,1991.)

The range of motion of the cervical spine was measured with a Cervical Spine Range of Motion goniometer. The ranges of motion that were measured were : forward flexion, extension, right and left lateral flexion, and left and right rotation.

The CROM model used in this study was the Performance Attainment Associates Model.

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

- The patient was made to sit in a chair with their thoracic spine maintaining contact with the back-rest of the chair and the lumbar spine filling the gap between the seat and the back rest. The feet were positioned flat on the floor and the arms rested freely at the sides.
- The plastic frame was places over the patient's nose and ears and secured in place with Velcro straps.
- The three orthogonally arranged dials attached to the frame were checked to insure they were set at zero.
- The flexion, extension and lateral flexion movements were assessed by gravity dependant goniometers, while rotation movements were assessed with a compass goniometer in conjunction with a magnetic yoke.
- To measure flexion the patient was asked to make a double-chin and then flex futher until full movement was obtained.
- To measure extension the patient was instructed to "nod the head back as far as it can go."
- To measure lateral flexion the patient was instructed to tip the left and right ears towards the respective shoulders without turning their head or raising their shoulders.

- To measure rotation, the magnetic yoke was places around the patient's neck and the compass was set to zero. The patient was instructed to turn the head as far to the right and left as possible without moving their shoulders.
- All the measurements were recorded on the Algometer/Goniometer form (appendix F).

3.7 THE SPECIFIC TREATMENT OF EACH SUB-PROBLEM

3.7.1 The First Sub-Problem

The first sub-problem was to determine the relative effect of four-electrode interferential current in the treatment of active myofascial trigger points as opposed to pen-electrode interferential current in terms of subjective clinical findings to determine which has a greater effect in the treatment of myofascial pain syndrome.

3.7.2 The Second Sub-Problem

The second sub-problem was to determine the relative effect of four-electrode interferential current in the treatment of active myofascial trigger points as opposed to pen-electrode interferential current in terms of objective clinical findings to determine which has a greater effect in the treatment of myofascial pain syndrome.

3.7.3 The Third Sub-Problem

The third sub-problem was to integrate the subjective and objective data in order to determine the relative effect of four-electrode interferential current as compared to pen-electrode interferential current in the treatment of myofascial pain syndrome.

3.8 TREATMENT OF THE DATA

The subjective data was treated as follows:

- After the questionnaires were completed by the patient, they were checked to ensure that they were completed correctly.
- The figures obtained from the questionnaires were converted into percentages, data from the two treatment groups were recorded seperately.
- The data was then analysed statistically using a 95% level of confidence.

The objective data was treated as follows:

- The cervical spine ranges of motion, recorded in degrees, were recorded seperately for the two groups.
- The algometer readings, in Kg/cm^2, were also recorded seperately for the two treatment groups.
- The data was then analysed statistically using a 95% level of confidence.

3.9 STATISTICAL PROCEDURES

Non-parametric tests were used to analyse the data due to the small size of the sample group, the sample group being thirty patients. Parametric tests such as the two-sample unpaired t-test could unfortunately not be used, due to the small sample group size.

3.9.1 PROCEDURE 1: Wilcoxon Signed Rank Test

The Wilcoxon Signed Rank Test was used, at a 95% level of confidence, to find out whether there was any statistically significant change within group 1 as well as within

group 2 between treatment 1 and treatment 5, between treatment 5 and the one month follow-up appointment and finally between treatment 1 and the follow-up appointment with respect to the Numerical Pain Rating Scale-101 (the average of the worst and least pain), the Short-Form McGill Pain Questionnaire, the CMCC Neck Disability Index, the goniometric readings and, finally, the algometer readings.

Hypothesis testing and the decision rule:

The null hypothesis (Ho) stated that there was no significant improvement between treatment 1 and 5, between treatment 5 and the follow-up appointment and finally between treatment 1 and the follow-up appointment in the subjective and objective clinical findings on analysis of data, showing that this treatment protocol was ineffective. The alternative hypothesis (H1) stated that there would be a significant difference between the treatment intervals stated above in the subjective and objective clinical findings on analysis of data, showing that this treatment protocol was effective.

H^O : there was no significant difference

H1 : there was a significant difference

α = 0.05 = the level of confidence.

For a two-tailed test:

Reject H^O if $P \leq \alpha / 2 = 0.025$

Accept H^O if $P > \alpha / 2 = 0.025$

P was the observed significance level.

3.9.2 PROCEDURE 2: Mann-Whitney Unpaired Tests

This test was used to make comparisons between the two experimental groups. The two groups were treated as being independent of one another. The purpose was to find out whether there was a significant difference between the two groups at the $\alpha / 2 = 0.025$ level of confidence with respect to the Numerical Pain Rating Scale-101 (the average of the worst and least pain), the Short-Form McGill Pain Questionnaire, the CMCC Neck Disability Index, the goniometric readings and finally the algometer readings. Mann-Whitney Unpaired Tests were used to compare groups one and two for measurements taken at treatment 1, treatment 5, and the one month follow-up appointment.

Hypothesis testing and the decision rule

The null hypothesis (Ho) stated that there was no significant difference between the two groups with respect to the subjective and objective clinical findings on analysis of inter-group data, showing that the two treatment protocols are equally effective.
The alternative hypothesis (H1) stated that there was a significant difference between the two groups with respect to the subjective and objective clinical findings on analysis of inter-group data, showing that the two treatment protocols are not equally effective.

Ho : $\mu 1 = \mu 2$

H1 : $\mu 1$ and $\mu 2$ were significantly different from each other.

$\alpha = 0.05$ = the level of significance.

For two-tailed test:

Reject H^O if $P \leq \alpha / 2 = 0.025$

Accept H^O if $P > \alpha / 2 = 0.025$

P was the observed significance level.

3.9.3 PROCEDURE 3: Summary Statistics

Summary Statistics including the mean, median, standard deviation and standard error were obtained to support the results from the Wilcoxon Signed Rank Test and the Mann-Whitney U Test.

If the two statistical tests calculated any significant difference between the two groups, then the mean was used to identify the superior group. The reliability of the mean was then measured using the standard deviation which measures the spread of the data around the mean. The bigger the value, the bigger the spread of the values and hence the less reliable the data. The standard error was used to measure the reliability of the mean used in the statistical tests.

The Wilcoxon Signed Rank Test and the Mann-Whitney U Test used the median within the calculations, so the mean was used to complement the results, increasing the reliability of the statistical analysis.

CHAPTER FOUR

RESULTS

CHAPTER FOUR

4.0 THE RESULTS

4.1 INTRODUCTION

This chapter covers the results obtained from the statistical analysis of the data collected from the following measurements criteria:

- Algometer readings
- CROM readings
- Short-form McGill Pain Questionnaire
- Numerical Pain Rating Scale-101
- CMCC Neck Disability Index

KEY FOR ABBREVIATIONS

S.D : Standard deviation

S.E : Standard error

4.2 NON-PARAMETRIC PAIRED HYPOTHESIS TESTS

4.2.1 Subjective data

TABLE 4.1 Statistical results of the subjective findings comparing consultation 1 and 5 in Group A

Group A

	Consultation 1					**Consultation 5**			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	25.27	24	13.71	3.54	0.0003 s	12.2	14	9.46	2.44
McGILL	19.87	16	11.93	3.08	0.00087 s	8.8	9	8.47	2.19
NPRS 101	44.67	40	14.07	3.63	0.00328 s	21.33	20	12.74	3.29
POWER			CMCC		0.13				
			McGILL		0.21				
			NPRS 101		0.93				

The null hypothesis is rejected when comparing the results of the first and fifth consultation in Group A, as there was a statistically significant difference for all three questionnaires, indicating that there was a subjective improvement as a result of the four electrode interferential current therapy.

TABLE 4.2 Statistical results of the subjective findings comparing consultation 5 and the final consultation (F) in Group A

Group A

	Consultation 5					**Consultation F**			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	12.2	14	9.46	2.44	0.78926 ns	13.13	12	10.63	2.74
McGILL	8.8	9	8.47	2.19	0.22779 ns	10.53	9	7.11	1.84
NPRS 101	21.33	20	12.74	3.29	0.22779 ns	25	25	16.8	4.34
POWER			CMCC		0.8				
			McGILL		0.31				
			NPRS 101		0.32				

The null hypothesis is accepted, as there was no statistically significant difference between the fifth and final consultation in Group A, this indicates that there was no significant improvement during the follow-up period.

TABLE 4.3 Statistical results of the subjective findings comparing consultation 1 and the follow-up consultation (F) in Group A

Group A

	Consultation 1					Consultation F			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	25.27	24	13.71	3.54	0.00051 s	13.13	12	10.63	2.74
McGILL	19.87	16	11.93	3.08	0.00982 s	10.53	9	7.11	1.84
NPRS 101	44.67	40	14.07	3.63	0.00087 s	25	25	16.8	4.34
POWER			CMCC		0.11				
			McGILL		0.42				
			NPRS 101		0.4				

The null hypothesis is rejected for Group A as there was a statistically significant difference in the data from the three questionnaires from the first and follow-up consultation. This finding indicated that there was subjective improvement as a result of this form of treatment.

TABLE 4.4 Statistical results of the subjective findings comparing consultation 1 and 5 in Group B

Group B

	Consultation 1					Consultation 5			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	19.47	16	13.38	3.46	0.00051 s	7.33	8	5.84	1.51
McGILL	18.27	16	12.45	3.21	0.00328 s	7.87	9	4.96	1.28
NPRS 101	43.3	40	16.22	4.19	0.00051 s	18.67	15	9.15	2.36
POWER			CMCC		0.19				
			McGILL		0.36				
			NPRS 101		0.86				

The analysis of the subjective data for Group B shows a statistically significant difference between the first and fifth consultations, thus the null hypothesis is rejected indicating a subjective improvement due to this form of therapy.

TABLE 4.5 Statistical results of the subjective findings comparing consultation 5 and the final consultation (F) in Group B

Group B

	Consultation 5					**Consultation F**			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	7.33	8	5.84	1.51	0.72367 ns	7.4	7	5.83	1.51
McGILL	7.87	9	4.96	1.28	0.07044 ns	5.47	4	4.52	1.17
NPRS 101	18.67	15	9.15	2.36	0.77283 ns	18.67	15	10.43	2.69
POWER			CMCC		0.72				
			McGILL		0.31				
			NPRS 101		0.77				

The null hypothesis is accepted for the comparison of the fifth and follow-up consultation in Group B because of no statistically significant difference, indicating that subjectively there was no significant improvement during the one month follow-up period.

TABLE 4.6 Statistical results of the subjective findings comparing consultation 1 and the follow-up consultation (F) in Group B

Group B

	Consultation 1					Consultation F			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	19.47	16	13.38	3.46	0.00087 s	7.4	7	5.83	1.51
McGILL	18.27	16	12.45	3.21	0.00328 s	5.47	4	4.52	1.17
NPRS 101	43.3	40	16.22	4.19	0.0003 s	18.67	15	10.43	2.69
POWER			CMCC		0.24				
			McGILL		0.64				
			NPRS 101		0.76				

As there was a statistically significant difference for the subjective data for the first and follow-up consultation comparison in Group B , the null hypothesis is rejected signifying subjective improvement.

4.2.2 Objective data

TABLE 4.7 Statistical results of the objective findings comparing consultation 1 and 5 in Group A

Group A

	Consultation 1					**Consultation 5**			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	58.2	62	12.51	3.23	0.00554 s	66.8	68	10.71	2.77
EXTENSION	57.33	58	16.47	4.25	0.00328 s	65.2	60	13.62	3.52
(L) LAT FL	40	40	9.32	2.41	0.00051 s	48.27	50	11.49	2.96
(R) LAT FL	40.93	42	8.81	2.28	0.00555 s	49.73	50	12.85	3.32
(L) ROT	62	62	10.95	2.83	0.0003 s	71.53	72	11.73	3.03
(R) ROT	62.33	62	8.73	2.25	0.0003 s	72.06	74	10.04	2.59
ALGOMETER	1.99	2	0.63	0.16	0.0003 s	2.8	2.9	0.83	0.21
POWER			FLEX		0.17				
			EXT		0.04				
			(L) LAT		0.04				
			(R) LAT		0.2				
			(L) ROT		0.04				
			(R) ROT		0.1				
			ALGOM		0.13				

The null hypothesis is rejected for the comparison of the objective measurements taken in the first and fifth consultation in Group A, as there was a statistically significant difference, indicating an objective improvement as a result of this specific treatment protocol.

TABLE 4.8 Statistical results of the objective findings comparing consultation 5 and the final consultation (F) in Group A

Group A

	Consultation 5					Consultation F			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	66.8	68	10.71	2.77	0.07044 ns	64.13	68	10.7	2.76
EXTENSION	65.2	60	13.62	3.52	0.01586 s	62.13	60	12.5	3.23
(L) LAT FL	48.27	50	11.49	2.96	0.0265 ns	45.6	48	11.76	3.04
(R) LAT FL	49.73	50	12.85	3.32	0.02686 ns	46.67	48	11.36	2.93
(L) ROT	71.53	72	11.73	3.03	0.00257 s	68.47	70	10.12	2.61
(R) ROT	72.06	74	10.04	2.59	0.00555 s	69.6	70	7.97	2.06
ALGOMETER	2.8	2.9	0.83	0.21	0.22778 ns	2.75	2.4	1.09	0.28

POWER			
	FLEX		0.13
	EXT		0.04
	(L) LAT		0.05
	(R) LAT		0.06
	(L) ROT		0.01
	(R) ROT		0.02
	ALGOM		0.23

The null hypothesis is accepted for forward flexion, left and right lateral flexion and the algometer readings for the comparison of the fifth and follow-up consultation in Group A, as there was no statistically significant difference, indicating no significant objective improvement during the follow-up period. The statistically significant difference recorded for the measurements taken for extension, left rotation and right rotation for the fifth and follow-up consultation in Group A, rejects the null hypothesis and indicates that there was an objective improvement during this period for these ranges of motion.

TABLE 4.9 Statistical results of the objective findings comparing consultation 1 and the follow-up consultation (F) in Group A

Group A

	Consultation 1					**Consultation F**			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	58.2	62	12.51	3.23	0.00087 s	64.13	68	10.7	2.76
EXTENSION	57.33	58	16.47	4.25	0.01616 s	62.13	60	12.5	3.23
(L) LAT FL	40	40	9.32	2.41	0.00555 s	45.6	48	11.76	3.04
(R) LAT FL	40.93	42	8.81	2.28	0.00555 s	46.67	48	11.36	2.93
(L) ROT	62	62	10.95	2.83	0.00051 s	68.47	70	10.12	2.61
(R) ROT	62.33	62	8.73	2.25	0.0003 s	69.6	70	7.97	2.06
ALGOMETER	1.99	2	0.63	0.16	0.00051 s	2.75	2.4	1.09	0.28
POWER			FLEX		0.014				
			EXT		0.06				
			(L) LAT		0.06				
			(R) LAT		0.08				
			(L) ROT		0.02				
			(R) ROT		0.05				
			ALGOM		0.05				

The null hypothesis is rejected for all the objective measurements when comparing the first and follow-up consultation in Group A, as there was a statistically significant difference, indicating an objective improvement as a result of this form of treatment.

TABLE 4.10 Statistical results of the objective findings comparing consultation 1 and 5 in Group B

Group B

	Consultation 1					**Consultation 5**			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	60.27	58	7.89	2.04	0.00087 s	69.07	70	7.67	1.98
EXTENSION	53.2	56	11.36	2.93	0.00443 s	59.07	60	9.99	2.58
(L) LAT FL	42.8	40	7.39	1.91	0.0003 s	49	46	8.41	2.17
(R) LAT FL	38.53	36	8.26	2.13	0.0003 s	44.67	42	8.71	2.25
(L) ROT	62.4	62	6.51	1.68	0.0003 s	70.73	70	7.12	1.84
(R) ROT	59	60	9.12	2.35	0.0003 s	68.53	70	8.37	2.16
ALGOMETER	2.39	2.2	0.7	0.18	0.0003 s	3.52	3.5	0.72	0.19
POWER			FLEX		0.27				
			EXT		0.06				
			(L) LAT		0.03				
			(R) LAT		0.02				
			(L) ROT		0.22				
			(R) ROT		0.13				
			ALGOM		0.59				

For the comparison of objective measurements taken for the first and fifth consultation for Group B the null hypothesis is rejected, as there was a significant difference between the consultations considered, indicating an objective improvement due to the pen-electrode interferential current therapy.

TABLE 4.11 Statistical results of the objective findings comparing consultation 5 and the final consultation (F) in Group B

Group B

	Consultation 5					**Consultation F**			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	69.07	70	7.67	1.98	0.13057 ns	68.13	68	8.57	2.21
EXTENSION	59.07	60	9.99	2.58	0.61707 ns	58.47	58	10.56	2.73
(L) LAT FL	49	46	8.41	2.17	0.00937 ns	46.6	44	7.35	1.89
(R) LAT FL	44.67	42	8.71	2.25	0.14891 ns	45.47	42	7.58	1.96
(L) ROT	70.73	70	7.12	1.84	0.0265 ns	69	68	7.96	2.05
(R) ROT	68.53	70	8.37	2.16	0.57909 ns	68.53	68	6.95	1.79
ALGOMETER	3.52	3.5	0.72	0.19	0.0003 s	3.22	3.3	0.67	0.17
POWER			FLEX		0.15				
			EXT		0.62				
			(L) LAT		0.03				
			(R) LAT		0.16				
			(L) ROT		0.05				
			(R) ROT		0.58				
			ALGOM		0.003				

The null hypothesis is accepted for the measurements of forward flexion, extension, right lateral flexion, left rotation and right rotation, as there was no statistically significant difference , indicating no improvement in these range of motions during the one month follow-up period. However the null hypothesis is rejected for the algometer readings, as there was a statistically significant difference between these consultations, indicating a significant improvement in pain threshold levels during the

follow-up period.

TABLE 4.12 Statistical results of the objective findings comparing consultation 1 and the follow-up consultation (F) in Group B

Group B

	Consultation 1					**Consultation F**			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	60.27	58	7.89	2.04	0.00149 s	68.13	68	8.57	2.21
EXTENSION	53.2	56	11.36	2.93	0.00766 s	58.47	58	10.56	2.73
(L) LAT FL	42.8	40	7.39	1.91	0.00149 s	46.6	44	7.35	1.89
(R) LAT FL	38.53	36	8.26	2.13	0.0003 s	45.47	42	7.58	1.96
(L) ROT	62.4	62	6.51	1.68	0.0003 s	69	68	7.96	2.05
(R) ROT	59	60	9.12	2.35	0.0003 s	68.53	68	6.95	1.79
ALGOMETER	2.39	2.2	0.7	0.18	0.0003 s	3.22	3.3	0.67	0.17
POWER			FLEX		0.19				
			EXT		0.07				
			(L) LAT		0.02				
			(R) LAT		0.05				
			(L) ROT		0.05				
			(R) ROT		0.18				
			ALGOM		0.21				

For the comparison of the objective measurements of the first and follow-up consultation for Group B, the null hypothesis is rejected as there was a statistically significant difference, indicating an objective improvement due to the treatment administered.

4.3 NON-PARAMETRIC UNPAIRED HYPOTHESIS TESTS

4.3.1 Subjective data

Table 4.13 Statistical results comparing Group A and Group B in terms of the subjective measurements from the first consultation

	Group A Consultation 1					Group B Consultation 1			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	25.27	24	13.71	3.54	0.18978 ns	19.47	16	13.38	3.46
McGILL	19.87	16	11.93	3.08	0.81873 ns	18.27	16	12.45	3.21
NPRS 101	44.67	40	14.07	3.63	0.72209 ns	43.3	40	16.22	4.19
POWER			CMCC		0.44				
			McGILL		0.83				
			NPRS 101		0.73				

There was no statistically significant difference between the subjective data of Group A and Group B at the initial consultation, leading to the acceptance of the null hypothesis and indicating that the two groups were similar in terms of disability and pain intensity.

Table 4.14 Statistical results comparing Group A and Group B in terms of the subjective measurements from the fifth consultation

	Group A Consultation 5					Group B Consultation 5			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	12.2	14	9.46	2.44	0.18191 ns	7.33	8	5.84	1.51
McGILL	8.8	9	8.47	2.19	0.85044 ns	7.87	9	4.96	1.28
NPRS 101	21.33	20	12.74	3.29	0.27663 ns	18.67	15	9.15	2.36
POWER			CMCC		0.63				
			McGILL		0.86				
			NPRS 101		0.37				

The null hypothesis is accepted for the subjective measurements taken at the fifth consultation in both groups, as no statistically significant difference was evident between the groups, indicating that both forms of treatment were equally effective.

Table 4.15 Statistical results comparing Group A and Group B in terms of the subjective measurements from the follow-up consultation

	Group A Consultation F.					Group B Consultation F			
	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
CMCC	13.13	12	10.63	2.74	0.13359 ns	7.4	7	5.83	1.51
McGILL	10.53	9	7.11	1.84	0.05962 ns	5.47	4	4.52	1.17
NPRS 101	25	25	16.8	4.34	0.46038 ns	18.67	15	10.43	2.69
POWER			CMCC		0.61				
			McGILL		0.64				
			NPRS		0.72				

In this comparison of the two treatment groups, the null hypothesis is accepted, as there was no statistically significant difference between the consultations considered for both groups. This indicates that both treatment protocols, in terms of subjective findings, had equal effect at the month follow-up consultation.

4.3.2 Objective data

Table 4.16 Statistical results comparing Group A and Group B in terms of the objective measurements from the first consultation

	Group A Consultation 1					Group B Consultation 1			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	58.2	62	12.51	3.23	0.93331 ns	60.27	58	7.89	2.04
EXTENSION	57.33	58	16.47	4.25	0.51954 ns	53.2	56	11.36	2.93
(L) LAT FL	40	40	9.32	2.41	0.59791 ns	42.8	40	7.39	1.91
(R) LAT FL	40.93	42	8.81	2.28	0.21878 ns	38.53	36	8.26	2.13
(L) ROT	62	62	10.95	2.83	0.66062 ns	62.4	62	6.51	1.68
(R) ROT	62.33	62	8.73	2.25	0.25734 ns	59	60	9.12	2.35
ALGOMETER	1.99	2	0.63	0.16	0.14036 ns	2.39	2.2	0.7	0.18
POWER			FLEX		0.94				
			EXT		0.64				
			(L) LAT		0.73				
			(R) LAT		0.34				
			(L) ROT		0.66				
			(R) ROT		0.47				
			ALGOM		0.55				

The null hypothesis is accepted, as there was no statistically significant difference between Group A and Group B, indicating that the two groups were similar in terms of objective findings, at the initial consultation.

Table 4.17 Statistical results comparing Group A and Group B in terms of the objective measurements from the fifth consultation

	Group A					**Group B**			
	Consultation 5					**Consultation 5**			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	66.8	68	10.71	2.77	0.91683 ns	69.07	70	7.67	1.98
EXTENSION	65.2	60	13.62	3.52	0.40347 ns	59.07	60	9.99	2.58
(L) LAT FL	48.27	50	11.49	2.96	0.78641 ns	49	46	8.41	2.17
(R) LAT FL	49.73	50	12.85	3.32	0.15051 ns	44.67	42	8.71	2.25
(L) ROT	71.53	72	11.73	3.03	0.46588 ns	70.73	70	7.12	1.84
(R) ROT	72.06	74	10.04	2.59	0.09055 ns	68.53	70	8.37	2.16
ALGOMETER	2.8	2.9	0.83	0.21	0.02106 s	3.52	3.5	0.72	0.19
POWER			FLEX		0.93				
			EXT		0.73				
			(L) LAT		0.79				
			(R) LAT		0.42				
			(L) ROT		0.48				
			(R) ROT		0.25				
			ALGOM		0.54				

The null hypothesis is accepted for all ranges of motion of both groups for the fifth consultation comparison, as there was no statistically significant difference in these readings. The null hypothesis is rejected for the algometric readings from the fifth consultation, as there was a significant difference between the two groups, indicating that one of the treatment protocols was more effective than the other.

A statistically significant difference with regards to an increase in pain threshold in the pen-electrode group was noted after the fifth consultation. A median of 3.5 in the pen-electrode group (Group B) compared to a mean of 2.9 in the four-electrode group (Group A) demonstrates Group B's superior improvement.

Table 4.18 Statistical results comparing Group A and Group B in terms of the objective measurements from the follow-up consultation

	Group A					**Group B**			
	Consultation F					**Consultation F**			
GONIOMETER	MEAN	MEDIAN	S.D	S.E	P-VALUE	MEAN	MEDIAN	S.D	S.E
FLEXION	64.13	68	10.7	2.76	0.51837 ns	68.13	68	8.57	2.21
EXTENSION	62.13	60	12.5	3.23	0.47926 ns	58.47	58	10.56	2.73
(L) LAT FL	45.6	48	11.76	3.04	0.55974 ns	46.6	44	7.35	1.89
(R) LAT FL	46.67	48	11.36	2.93	0.28793 ns	45.47	42	7.58	1.96
(L) ROT	68.47	70	10.12	2.61	0.85137 ns	69	68	7.96	2.05
(R) ROT	69.6	70	7.97	2.06	0.34821 ns	68.53	68	6.95	1.79
ALGOMETER	2.75	2.4	1.09	0.28	0.05538 ns	3.22	3.3	0.67	0.17
POWER			FLEX		0.72				
			EXT		0.62				
			(L) LAT		0.58				
			(R) LAT		0.32				
			(L) ROT		0.85				
			(R) ROT		0.38				
			ALGOM		0.28				

The null hypothesis is accepted for the objective measurements from the follow-up consultation, as no statistically significant difference was evident. This result indicates that no difference in the efficacy of the two treatment groups exists.

4.4 DEMOGRAPHIC DATA

Table 4.19 Prevalence of Age

AGE INTERVALS	GROUP A	GROUP B
15-25	7 (47%)	6 (40%)
26-35	2 (13%)	3 (20%)
36-45	3(20%)	3 (20%)
46-55	3 (20%)	3 (20%)

Thirty-three (33) was the average age (mean) for both groups A and B.

Table 4.20 Gender Distribution

GENDER	GROUP A	GROUP B
MALES	3 (20%)	9 (60%)
FEMALES	12 (80%)	6 (40%)

The overall male : female ratio was 2:3.

4.5 DATA MEDIAN SCORES

FIGURE 4.1 Graphical comparison of CMCC median scores for Groups A and B.

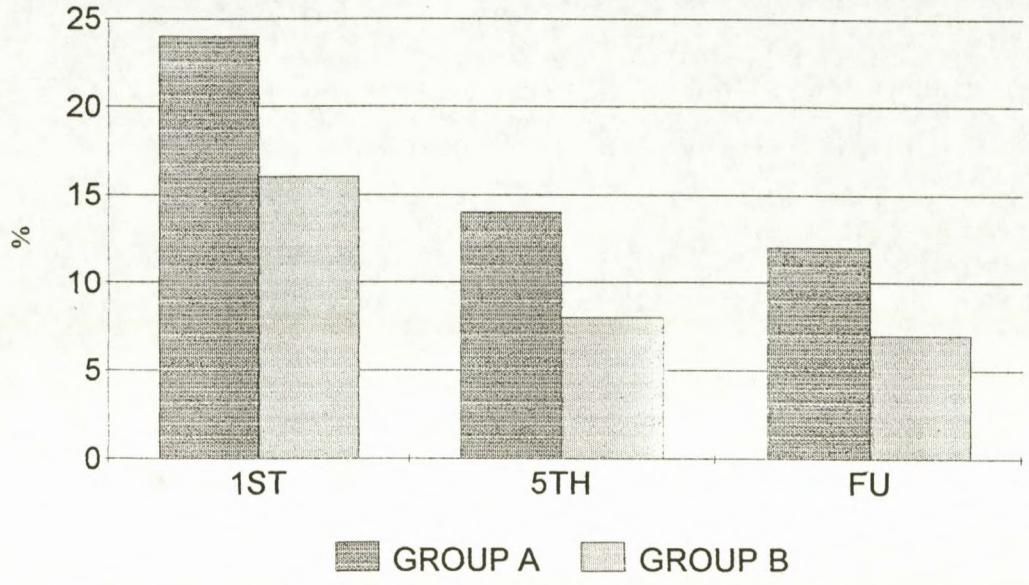


FIGURE 4.2 A graphical representation of McGill median scores from treatments one, five and follow-up of both groups.

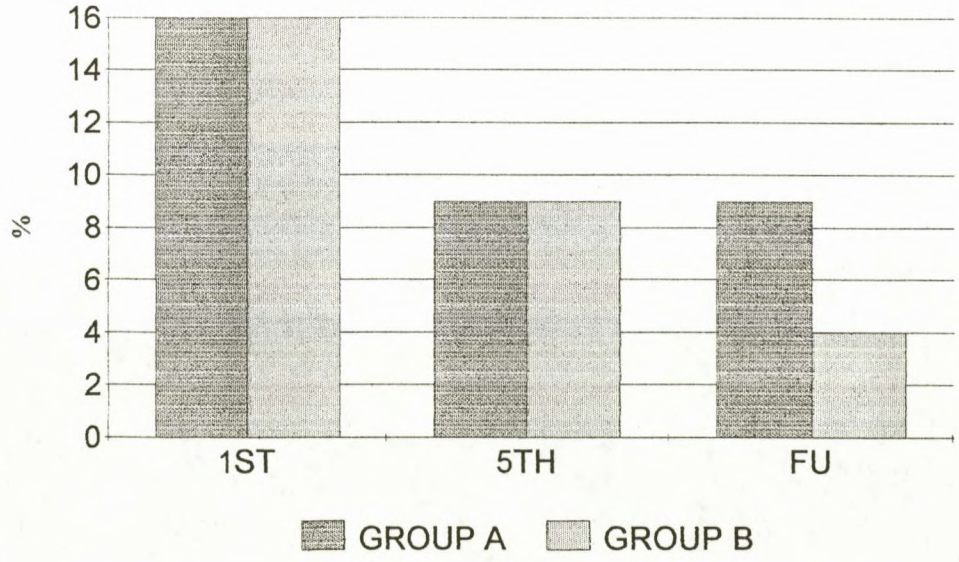


FIGURE 4.3 A comparison of NPRS-101 median scores from both groups for consultations one, five and follow-up.

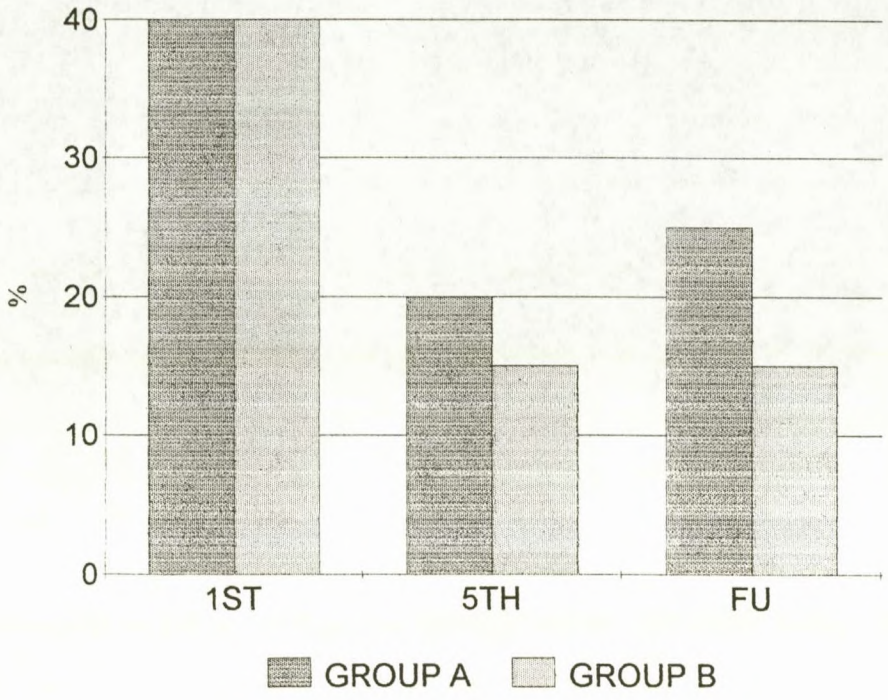


FIGURE 4.4 Flexion median scores from treatments one, five and follow-up for both groups A and B.

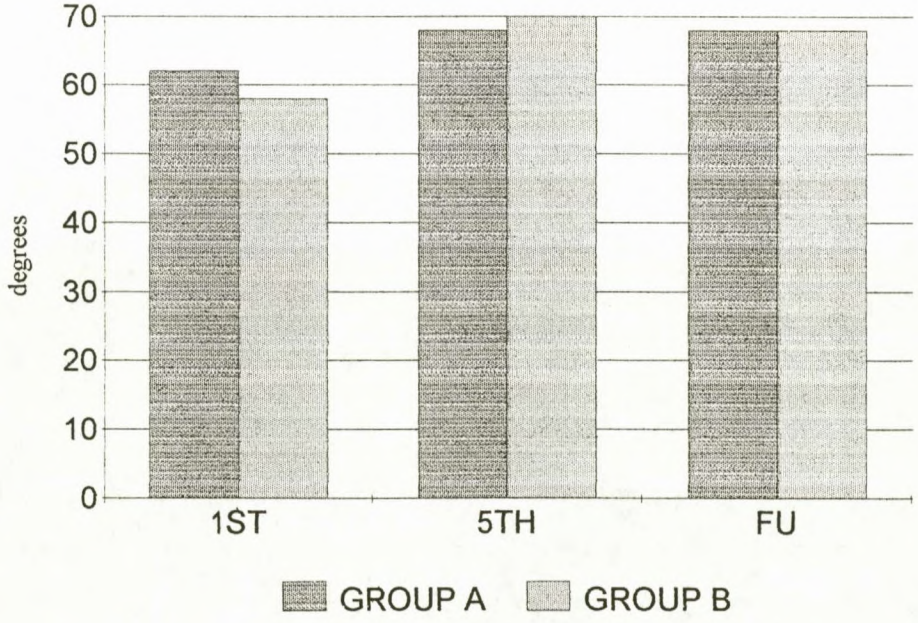


FIGURE 4.5 A graphical representation of the medain scores for the measurements taken in extension for all three consultations in both groups.

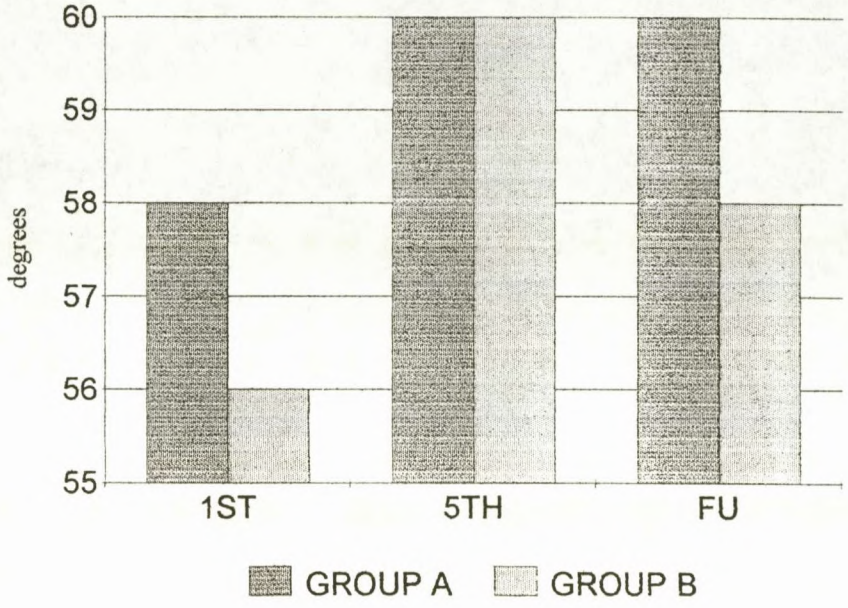


FIGURE 4.6 A graphical representation of left lateral flexion medain scores from treatments one, five and follow-up of both groups.

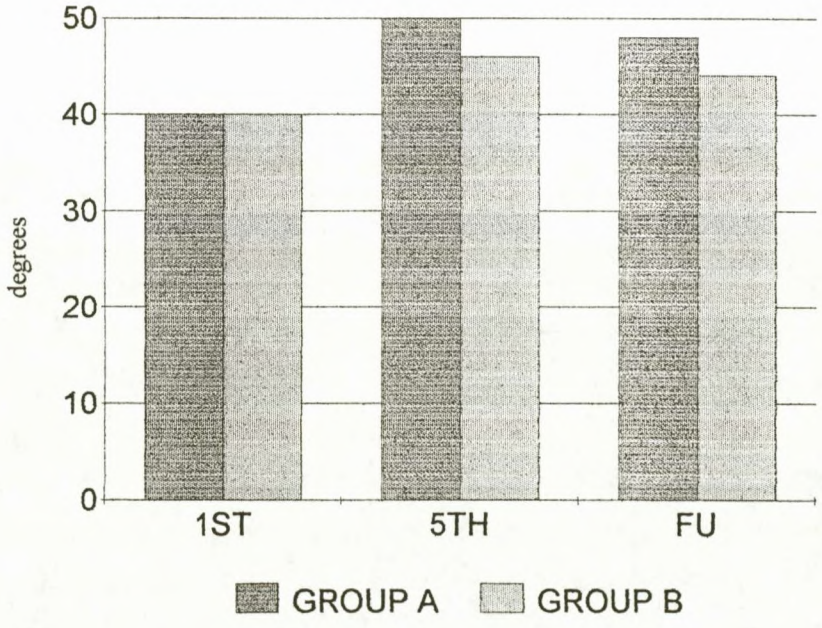


FIGURE 4.7 Right lateral flexion median scores from treatments one, five and follow-up for both groups A and B.

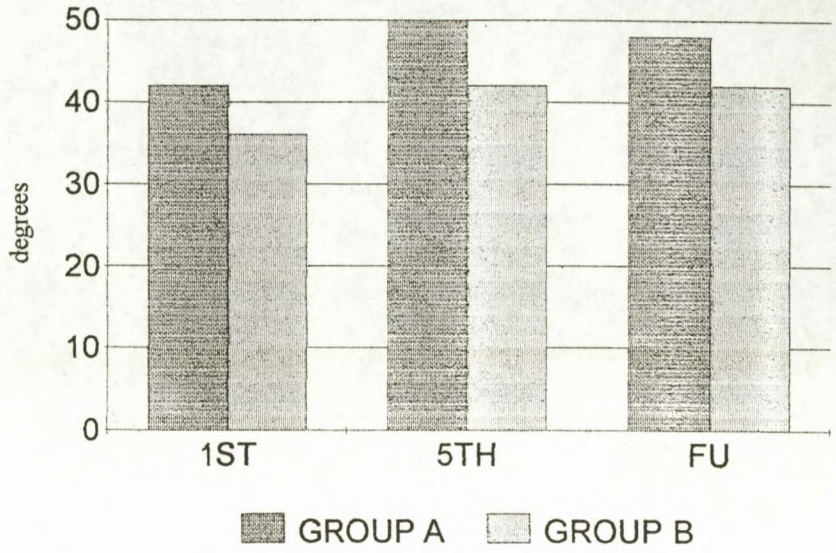


FIGURE 4.8 A graphical representation of left rotation median scores from treatments one, five and follow-up of both groups.

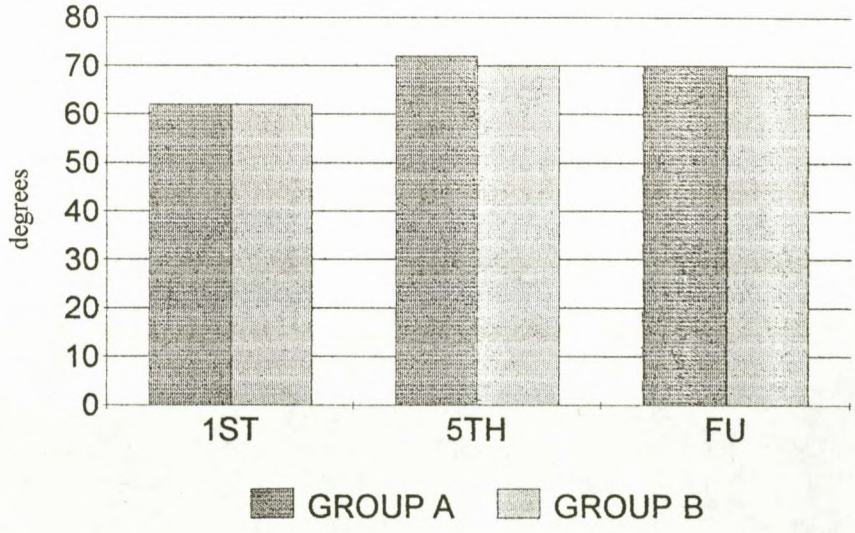


FIGURE 4.9 A graphical representation of the median scores for measurements taken in right rotation for both the four-electrode and pen-electrode groups.

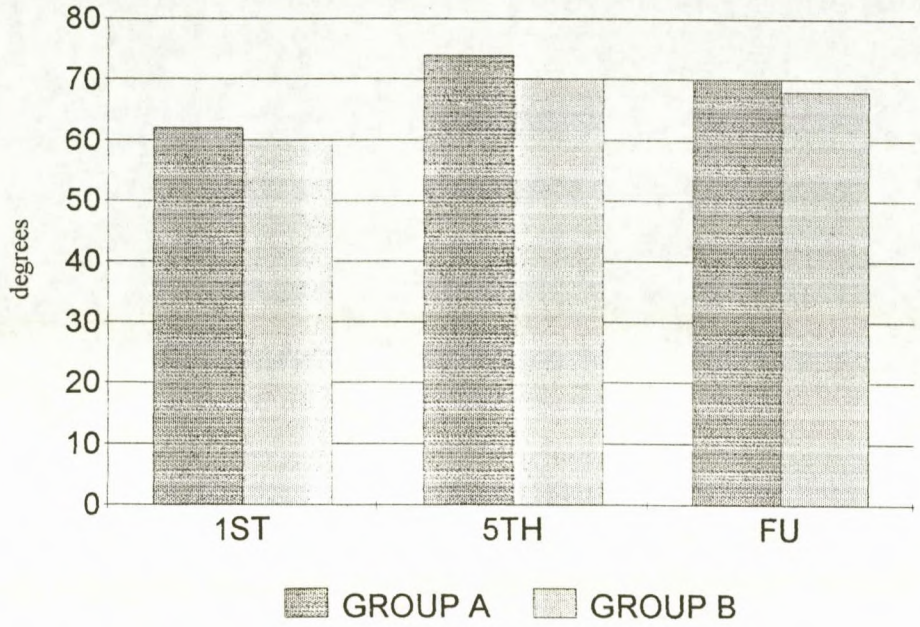
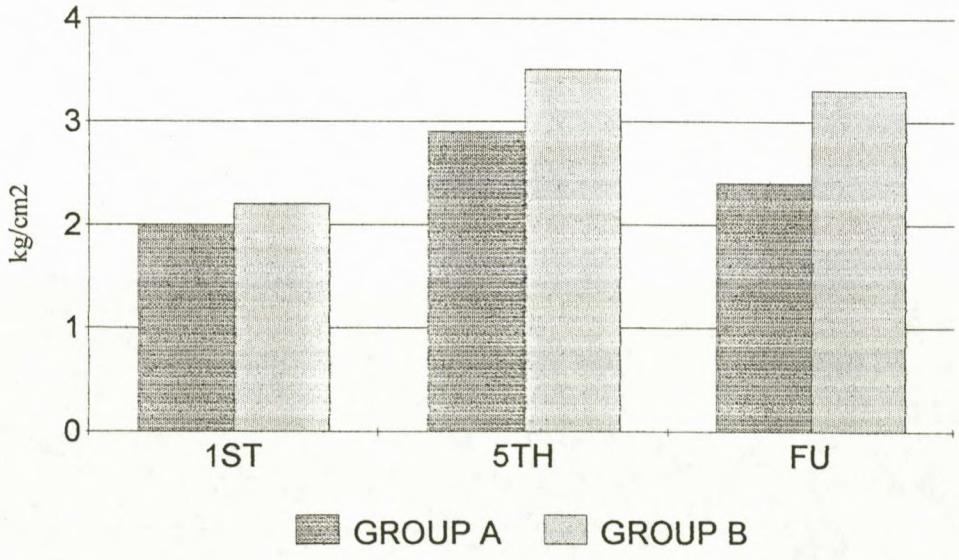


FIGURE 4.10 A graphical comparison of pain threshold measurements taken at consultations one, five and follow-up in both treatment groups.



CHAPTER FIVE

DISCUSSION OF RESULTS

CHAPTER FIVE

5.0 DISCUSSION OF RESULTS

5.1 INTRODUCTION

This chapter involves the discussion of the results obtained from the subjective and objective data.

Intra-treatment comparison: The assessment of the subjective and objective intra-treatment results of the first to fifth consultation represents the efficacy of the treatment regime. The comparison of the fifth to follow-up treatment indicates whether the treatment efficacy was maintained. The first to follow-up treatment period indicates the long term efficacy of the treatment and evaluates if the condition has returned. This was done with the data of both treatment groups.

Inter-treatment comparison: Comparison of subjective and objective data of both groups from the first consultation exhibits any differences between the two groups in terms of their original signs and symptoms. The comparison of the fifth consultation results confirms which treatment protocol has more effect. Finally, comparison of follow-up consultation results represents which treatment protocol maintained a more favourable response to treatment.

5.2 INTRA-GROUP COMPARISON

5.2.1 Subjective Data

5.2.1.1 The CMCC Neck Disability Index

Statistical assessment of the median values of the CMCC Neck Disability Index for the first to fifth consultation period depicted a statistically significant improvement in both groups (Table 4.1 and 4.4, Figure 4.1).

Comparing the measurements of the fifth to follow-up consultations disclosed no significant improvement during this period in either group (Table 4.2 and 4.5). Disability actually increased marginally in both groups (Figure 4.1).

Analysis of the first to the follow-up consultation showed a statistically significant improvement in both groups, suggesting that both groups maintained a favourable long term response to treatment without remission of the condition in terms of disability (Table 4.3 and 4.6, Figure 4.1).

5.2.1.2 The Short-Form McGill Pain Questionnaire

Comparative statistical analysis of the median values of each group between the first and fifth consultation show a statistically significant improvement in both groups (Table 4.1 and 4.4, Figure 4.2). However, comparison of the fifth and follow-up consultation in both groups revealed no statistically significant difference (Table 4.2 and 4.5, Figure 4.2).

Assessment of the median of both groups for the period between the first and follow-up consultation depicts a statistically significant decrease in pain perception in both groups (Table 4.3 and 4.6, Figure 4.2).

5.2.1.3 The Numerical Pain Rating Scale -101

Comparison of the first and fifth consultations revealed a statistically significant difference in both groups, indicating that in both groups the treatment used reduced the amount of pain experienced by the patients (Table 4.1 and 4.4, Figure 4.3).

The analysis of median values for the fifth to follow-up period in both groups exhibited no statistically significant improvement in either group (Table 4.2 and 4.5, Figure 4.3). Analysis of median values for the period from the first to the follow-up consultation revealed a statistically significant difference in both groups (Table 4.3 and 4.6, Figure 4.3). This indicates that both treatment groups had a favourable response to their respective treatment protocol with respect to degree of pain intensity.

5.2.2 Objective Data

5.2.2.1 Cervical ROM

Comparison of the first to fifth treatment period disclosed a statistically significant difference in all measured ranges of motion in both groups A and B (Tables 4.7 and 4.10). Analysis of data from the fifth to the follow-up consultation indicated a statistically significant difference in extension and right and left rotation in Group A. Forward flexion and right and left lateral flexion displayed no statistically significant

difference in Group A (Table 4.8). All the ranges of motion in Group B were found to have no significant difference (Table 4.11).

5.2.2.2 Algometer Readings

Analysis of algometer readings for the first to fifth consultation reveals no statistically significant difference for either group (Table 4.7 and 4.10). Analysis of algometer readings for the fifth to follow-up period showed a statistically significant difference for Group B and no statistically significant difference for Group A (Table 4.8 and 4.11).

Comparison of median for both groups for the first to follow-up consultation revealed a statistically significant difference (Table 4.9 and 4.12). Thus indicating that long term efficacy of the treatment was maintained in both groups.

5.3 INTER-GROUP COMPARISON

5.3.1 Subjective Data

5.3.1.1 The CMCC Neck Disability Index

The results of the measurements of the CMCC Neck Disability Index for the first consultation for both groups disclosed no significant difference in the degree of disability caused by the myofascial pain syndrome (Table 4.13). This implied that both treatment groups were similar in character in terms of disability. Analysis of data from the fifth consultation of both groups revealed no statistically significant difference, indicating that both groups responded equally well to their respective treatments protocols (Table 4.14).

Follow-up consultation measurements also showed no statistically significant difference between the groups (Table 4.15). Thus it can be said that long term efficacy was maintained equally in both groups. No clinically significant difference was evident between the two groups.

5.3.1.2 The Short-Form McGill Pain Questionnaire

Comparison of the first consultation of both groups showed no statistical significance, indicating that both groups were relatively homogenous with respect to pain perception (Table 4.13). No clinically significant difference was evident between the two groups.

Data analysis of the fifth consultation measurements for the Short-Form McGill Pain Questionnaire revealed no statistically significant difference (Table 4.14). A clinical difference was evident, with Group B responding slightly better then Group A (Figure 4.2).

Follow-up consultation measurement comparisons showed no significant statistical difference, indicating that treatment efficacy was maintained relatively similarly in both groups (Table 4.15). Group B once again showed a slightly better clinical response (Figure 4.2).

5.3.1.3 The Numerical Pain Rating Scale -101

Statistical comparison of the first consultation of the two groups revealed no difference in the inceptive degree of pain intensity, denoting a similarity in nature in terms of pain intensity (Table 4.13).

Analysis of the NPRS-101 readings of the fifth treatments suggested no statistically significant difference, indicating that both treatment protocols were equally effective (Table 4.14). Group B showed a slightly more clinically significant improvement when compared to Group A, depicting that maintenance of treatment efficacy would be slightly better in Group B (Figure 4.3).

Results of data analysis from the follow-up period indicated similar results to those from the fifth consultation with no statistically significant difference being noted (Table 4.15). Group B had a slightly more favourable clinical response but it can be said that treatment efficacy was maintained well in both groups (Figure 4.3).

5.3.2. Objective Data

5.3.2.1 Cervical ROM

Comparison of initial cervical range of motion measurements presented no statistically significant difference between the two groups, indicating that cervical spine range of motion of the two groups was similar (Table 4.16).

Comparison of data from the fifth consultation showed no significant difference statistically (Table 4.17). Thus it can be said that neither treatment protocol was more

effective than the other in terms of range of motion. Examination of table 4.17 of the median of motion readings taken for each of the planes of movement at the fifth consultation showed no clinical difference due to the similarity of the figures.

Data analysis for the follow-up period revealed no statistically significant difference between the groups, indicating that treatment efficacy was maintained equally in both groups (Table 4.18). Group B does display a slightly better clinical significance in right rotation where Group A displays a better clinical significance in left lateral flexion (Figure 4.9 and 4.6).

5.3.2.2 Algometer Readings

No significant difference was evident between the groups with respect to data from the first consultation, indicating that the groups were similar in terms of initial pain threshold levels (Table 4.16).

Comparison of algometer readings for the fifth consultation revealed a statistically significant difference between the groups, indicating that one group responded more favourably than the other. Analysis of the mean values showed that the pen-electrode group had a better statistical and clinical response to the treatment (Table 4.17).

Follow-up consultation measurements indicated no significant difference, thus it can be concluded that treatment efficacy was maintained equally effectively in both groups (Table 4.18). A clinical significance is evident with Group B showing a better clinical response, indicating a better maintenance of treatment efficacy in terms of pain threshold (Figure 4.10).

5.4 DISCUSSION

5.4.1 Intra-group Hypotheses

It was hypothesised that there would be a significant improvement between treatment 1 and 5, between treatment 5 and the follow-up and finally between treatment 1 and the follow-up in the subjective and objective clinical findings, showing that both treatment protocols were effective.

The two hypotheses, pertaining to improvement between treatment 1 and 5 and between treatment 1 and the follow-up, are accepted. The hypothesis, pertaining to improvement between treatment 5 and the follow-up, is rejected. Therefore it can be said that significant improvement occured in both groups between the first and fifth and between the first and follow-up consultations but no improvement occured between the fifth and follow-up consultations in either group.

It can be concluded that both treatment protocols were effective during the treatment period and that both groups displayed long term efficacy to their respective protocol but treatment efficacy was not maintained in either group.

5.4.2 Inter-group Hypotheses

It was hypothesised that there would be a significant difference between the two groups with respect to the subjective and objective clinical findings, showing that one treatment protocol was more effective than the other.

These hypotheses pertaining to the first treatment and the follow-up consultation were rejected, showing that the groups were relatively homogenous both before and after their respective treatments.

The hypotheses pertaining to the fifth consultation were rejected for all data , except for the algometer readings, for which the hypothesis was accepted. This would indicate that the pen-electrode was more effective than the four-electrode interferential current, in terms of increasing pain threshold.

5.4.3 Power Analysis

According to Portney and Watkins (1993: 351-352) the purpose of power analysis is to determine the probability that a Type II error (falsely accepting the null hypothesis) was committed when a non-significant finding resulted from a study. The probability of making a Type II error is denoted by beta (β). The closer the value of $1-\beta$ is to 1, the better the power of the test. A power of 0.80 represents a reasonable protection against a Type II error.

5.4.3.1 Intra-group Power Analysis

The power of the intra-group analysis is poor for all subjective and objective measurements, except for the Numerical Pain Rating Scale -101 readings for consultation 1 to 5, 5 to follow-up and 1 to follow-up in Group B, and for consultation 1 to 5 in Group A, where the power was high (Table 4.4, 4.5, 4.6 and 4.1).

5.4.3.2 Inter-group Power Analysis

Inter-group power analysis of subjective readings revealed a poor power for all measurements, except for short-form McGill Pain Questionnaire readings comparing the first and fifth consultations of both groups (Table 4.13 and 4.14).

The objective readings comparing both groups also displayed a poor power for all algometer and cervical ROM measurements, except for measurements comparing flexion at the first and fifth consultations and left lateral flexion at the fifth consultation of both groups (Table 4.16 and 4.17).

In general the power of this study was poor. According to Portney and Watkins (1993:351) when small sample sizes are used, as is often used in clinical research and was the case in this study, it is expected that power will be substantially low. Portney and Watkins (1993:352) also mention that the clinical significance of a study could be greater than suggested by the statistical outcome if a poor power analysis exists.

5.5 LIMITATIONS OF THE STUDY

Knowledge of the generalizibility of the sample and the willingness of the sample to be studied was poor. Information regarding the number of people solicited, the number of people who agreed to participate, the number of people who declined or the attrition due to various inclusion criteria, was not made available.

Patient selection should have been conducted by a independent observer, rather than the author, as the bias of the author could have had a severe effect on the results.

No symptom threshold was set, leaving natural history as an explanation of treatment effect. Also, no control group was included, which would increase the sample size, yet provide some indication of what might occur with no intervention.

The subjective measurements may have had their limitations in terms of the condition being treated and the treatment protocols administered as these questionnaires were not designed purely for this condition or for these treatment protocols.

Misunderstanding of the questionnaires by the patient may have affected their response, and therefore the outcome of the results. Patients may also have recorded improvements which were beyond those actually felt in order to please the researcher.

Regarding the objective measurements, results could have been faulty due to both human error when reading calibrations and the possible risk of incorrect user methods. The accuracy when refinding active trigger points on subsequent visits must also be questioned.

The inclusion criteria for myofascial pain syndrome are taken directly from Travell and Simons, however the characteristics have not sufficiently been shown to be reliable in the literature. Trigger points are notoriously elusive, even among trained observers.

The small sample size of this study is also a weakness, as this could have resulted in Type II errors occurring.

Demographics of the study must also be considered. The gender distribution was relatively poor within both groups, where an imbalance existed, with a much larger percentage of females participating in the study, and between the two groups, where

an imbalance of gender is evident when comparing the two groups. Group A (20%) had a much smaller percentage of males when compared to Group B (60%). A closer distribution would have given more representative results (Table 4.20). The age distribution was reasonably acceptable when comparing the two groups and was good within each group, with a large percentage of patients being between 18-25 years of age (Table 4.19).

5.6 COMPARISON OF THE RESULTS WITH OTHER RESEARCH

Comparison to a study done by Christie (1995).

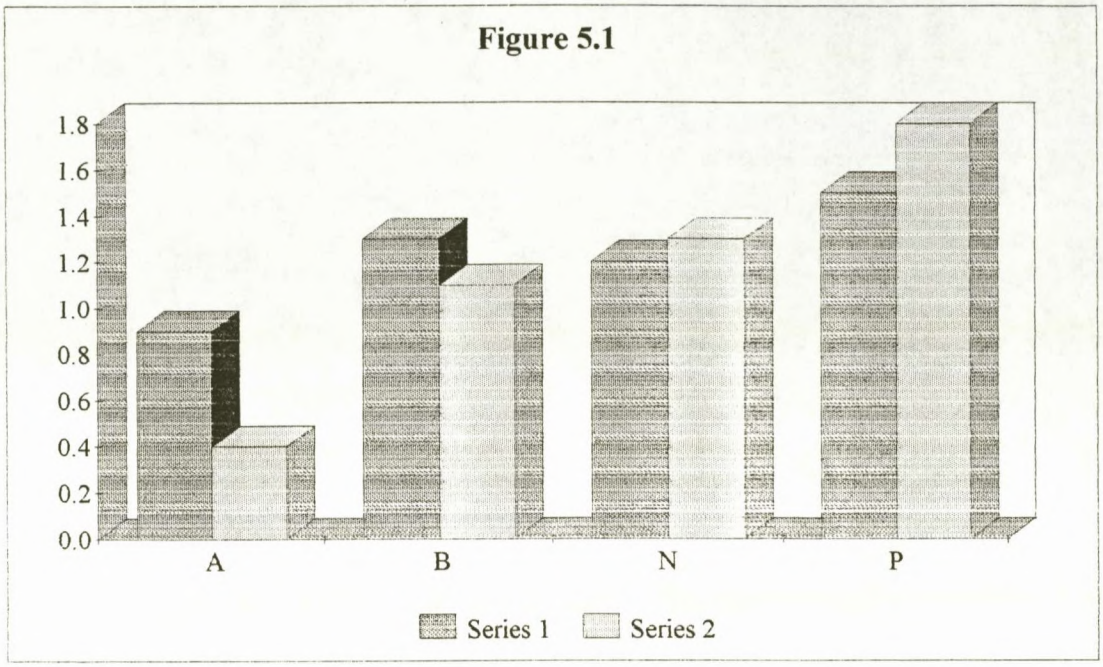
The results of the study are compared to those of Christie (1995) in terms of median scores of the Numerical Pain Rating Scale -101 (NPRS -101) (Figure 5.1) and the algometer readings (Figure 5.2). This study is compared to the study done by Christie (1995) due to their similarity. The sample size, the condition treated, the muscles treated, the number of treatments were identical. The time period was also identical excepting for the follow-up period which was three weeks compared to the one month period in this study. Christie (1995) compared dry needling to pen electrode interferential current in the treatment of myofasciitis. One significant difference between the studies is that in Christie's study both groups were given the relevant stretches, which were done after each treatment and every morning and evening by the patient. Each stretch was held for 2 minutes.

Comparison of results of both groups from the first, last and follow-up consultations revealed no statistically significant difference for all subjective and objective measurements. Christie (1995) concluded from his study that pen-electrode interferential current therapy is as an effective non-invasive alternate form of

treatment as dry needling agitation for the treatment of active myofascial trigger points.

It can be seen from the figure below that pain intensity increased between the fifth and follow-up consultations in both groups in this study as compared to a decrease in pain intensity in both groups in Christie's study. This could be due to the difference in the length of follow-up periods between the two studies. Groups B, N and P in figure 5.1 are comparable in terms of improvement in pain intensity at the fifth consultation. This could possibly be interpreted that these three treatment protocols were relatively equally effective. Group A shows the least improvement out of all the groups after both the fifth and follow-up consultations. Thus one can assume that Group A was the least effective in decreasing pain intensity. The pen-electrode group in Christie's study appears to be the superior treatment protocol, as it displays the most favourable long term response to treatment when compared to the other groups depicted in figure 5.1.

Figure 5.1 Comparison of median improvement of NPRS -101 scores with Christie's (1995) study.



Series 1 = percentage improvement at the fifth consultation

Series 2 = percentage improvement at the follow-up consultation

A = Group A (Four-electroce IFC)

B = Group B (Pen-electrode IFC)

N = Needling group (Christie,1995)

P = Pen-electrode IFC (Christie,1995)

Figure 5.2 Comparison of median improvement of algometer readings (kg/cm^2) with Christie's (1995) study.

A = Group A

B = Group B

N = Needling group (Christie, 1995)

P = Pen-electrode IFC (Christie, 1995)

Figure 5.2 compares the improvement in pain threshold of the groups in both studies at the fifth and follow-up consultations. When comparing the two studies it can be assumed that the two treatment protocols in Christie's study had a more favourable long term effect. The pen-electrode group in Christie's study appears once again to be the superior protocol for both treatment effectivity and long term response. The four-electrode group in this study displays the least effective results to treatment. The

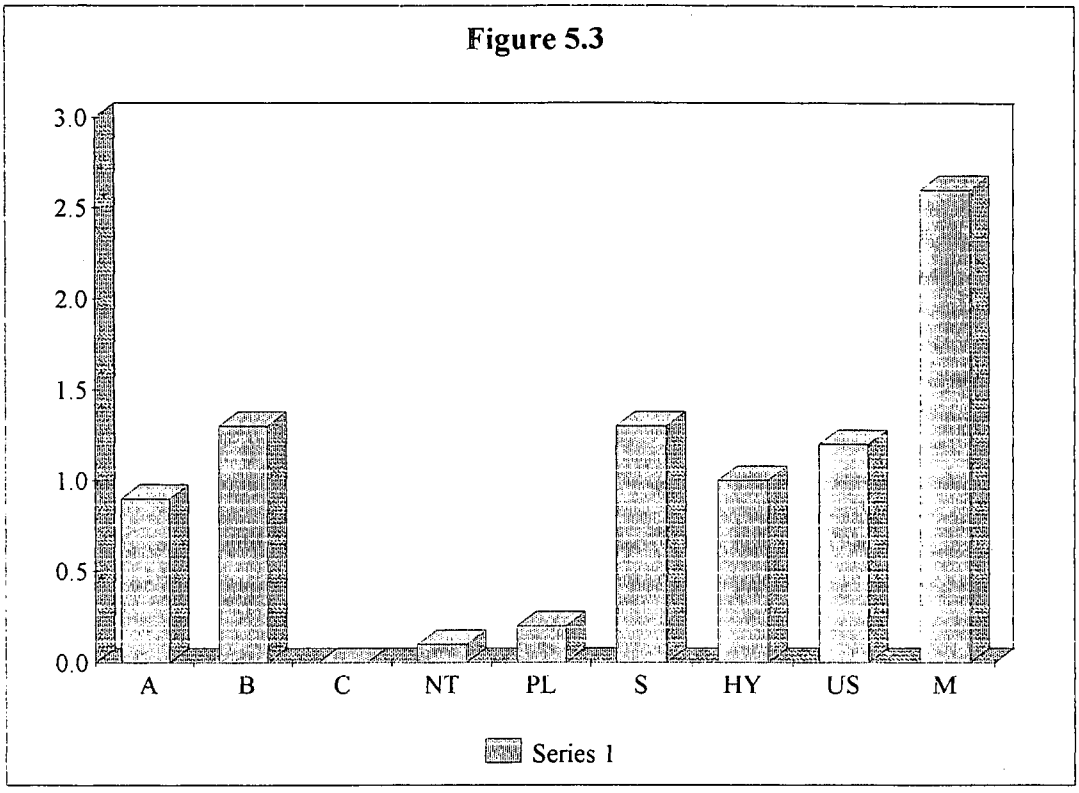
pen-electrode group in this study is again comparable to the needling group in Christie's study.

A comparison with a study done by Hong et al. (1993).

Hong et al. (1993) conducted a randomised controlled study which involved 84 patients with myofascial pain syndrome and 24 normal subjets. The objective of the study was to evaluate the immediate effectiveness of treatment on active myofascial trigger points with physical medicine modalities, including spray and stretch, hydrocollator superficial heat, ultrasound and deep pressure soft tissue massage. Only objective measurements were taken, this involved algometer readings before and after the treatment. Three pain threshold readings were taken before treatment and three readings were taken within 2 minutes after treatment.

The study by Hong et al. (1993) differs from this study in the following way, patients in Hong et al.'s study only received one treatment compared to the five treatments received by patients in this study. The sample sizes are similar, with the average number of patients being 18 in the study done by Hong et al. (1993) compared to 15 patients in each group in this study. Another similarity is that the trapezius muscle was the muscle treated in Hong et al.'s study. Hong et al. (1993) concluded from their results that all four physical medicine modalities studied are effective in increasing pain threshold of active myofascial trigger points immediately after treatment. They also found deep pressure massage to be more effective than the other modalities in increasing pain threshold levels. They also concluded that spray and stretch was more effective than the thermotherapy (hyrocollator and ultrasound).

Figure 5.3 Comparison of median improvement of algometer readings (kg/cm2) for the last treatment with Hong et al.'s (1993) study.



Series 1 = readings taken at the last treatment in all groups in both studies.

A = Group A (n=15)

B = Group B (n=15)

C = Control group, normal (n=24), Hong et al. (1993)

NT = Patients received no therapy (n=21), Hong et al. (1993)

PL = Patients -placebo treatment (n=16), Hong et al. (1993)

S = Spray and Stretch (n=19) ,Hong et al. (1993)

HY = Hydrocollator (n=17), Hong et al. (1993)

US = Ultrasound (n=16) ,Hong et al. (1993)

M = Massage (n=16), Hong et al. (1993)

When compared visually, the results from the pen-electrode group of this study are similar to the spray and stretch and the ultrasound groups of Hong et al.'s study, these three groups are relatively similar in terms of increasing the pain threshold of active myofascial trigger points. The four-electrode group is comparable to the hydrocollator group in Hong et al.'s study. The deep massage group is by far the superior group when comparing all the groups from both studies. As can be seen from figure 5.3 the control, no therapy and placebo groups in Hong et al.'s study are the least effective in increasing pain threshold.

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

CHAPTER SIX

6.0 RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

It is recommended that a much larger sample size and double blind measures be used if this study is repeated. The small sample size used in this study makes accurate statistical analysis difficult. A larger sample size (e.g. 30 patients in each group) is recommended so that paired and unpaired t-tests can be performed, sensitivity to subtle changes is greater and trends in the data would be more apparent.

It is recommended that for future studies in which a comparison is to be made that the random sampling method used takes into account the patient's age, gender and possibly physique. Consideration of the duration of the complaint, amount of dysfunction and dismissal of patients with concomitant or associated complaints is also recommended.

If this study is to be repeated it is recommended that a sham treatment group be added (e.g. the interferential current unit is switched off), so as to evaluate the effectivity of the medium frequency current. A control group could also be used. This group would receive no treatment but data would be collected at the same time intervals.

6.2 CONCLUSIONS

This study comprised of 30 patients all of which were diagnosed with active myofascial trigger points of any of the following muscles: trapezius, levator scapulae, supraspinatus, infraspinatus and rhomboid major and minor, after extensive clinical and physical examination.

The patients were randomly divided into two groups of 15, Group A received four-electrode interferential current therapy, while Group B received pen-electrode interferential current therapy. Each patient received 5 treatments within a three week period and then a one month follow-up consultation.

It is evident from the data that patients in both groups responded favourably to their respective treatments. Significant improvement was noted between the first and fifth, and first and follow-up consultations in both groups. The pen-electrode group displayed a more favourable long term clinical response to treatment, and it is possible that this treatment protocol may maintain this more favourable response and there may be less likelyhood that symptoms may return.

A statistically significant difference was evident between the two groups with regards to the algometer readings comparing pain threshold levels at the fifth consultation. The pen-electrode group (Group B) was significantly more effective in increasing pain threshold levels when compared to the four-electrode group (Group A) at the fifth consultation. With exception of the above, there was no other statistically significant difference present between the two groups.

From the above it is noted that four-electrode and pen-electrode interferential current therapies are reliable interventions for the treatment of active myofascial trigger points. It must be noted that the pen-electrode interferential current therapy may be a more effective treatment when compared to four-electrode interferential current therapy in the treatment of active myofascial trigger points. This can be suggested from the statistically significant difference that was evident when comparing algometer readings from the fifth consultation and the better clinical response that was also noted throughout the treatment regime, in patients from the pen-electrode group.

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APPENDICES

Appendix A

PATIENT NUMBER	GROUP ALLOCATION
1	4
2	4
3	4
4	4
5	1
6	4
7	1
8	1
9	1
10	1
11	4
12	1
13	4
14	4
15	4
16	1
17	4
18	1
19	1
20	1
21	1
22	4
23	1
24	1
25	4
26	4
27	1
28	1
29	4
30	4

Appendix B

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

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

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:

- 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
- Wrist

- 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:

Appendix D

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

Patient: _____ File: _____

Date: _____ Intern/Resident: _____

Clinician: _____ Sign: _____

OBSERVATION:

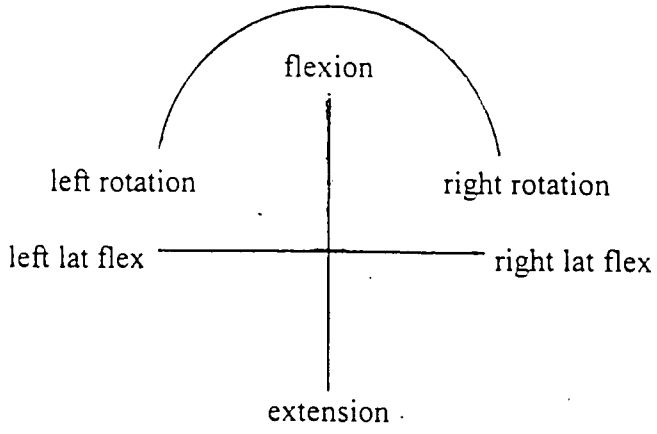
Posture
Swellings
Scars
Discolouration
Hair Line
Bony & Soft Tissue Contours

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

Dizziness rotation test
Brachial plexus tension

Lhermitte's sign

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:

Upper T horacics:
Motion Palpation:
Joint Play:

Basic Exam: Thoracic Spine:
Case History:

ROM: Motion Palp:
Active:
Passive:
Orthopaedic/Neuro/

Appendix E

INFORMED CONSENT FORM

(To be completed in duplicate by patient/subject*) *Delete whichever is not applicable.

TITLE OF RESEARCH PROJECT

_____

_____

NAME OF SUPERVISOR

_____

NAME OF RESEARCH STUDENT

_____

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 enough information about this study? YES/NO.

6. Who have you spoken to? _____

7. Do you understand the implications of your involvement in this study? YES/NO

8. Do you understand that you are free to withdraw from this study? YES/NO
   a) at any time
   b) without having to give a reason for withdrawing, and
   c) without affecting your future health care.

9. Do you agree to voluntarily participate in this study? YES/NO

PATIENT/SUBJECT* Name_____ Signature_____
(in block letters)

PARENT/GUARDIAN* Name_____ Signature_____
(in block letters)

WITNESS Name_____ Signature_____
(in block letters)

Appendix F

PATIENT NAME: FILE #:

ALGOMETER READINGS

TRIGGER POINT	FIRST	FIFTH	FOLLOW-UP

GONIOMETER

	FIRST	FIFTH	FOLLOWUP
FLEXION			
EXTENSION			
LEFT LAT.FLEX			
RIGHT LAT FLEX			
LEFT ROTATION			
RIGHT ROTATION			

MEASUREMENT OF PAIN

SHORT-FORM McGILL PAIN QUESTIONNAIRE

RONALD MELZACK

PATIENT'S NAME: _____ DATE: _____

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

Appendix H

NUMERICAL PAIN RATING SCALE 101.

Patient Name:_____

File number:_____ Date:_____

Please indicate on the line below the number between 0 and 10 that best describes the pain of your major problem at this point, when it is at its WORST. A zero (0) would mean "no pain at all" and ten (10) would mean "pain as bad as it could be".

Please write only one number.

0 _____ 10

Please indicate on the line below the number between 0 and 10 that best describes the pain of your major problem at this point, when it is at its LEAST. A zero (0) would mean "no pain at all" and ten (10) would mean "pain as bad as it could be".

Please write only one number.

0 _____ 10

Appendix I

CMCC NECK DISABILITY INDEX

PATIENT NAME:_____ FILE #:_____ DATE:_____

This questionnaire has been designed to give the doctor information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark in each section only the ONE box which applies to you. We realize you may consider that two of the statements in any one section 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 etc.)

- ☐ 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 very light weights.
- ☐ I cannot lift or carry anything at all.

Section 4 - Reading

- ☐ I can read as much as I want to with no 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 can't 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 a 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 only do 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 can't 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 want with moderate pain in my neck.
- ☐ I can't 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 can't drive my car at all.

Section 9 - Sleeping

- ☐ I have no trouble sleeping.
- ☐ My sleep is slightly disturbed (less than 1 hr. sleepless).
- ☐ My sleep is mildly disturbed (1-2 hrs. sleepless).
- ☐ My sleep is moderately disturbed (2-3 hrs. sleepless).
- ☐ My sleep is greatly disturbed (3-5 hrs. sleepless).
- ☐ My sleep is completely disturbed (5-7 hrs. sleepless).

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 can't do any recreation activities at all.