

**A PRAGMATIC CLINICAL INVESTIGATION OF THE COMPARATIVE
EFFECTIVENESS OF ISCHAEMIC COMPRESSION AND CRYO-
ISCHAEMIC COMPRESSION IN THE TREATMENT OF RHOMBOID
MYOFASCIAL PAIN SYNDROME**

By

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A dissertation submitted to the Faculty of Health in partial compliance with the requirements for a Masters Degree in Technology: Chiropractic at the Durban Institute of Technology.

I, Sholini Sookraj, do hereby declare that this dissertation represents my own work both in concept and execution.

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Approved for final submission

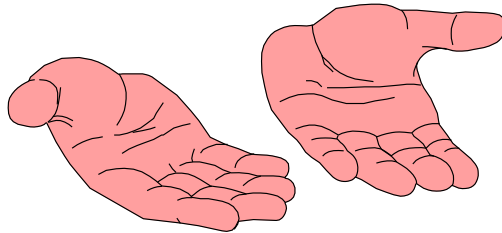
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**THE HANDS THAT SERVE
ARE HOLIER
THAN THE LIPS THAT PRAY**

Shri Sathya Sai Baba



DEDICATION

To my **God**, my anchor and my constant source of comfort.

To my **Parents**

Although I chose my own mountain to climb, whenever I stumbled there were loving arms to comfort me, warm words of encouragement to help me persevere and unwavering faith that enabled me to reach the summit.

Thank you Mum and Dad.

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I thank you for the encouragement and support that each of you has given me throughout the difficult times. Nivash, thank you for always making the time to help me.

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Thank you for your constant support. Most importantly I thank you for always having a sympathetic ear and a strong shoulder.

The staff at DIT Chiropractic Day Clinic

To Pat, Linda and Mrs. Ireland, thank you for all your help over the years. To Pat, I thank you for the kindness and compassion that you have shown to me in the past year.

The patients

Thank you for your time and loyalty.

To my friends

Thank you for making this journey enjoyable.

Damian, thank you all your help and for always being a phone call away.

Lynette, I am blessed to have a friend like you.

ABSTRACT

The purpose of this study was to determine the comparative effectiveness of cryo-ischaemic compression, using the Cold Tennis-ball Technique, and ischaemic compression, using normal tennis balls, in the treatment of Myofascial Pain Syndrome.

The study was a randomised, controlled, comparative clinical trial. The sample population comprised of sixty patients between the ages of 18-35 years. Patients were screened according to the inclusion and exclusion criteria, were selected and randomly divided into two groups. One group, of thirty patients, received ischaemic compression using normal tennis balls, whilst the second group, of thirty patients, received ischaemic compression using the Cold Tennis-ball Technique. Patients received four treatments over a period of two weeks.

Data was obtained from each patient prior to and immediately after each treatment. Objective data was obtained from pressure threshold algometry and the Myofascial Diagnostic Scale. Subjective data was obtained from the Numerical Pain Rating Scale (NRS) and patients were required to give a sensory description of their pain at two-minute intervals during the course of the treatment.

Statistical analysis of the data was performed using the SPSS version 11.5 and Stata version 9.0 software. Treatment effects for quantitative outcomes were analysed using repeated measures ANOVA. Profile plots were examined in order to assess in which direction the significance lay. Ordinal outcomes were examined for a treatment effect using ordinal logistic regression modelling. These models also examined a time by group interaction. Nonparametric Spearman's correlation coefficients were used to examine intra-group relationships.

The results of the study showed a significant improvement, in terms of pain and clinical signs, in both groups.

In terms of objective findings the statistical analysis revealed no statistically significant difference between the two groups. Although both groups showed an improvement over time, the method of treatment did not influence the rate of improvement.

In terms of subjective measures, no difference was noted between the two groups.

Due to the fact that both groups tended to show a significant improvement it was concluded that cryo-ischaemic compression is an effective form of treatment for the active trigger points associated with Myofascial Pain Syndrome and should be considered as an adjunct to the various treatment protocols that are currently available.

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CHAPTER 1

INTRODUCTION

1.1 THE PROBLEM AND ITS SETTING

According to Daniels *et. al.* (2003) musculoskeletal complaints are among the leading reasons for visits to physicians. About one third of these patients meet the criteria for myofascial pain syndrome. Untreated myofascial pain syndromes can become chronic pain conditions. Chronic pain conditions not only cause disability due to pain but can also be responsible for related conditions including depression, sleep disturbances and psychological and behavioral disturbances (Rachlin, 1994:145).

Myofascial pain syndrome is a common muscular pain syndrome resulting from myofascial trigger points (Esenyel *et. al.*, 2000). Myofascial trigger points are hyper-irritable spots within a taut band of skeletal muscle. They are painful on compression and can give rise to characteristic referred pain, tenderness, tightness, local twitch response and autonomic phenomena (Hsueh *et. al.* 1997).

Myofascial trigger points have been described as being either active or latent. According to Travell, Simons and Simons (1999:1) an active myofascial trigger point is always tender, prevents lengthening of the muscle, weakens the muscle, mediates a local twitch response and when directly compressed refers pain within a specific pattern characteristic of each muscle. Active trigger points may also produce autonomic phenomena in their pain reference zone. A latent trigger point may have all the characteristics of an active trigger point with the absence of spontaneous pain (Travell, Simons and Simons, 1999:3).

The major goal of trigger point therapy is to relieve pain and tightness of the involved muscle (Hsueh *et. al.*, 1997). Treatment procedures include; spray and

stretch, transcutaneous electrical nerve stimulation, ischaemic compression, ultrasound therapy, massage therapy, trigger point injection, dry needling and the elimination of causative and perpetuating factors (Esenyel *et. al.*, 2000).

1.2 NEED FOR A SOLUTION TO THE PROBLEM

This research study is designed to investigate the comparative effects of ischaemic compression and cryo-ischaemic compression in the treatment of rhomboid myofascial pain syndrome.

According to Wheeler (2004), muscular injury can occur when soft tissues are exposed to single or recurrent episodes of biomechanical overloading, with the first point of damage being the formation of a trigger point. The rhomboid muscles are constantly involved in stabilizing and moving the scapular (Travell, Simons and Simons, 1999:614). Hence, the biomechanical function of the rhomboid muscles makes them susceptible to the formation of myofascial trigger points.

Ischaemic compression is a method of trigger point therapy that is frequently used by therapists. It involves the application of deliberate and sustained pressure on a trigger point until a barrier of tissue resistance is encountered. Contact is then maintained until the tissue barrier releases. The pressure is then increased to reach a new barrier in order to eliminate the trigger point tension and tenderness (Travell, Simons and Simons, 1999:140).

According to Aaslid (2001:54), the applied pressure increases circulation by creating a buildup of pressure in the vessels carrying fluids causing the fluids to rush through with greater speed when you let go. This in turn flushes out inflammatory exudate, breaks down scar tissue and reduces muscle spasm. Schneider (1996) proposes that the localised compression causes a stretch of the contracted fibres thereby producing a mechanical separation of the actin-

myosin cross fibre links. The unlocking of the actin and myosin filaments results in the 'release' or softening of the trigger point (Hammer, 1991:219).

In two independent studies conducted by Garvey (1989) and Hong *et. al.* (1993), ischaemic compression was found to be more effective than other modalities in the treatment of myofascial trigger points. Garvey (1989) found ischaemic compression to be more effective than lidocaine injection and dry needling in a randomised, double – blinded, prospective study involving 63 patients, while Hong *et. al.* (1993) found ischaemic compression to be more effective than spray and stretch, moist heat packs and ultrasound.

Ischaemic compression can be applied using either the thumb, finger or elbow, however an alternative method is to apply pressure by placing a tennis ball under the sore spot (Hammer, 1991:219 and Chaitow, 1993:87).

This technique involves placing two tennis balls in a sock with the ends tied. This allows the patient to place the balls behind their back and move them down the spine until the sore spot is found (Chaitow, 1993:87). The pressure created by the tennis ball has two effects: it creates a small, local stretch and it deforms the tissue, squashing stagnant fluids out of the area (Ingraham, 2004).

Travell, Simons and Simons (1999:490) have recommended the use of the Cold Tennis-ball Technique in the treatment of bilateral rhomboid myofascial trigger points. Two tennis balls are needed. One is placed in the toe of a sock and a knot is tied to keep it in place. The second tennis ball is then placed in the sock and a knot is tied on the other side of the second ball. The sock is then placed in the freezer until it is needed. During treatment the patient is asked to lie supine with the tennis balls placed directly under the trigger point. The patient is asked to hold this position and to control the pressure exerted by gradually increasing their body weight pressure against the tennis balls (Chaitow, 1993:87)

According to Lechnyr (2004), the application of cold to an area treated by accupressure helps to increase the muscle length and flexibility. The application of cold to local areas also has other therapeutic effects including the reduction of temperature and swelling, analgesia and an anti-inflammatory effect (Cameron, 1999:130 and Vasudevan, 1997).

Therefore this study compares the relative effectiveness of cryo-ischaemic compression as opposed to ischaemic compression in an effort to further improve the management of myofascial trigger points.

1.3 STATEMENT OF THE PROBLEMS

The aim of the study is to evaluate the therapeutic effectiveness of ischaemic compression versus cryo-ischaemic compression using the Cold Tennis-ball Technique, in terms of subjective and objective clinical findings, for the treatment of myofascial trigger points.

1.3.1 Sub-problem one

To determine the relative effectiveness of ischaemic compression and cryo-ischaemic compression using the Cold Tennis-ball Technique in the treatment of myofascial trigger points in terms of subjective clinical findings

1.3.2 Sub-problem two

To determine the relative effectiveness of ischaemic compression and cryo-ischaemic compression using the Cold Tennis-ball Technique in the treatment of myofascial trigger points in terms of objective clinical findings.

1.4 HYPOTHESIS

1.4.1 The first hypothesis

It is hypothesised that cryo-ischaemic compression will be effective in the treatment of patients with myofascial trigger points in terms of both subjective and objective clinical findings.

1.4.2 The second hypothesis

It is hypothesised that ischaemic compression using a tennis ball will be effective in the treatment of patients with myofascial trigger points in terms of both subjective and objective clinical findings.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Myofascial pain is a common, though poorly understood, source of discomfort and disability for many patients (Fomby *et. al.*, 1997). The concept of myofascial pain syndrome was developed by Janet Travell, MD. in the 1980's.

Myofascial pain syndrome may be defined as: the sensory, motor and autonomic symptoms caused by myofascial trigger points or hyperirritable spots within skeletal muscles that are associated with palpable nodules in a taut band (Travell, Simons and Simons, 1999:5). Myofascial trigger points can be classified as being either active or latent. Active trigger points cause persistent, ongoing pain whilst latent trigger points are silent until they are palpated. Both result in decreased range of motion, weakness in the affected muscle group and decreased ability of the muscle to stretch (Campbell, 1989).

According to Auleciems (1995), myofascial pain syndrome has an excellent prognosis. Besides specific trigger point therapy, treatment must involve lifestyle changes and long-term treatment to prevent recurrence. The following chapter is an overview of the current literature and concepts in trigger point aetiology, pathogenesis, diagnosis and management.

2.2 PREVALENCE AND INCIDENCE

Myofascial pain syndrome is one of the most predominant soft tissue syndromes seen in clinical practice and there is a growing interest within the Chiropractic profession towards the management of soft tissue disorders such as myofascial pain syndrome (Schneider, 1995).

Although myofascial trigger points have been diagnosed in both children and young adults the syndrome most often occurs between the ages of 30 and 60 years, with the prevalence declining with advancing age (Rachlin, 1994:145 and Fomby *et. al.*, 1997). The likelihood of developing active trigger points increases with age and activity level into the middle years. With the reduced activity of more advanced age, the stiffness and restricted range of motion of latent trigger points tend to become more prominent than the pain of active trigger points (Travell, Simons and Simons, 1999:13).

According to Rachlin (1994:145) the incidence of myofascial trigger points appears to be higher in females. Studies conducted by Walker and Wilks substantiate the fact that myofascial pain appears to be more common in females. Walker (2002) found that 72% of the 60 patients treated were female while Wilks (2003) found that of the 60 patients treated for myofascial trigger points 60% were female. The pain appears to increase during the second week of the menstrual cycle, which suggests a hormonal influence (Severino and Moline, 1990).

Sola *et. al.*, (1990) found that the muscles of the head and neck, shoulder girdle and lower back demonstrated a higher frequency of trigger points than any other region. This is due to the fact that these muscles are constantly involved in maintaining posture (Travell, Simons and Simons, 1999:12-13).

2.3 AETIOLOGY

The aetiology for myofascial trigger points is multifactorial. A taut band is a likely precursor to the development of trigger points. Latent trigger points can easily develop into active trigger points (Finley, 2005). According to Travell, Simons and Simons (1999:179), acute injuries may cause immediate symptoms, while chronic stresses are more likely to cause a gradual onset of symptoms. These

chronic stresses are the result of repetitive movements or excessively prolonged contraction.

Trigger points can also be activated reflexly through the nervous system from bones, its viscera, blood vessels and the brain (Travell, 1983).

According to Bendtsen et.al. (1996) several other factors are responsible for the formation of myofascial trigger points:

- Generalised fatigue
- Systemic conditions (e.g. Heart attack, appendicitis)
- Lack of activity
- Nutritional deficiencies
- Hormonal changes
- Nervous tension or stress
- Chilling of areas of the body

According to Gay et.al. (1994) the aetiology of myofascial trigger points is that of a cycle of muscle hyperactivity, which leads to muscle spasm, pain and finally constant chronic muscle fatigue.

The following are factors that result in the activation of trigger points in the rhomboid muscles (Travell, Simons and Simons, 1999:613).

- Holding the arm in flexion or abduction above 90 degrees for a prolonged period.
- Prolonged leaning forward and working in a round-shouldered position.
- Prolonged stretch due to prominence of the scapula on the convex side in an upper thoracic scoliosis.
- Sustained tension caused by a shortened pectoralis major muscle.

2.4 PATHOPHYSIOLOGY

There are several theories and hypotheses as to how myofascial trigger points are formed with the common factor being the dysfunction of the skeletal muscle fiber.

Travell, Simons and Simons (1999:73) and Rachlin (1994:39) have similar theories as to how trigger points are formed. It is proposed that acute injury or chronic microtrauma to the muscle causes the sarcoplasmic reticulum to tear and release calcium. In the presence of adenosine triphosphate (ATP), the free calcium stimulates actin and myosin interaction and increased metabolic activity. The locking of the actin/myosin heads causes contraction and shortening of the muscle in a localised area producing a taut band.

The sustained contractile activity causes an increase in metabolic activity and a decrease in blood circulation. The increased metabolic activity activates an increase in the release of serotonin, histamine, kinins and prostaglandins which causes hyperirritability of sensory nerve endings producing pain.

Studies conducted by electron microscopy have shown distinct structural changes in trigger point cells, which correlate with the chronic nature of the complaint. In acute cases there is a small amount of microfilament destruction and mitochondrial swelling and in chronic cases there is complete destruction of sarcomeres and fibers, necrosis and fibrosis in the muscle cells and collagen and scar accumulation (Schneider, 1995:403).

Hubbard and Berkoff found “increased electromyography activity when a fine needle electrode was placed precisely within the trigger point” (Schneider, 1995:403). Movement of the electrode away from the centre of the trigger point resulted in a decrease in EMG activity. They hypothesised that there is a reflex loop with the central nervous system which maintains the trigger points and that the activity detected is from the intrafusal muscle fibres.

2.5 PERPETUATING FACTORS

A large part of managing myofascial pain syndrome is recognizing underlying problems that might influence a patients' pain by increasing tension and irritability in a muscle group (Fomby et. al., 1997). According to Aulecians (1995) the event that activates myofascial trigger points is quite different from the factors which perpetuate them. The key to successful treatment is the identification and correction of these perpetuating factors.

Mechanical factors can contribute to myofascial pain by increasing stress and strain on the musculoskeletal system. These include skeletal asymmetry (leg-length discrepancy or small hemipelvis), disproportion (short upper arms), poor posture, prolonged immobilisation or poor work ergonomics (Fomby et. al., 1997).

In addition to the mechanical factors Travell, Simons and Simons (1999:178-228) have identified several groups of factors. These include:

- Nutritional inadequacies. These include vitamin and mineral deficiency and excessive consumption of stimulants.
- Metabolic and endocrine inadequacies that often perpetuate trigger points are hypothyroidism, hyperuricemia and hypoglycemia.
- Psychological factors can also perpetuate myofascial pain syndromes. High levels of anxiety, hostility and difficulty in verbalizing anger cause an increase in muscle contraction as a result of the stress experienced through these habits (Schneider, 1994).
- Chronic infection due to either viral or bacterial diseases as well as some parasitic infestations can prevent recovery from myofascial pain syndromes.

- Other factors such as allergic rhinitis, impaired sleep and nerve impingement should also be considered.

2.6 CLINICAL FEATURES

2.6.1 SYMPTOMS

The pain resulting from myofascial trigger points varies ranging from a mild ache to excruciating pain that is either sharp, dull, burning or heavy and that is often associated with general fatigue, decreased range of motion and muscle strength (Han and Harrison, 1997). Patients usually seek treatment for the spontaneous referred pain that occurs when a trigger point becomes active. Latent trigger points cause some increased muscle tension and limitation of movement which patients usually accept (Travell, Simons and Simons, 1999).

Trigger points can also affect the autonomic system producing various signs such as: coryza, lacrimation, localised vasoconstriction, sweating, salivation, pilomotor activity and proprioceptive disturbances eg. Dizziness and imbalance Travell, Simons and Simons, 1983).

The pain referred from trigger points usually follows a characteristic referral pain pattern for each muscle. Trigger points in the rhomboid muscles refer pain medially along the vertebral border of the scapula and between that border and the vertebrae (Travell, Simons and Simons, 1999:613).

Patients with trigger points in the rhomboid muscles usually describe the pain as a superficial ache at rest. Patients reach for, and try to rub, the area of pain referred from the trigger points. They may also present with snapping or crunching noises during movement of the scapular (Travell, Simons and Simons, 1999:617).

2.6.2 SIGNS

On palpation trigger points are described as being taut bands of muscle fibers that are ropey and tender to the touch and when palpated create a local twitch response (Fomby et. al., 1997).

Trigger points may be active or latent. Active trigger points cause persistent, ongoing pain whilst latent trigger points are silent until they are palpated. On palpation both create a local twitch response, decreased range of motion, weakness in the affected muscle group and decreased ability of the muscle to stretch (Fomby et. al., 1997).

Ruane (2001) has put forward the following signs that are evident upon examination of myofascial trigger points:

- Pain within the affected muscle is increased by passive or active stretching of the muscle.
- The range of motion, of the affected muscle, is decreased.
- Contracting the muscle against fixed resistance significantly increases the pain.
- Tenderness and dysesthesias are commonly referred in characteristic, well-defined zones.
- Firm pressure applied over the point usually elicits a “jump sign,” with the patient crying out, wincing or withdrawing from the stimulus.
- One or several fasciculations, called local twitch response, may be observed when firm pressure is applied over the point.

In addition to the above Travell, Simons and Simons (1999:34) have also found the following:

- Sustained, moderate pressure on a myofascial trigger point produces or increases pain in the referred pain zone of the trigger point.
- The skin overlying active myofascial trigger points has, in some patients, shown to exhibit panniculosis or dermatographia.

2.7 DIAGNOSIS OF MYOFASCIAL PAIN SYNDROME

Rachlin (1994:22) outlines a set of diagnostic criteria, as suggested by Simons, for myofascial pain syndrome:

Major criteria

- Regional pain complaint
- Taut band palpable in accessible muscle
- Exquisite spot tenderness in the taut band
- Pain complaint or altered sensation in the expected distribution of referred pain from the tender spot
- Some restricted range of motion, when measurable

Minor criteria

- Reproduction of clinical pain complaint or altered sensation by pressure on the tender spot
- Local twitch response by transverse snapping palpation or needle insertion into the taut band
- Pain is diminished or eliminated by muscular therapy

To diagnose myofascial pain syndrome, all five major criteria should be present with at least one of the three minor criteria.

Travell, Simons and Simons (1999) suggested that minimum acceptable criteria for identifying a trigger point are a combination of the spot tenderness in a palpable band and patient recognition of the pain.

2.8 TREATMENT OF MYOFASCIAL PAIN SYNDROME

The major goal of trigger point therapy is to relieve pain and tightness of the involved muscles (Hsueh, 1997). Many approaches can be used to treat

myofascial pain syndrome. Often a combination of methods are necessary to obtain pain relief and full functional recovery (Fomby et. al., 1997). In order to obtain satisfactory results active participation by the patient is required. Patients need to be taught how to do their own trigger point therapy, on a frequent basis, until full functional recovery is obtained (Lechnyr, 1998).

2.8.1 Spray and stretch

Travell and Simons introduced this technique in the 1940s. Using a vapocoolant spray the clinician passively stretches the muscle containing the trigger point to its normal maximum length (Fomby et. al., 1997). The vapocoolant spray aids in blocking the pain and spasm reflexes and gradually allows the passive stretch of the muscle (Travell, Simons and Simons, 1999:340).

2.8.2 Needling

Injections are recommended for more chronic myofascial pain and should be avoided in an acute setting (Fomby et. al., 1997). Travell and Simons (1983) state that needling is known to be effective whether done by injection with local anaesthetic, with saline or whether done by dry needling.

The procedure involves the following (Ruane, 2001):

The trigger point is located by palpation and is immobilised between the second and third digits by using downward pressure on either side of the nodule. The needle is then inserted through the tissue in the direction of the trigger point. The patient may have a sudden increase in pain and may also experience radiating pain along adjacent muscle and tendons. Active trigger points will often yield a local twitch response when penetrated.

2.8.3 Electrotherapy

Trigger points can be treated with various electrotherapeutic devices, including high-voltage stimulation, transcutaneous electrical nerve stimulation (TENS) and ultrasound (Murphy, 1989).

Auleciems (1995) attributed the benefit of electrotherapy in the treatment of myofascial pain syndrome to the stimulation of muscle contractions, which squeezes out edema, increases blood flow and relaxes muscle.

According to Esenyel et. al. (2000), pain relief from ultrasound therapy is theorized to be due to the washout of pain mediators, changes in nerve conduction, or alterations in cell membrane permeability that decrease inflammation.

Hsueh et. al. (1997) compared electrical nerve stimulation therapy (ENS) and electrical muscle stimulation therapy (EMS) in the treatment of myofascial trigger points. They found that ENS is more effective for immediate relief of myofascial trigger point pain than EMS ($p < 0.05$), and EMS has a better effect on immediate release of muscle tightness than ENS ($p < 0.05$).

Hans and Harrison (1997) report that TENS has become a popular therapy for acute and chronic pain conditions including myofascial trigger points. TENS can reduce myofascial pain but it may be insufficient as a long-term treatment.

2.8.4 Massage therapy

Massage by a massage therapist may be a valuable primary or adjunct therapy. Deep massage of the trigger point and surrounding tissue often provides relief of pain (Fomby et. al., 1997).

2.8.5 Ischaemic compression

Ischaemic compression is believed to be the most widely recognized form of manual therapy for the treatment of myofascial pain syndrome (Travell, Simons and Simons, 1999:140). It consists of an application of sustained pressure over a trigger point so as to reduce the muscle spasm and deactivate the trigger point (Gatterman, 1990:296). Compression can be applied using the index or middle

fingers, the thumb or elbow (Prentice, 1994:356). Pressure is applied within the patient's tolerance as excessive pain stimulation leads to reactive muscle contraction as the patient seeks to avoid the pain (Hammer, 1991:219). Generally, the more pressure the patient can tolerate, the more effective the treatment (Hammer, 1991:219).

Garvey et. al., (1989) found ischaemic compression to be more effective ($p=0.09$) than lidocaine injection and dry needling in a randomised, double-blinded, prospective study involving 63 patients.

Research done by Hong et. al., (1993) lends credibility to the statement that ischaemic compression is superior to other physical modalities for treating trigger points. He compared spray and stretch, heat packs, ultrasound and ischaemic compression and found the latter to be the most effective ($p < 0.05$).

Hanten et. al., (2000) found a home program of ischaemic compression followed by sustained stretch to be effective ($p < 0.05$) in reducing both trigger point sensitivity and pain intensity in 40 individuals with active trigger points.

Essentially the application of sustained pressure to the trigger point, in the form of ischaemic compression, creates an area of ischaemia and creates a buildup of pressure in the vessels carrying fluids to the area (Lechnyr, 1998 and Aaslid, 2001:55). The reactive hyperemia that occurs when the pressure is released improves local circulation and aids in the elimination of sensitizing agents (Hammer, 1991:219). During compression one can also feel the "release" or softening of the palpable band. This is probably due to the unlocking of the actin and myosin filaments, which results in muscle relaxation (Hammer, 1991:219). The reactive hyperemia that occurs when the pressure is released improves local circulation and aids in the elimination of sensitizing agents (Hammer, 1991:219).

According to Schnieder (1994:25) the therapeutic benefit of ischaemic compression may be the result of the following:

- Ischaemic nerve block: action potentials can only be propagated in the presence of oxygen. The ischaemia produced by prolonged pressure inhibits this resulting in a 'nerve block'. Deep pressure also suspends any reflex motor neuron excitation by incoming sensory afferents.
- Reflex vasodilation: following the initial blanching and ischaemia caused by the pressure the region undergoes reflex vasodilation, bringing fresh blood and oxygen to the area.
- Release of endorphins or enkephalins: the intensified pain induced deep pressure hyperstimulates interneurons in the dorsal horn to release endorphins. Higher levels, such as the thalamus, may also be stimulated resulting in the release of enkephalins.
- Localised stretch: ischaemic compression is a form of intense, specific stretching of the contracted fibers within the trigger point nodule which results in the separation of the actin and myosin cross-links responsible for maintaining the trigger point in a state of contracture.

2.9 CRYOTHERAPY

Cryotherapy is defined as: the local or systemic application of cold for therapeutic purposes (Olson and Stravino, 1972). The therapeutic use of cold can produce dramatic relief of pain arising from muscle spasm and from irritable myofascial trigger points (Mennel, 1975). Tools for cryotherapy include ice packs, ice cubes, vapo-coolant sprays, cold baths and controlled cold-compression units (Carr and Mann, 2000:97 and Michlovitz, 1996:98). The application of cryotherapy produces a three-to four-stage sensation. First there is an uncomfortable sensation of cold followed by a stinging, then a burning or aching feeling and finally numbness or analgesia (Prentice, 1994:184 and Olson and Stravino, 1972). This sequence can occur within 5 to 15 minutes of ice application (Prentice, 1994:184).

2.9.1 CLINICAL INDICATIONS FOR CRYOTHERAPY

Cold is used as the initial treatment for most conditions in the musculoskeletal system (Prentice, 1994:178). According to Michlovitz (1996:96), the application of ice over a trigger point reduces symptoms and allows for stretching and strengthening of the muscle involved.

The following is a list of some of the most common indications for cryotherapy (Zohn, 1988:126, Saxon, 1991:68 and Michlovitz, 1996:90):

- To decrease swelling and edema following trauma.
- To treat burns.
- To inhibit spasticity (the cooling process requires a minimum of 10 minutes).
- To reduce muscle spasm.
- To reduce metabolism.
- To produce reactive hyperemia.
- To facilitate muscular contraction for various forms of neurogenic weakness and for muscle re-education.
- To decrease sensitivity of the skin by cooling.

2.9.2 CONTRAINDICATIONS FOR CRYOTHERAPY

Cryotherapy should not be used when treating patients with specific cold-sensitivity symptoms (Michlovitz, 1996:102). These conditions include, but are not limited to, cold urticaria, cryoglobulinemia, Raynaud's phenomenon and paroxysmal cold hemoglobinuria (McMaster, 1982). Cold should not be applied over areas of compromised circulation, eg. peripheral vascular disease affecting arterial circulation (Michlovitz, 1996:102). Some patients have a cold allergy which produces hives and joint pains and hence cryotherapy should be avoided (McMaster, 1982).

2.9.3 PHYSIOLOGICAL EFFECTS OF CRYOTHERAPY

(Prentice, 1994:178, McMaster, 1982 and Saxon, 1991:68)

- Decreased local temperature
- Decreased metabolism

- Vasoconstriction of arterioles and capillaries.
- Decreased blood flow.
- Decreased nerve conduction velocity.
- Decreased muscle excitability.
- Decreased muscle spindle depolarization.
- Decreased formation and accumulation of edema.
- Extreme anesthetic effects.

2.9.4 THE THERAPEUTIC USE OF COLD IN THE TREATMENT OF MYOFASCIAL TRIGGER POINTS

According to Mennel (1975)

The constant factors involved in the treatment of myofascial trigger points are the touch-cold sensation and the muscle stretch, both of which can affect the muscle spindle apparatus. The important implication in the touch-cold sensation is that the point at which the patient feels the pain and the point at which the pain originates are usually not the same. It is therefore important that the examiner accurately palpates the trigger point and elicits a characteristic referred pain pattern.

The smaller the ice source used, the more accurately the touch-cold impulse can be applied. The ice should have direct contact with the skin.

The cold is used to promote the restoration of the normal resting length of the muscle by increasing the sensory input of touch and cold. The excessive use of cold should be avoided, as this would enhance existing muscle spasm and decrease the resting length of the muscle.

Failure to produce predictable relief of pain by use of counterirritant application of the touch-cold method may mean that the bombardment of the central nervous system by the noxious impulses from the trigger point is too intense to be blocked by the relatively mild substituted sensation of cold. The nonspecific application of cold would result in only a temporary relief of the symptoms.

Michlovitz (1996:97) reports that, in some cases, an ice massage may be necessary to initially deactivate trigger points so that stretching of the muscle and active exercise can follow.

The nerves for muscles in the neck, shoulders and back are mediated by the spinal cord reflex which develops a memory for the muscles (Lechnyr, 1998). Cold applied to an area just treated by accupressure helps to distract this reflex. The cold helps to depress the nerve endings and increase pain threshold (Prentice 1994:178). This causes the spinal cord synapse reflex to 'let go' enabling the muscle to increase in length and flexibility (Lechnyr, 1998).

2.10 BRIEF OVERVIEW OF RHOMBOID MUSCLES

2.10.1 FUNCTION

No distinction has been drawn between the functions of rhomboid minor and major muscles. The rhomboid muscles adduct and elevate the scapula. They are involved in swinging the arms during walking and they also stabilize the scapula (Travell, Simons and Simons, 1999).

2.10.2 ATTACHMENTS

Both the rhomboid major and minor muscles attach laterally to the medial border of the scapula from the level of the spine to the inferior angle. Medially rhomboid minor attaches to Ligamentum Nuchae and the spinous process of C7-T1 vertebrae. The rhomboid major attaches to the spinous process of T2-T5 vertebrae (Moore, 1992:533).

2.10.3 INNERVATION

The rhomboid muscles are innervated by the dorsal scapular nerve – C4 and C5 (Moore, 1992:533).

2.10.4 TRIGGER POINT EXAMINATION

Palpation discloses multiple trigger points between the vertebral column and the vertebral border of the scapula (Travell, Simons and Simons, 1999:617).

Diagram A illustrates the location of the trigger points in the rhomboid muscles (www.mypressureproducts.com/Rhomboid_trigger_points.htm).

2.10.5 REFERRAL PAIN PATTERN

Referred pain concentrates medially along the vertebral border of the scapula, and between that border and the vertebrae (Travell, Simons and Simons, 1999:613). The referral pain pattern is illustrated in diagram B (www.mypressureproducts.com/Rhomboid_trigger_points.htm).

2.10.6 DIAGRAMS OF THE RHOMBOID MUSCLES

A: LOCATION OF THE TRIGGER POINTS



B: REFERRAL PAIN PATTERN



CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter is an outline of the procedures followed in the execution of this research study. It includes a detailed description of the study design and protocol, methods used in the gathering of subjective and objective data as well as the methods of statistical analysis used for evaluation of the data.

3.2 STUDY DESIGN AND PROTOCOL

3.2.1 STUDY DESIGN AND SAMPLE SIZE

This study was a randomised, controlled, comparative clinical trial involving 60 patients divided into 2 groups of 30 individuals each. Advertisements (Appendix J) for patients suffering from upper back pain or pain between the shoulder blades were posted around the D.I.T. campus, in local community newspapers and fliers were distributed in the surrounding neighbourhood. Patients were interviewed telephonically in order to determine their eligibility for the study. All appointments were scheduled within a day of the telephonic interview.

3.2.2 TELEPHONIC INTERVIEW

Patients were asked the following questions:

- Their age
- If they had pain in the upper thoracic region i.e. between the shoulder blades
- If they had previously been diagnosed with fibromyalgia. Patients with fibromyalgia were excluded as the condition differs from myofascial pain syndrome. The tender points do not exhibit twitch responses and the pain is more widespread (Fomby *et. al.*, 1997).

- If they were receiving any other form of treatment. All other forms of manual therapy needed to be discontinued and patients on anti-inflammatory drugs needed to allow for a washout period of 48 hours before they could be treated (Spypolt, 2002).
- Patients were required to rate their pain on a scale of 0-10. Only patients with a pain rating of between 4 and 8 were included in the study. This was done in order to standardise the statistical results.

3.2.3 DIAGNOSTIC CRITERIA

Myofascial trigger points are described as being either active or latent. Both cause stiffness, restricted range of motion and pain on manual compression. However, according to Travell, Simons and Simons (1999), only active myofascial trigger points cause spontaneous pain referral.

Only patients with bilateral, active rhomboid myofascial trigger points were accepted in the study. Bilateral rhomboid myofascial trigger points are easier to treat when doing ischemic compression with tennis balls. The referral pattern of rhomboid myofascial trigger points concentrates along the vertebral border of the scapular, however it may spread upward over the supraspinous portion of the scapular (Travell, Simons and Simons, 1999).

3.2.4 INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria for the study was as follows:

1. Only patients between the ages of 18-35 years were accepted into the study. A relatively young population was chosen to minimise the number of patients presenting with pain resulting from age related diseases, with examples being degenerative disc or joint disease (Esenyel *et. al.*, 2000).
2. Both male and female volunteers were able to participate in this study.
3. Patients were required to have active trigger points in their rhomboid muscles bilaterally. An active trigger point is one that displays the following characteristics (Hsueh *et. al.*, 1997 and Travell, Simons and Simons, 1999):

- A palpable taut band of muscle
 - Tender nodule palpated within this taut band of muscle fibres
 - Local twitch response of the taut band of fibres to snapping palpation
 - A typical referred pain pattern must be elicited on compression of the trigger point
4. Only patients with a pain rating of between 4 and 8 were included in the study. This was done to standardise the statistical results.

The exclusion criteria for the study were as follows:

1. Patients with an adverse reaction to cryotherapy were excluded. Examples included Raynaud's disease, arterial deficiencies, hypersensitivity to cold and an anaesthetised area (Shipton, 1993).
2. Patients who exhibited signs of fibromyalgia were excluded from the study. These patients often have diffuse tenderness; general malaise, widespread pain and their muscles feel soft and doughy to palpation (Warfield *et. al.*, 2002).
3. Patients taking anti-inflammatory drugs or any other form of analgesics needed to allow a washout period of 48 hours before they could be included in the study (Spypolt, 2002).
4. Participants were not to receive any other form of treatment for Myofascial Pain Syndrome or related musculoskeletal conditions for the entire duration of the study.

3.3 DETAILED PATIENT PROCEDURE

On presentation to the clinic the nature and importance of the study was explained to each patient. Each patient also received an additional letter of information (Appendix A). A full case history (Appendix C), physical (Appendix D) and regional examination (Appendix E) was performed followed by a screening of the rhomboid muscles for active myofascial trigger points. Each patient was asked to complete an informed consent form (Appendix B) before commencement of the treatments.

Patients were randomly allocated into one of two groups. Group A received treatment using the Cold Tennis-ball Technique whilst group B received ischaemic compression using normal tennis balls at room temperature. Each group received 4 treatments over a period of 2 weeks.

3.3.1 Clinic procedure

Each method of treatment required the use of two tennis balls. One ball was placed in the toe of the sock and a knot was tied to keep it in place. The second ball was then placed in the sock and a knot was tied on the other side of the ball. One set was kept in the freezer until it was required for the Cold Tennis-ball Technique (Travell, Simons and Simons, 1999:490).

At each consultation, for both group A and B, the examiner located the trigger points in the rhomboid major and minor muscles bilaterally by digital palpation. The patient was asked to lie supine and the tennis balls were positioned directly beneath the trigger points. The patient was asked to hold this position and to control the pressure exerted on the tennis balls by gradually increasing or decreasing their body weight against the tennis balls. The pressure was maintained for 10 minutes (Chaitow, 1993:87).

The Cold Tennis-ball Technique required the use of 2 sets of tennis balls. One set was used for the first 5 minutes of treatment and the second set of cold tennis balls was used for the second half of the treatment procedure. This was done to ensure that the tennis balls remained cold throughout the duration of treatment.

3.4 THE DATA

3.4.1 The Primary Data

The primary data included the following information for each patient.

Subjective data Numerical Pain Rating Scale (Appendix F)

Patients were required to give a sensory description of their pain at intervals during treatment (Appendix I)

Objective data Algometric measurement (Appendix H)
Myofascial Diagnostic Scale (Appendix G)

Both the subjective and objective data were collected prior to and immediately after each treatment.

3.4.2 The secondary data

Secondary data was collected from related literature found in journal articles, textbooks and the internet.

3.5 METHODS OF MEASUREMENT

3.5.1 Subjective Measurements

3.5.1.1 The Numerical Pain Rating Scale

This scale ranges from 0-100, with 0 representing 'no pain' and 100 representing 'pain at its extreme'. The patient was asked to choose a number between 0 and 100 that best described their pain prior to and after each treatment. This data showed the progression or regression of the subjects' pain levels throughout the study. The NRS was chosen for its ease of application and scoring. It has also been proven to be valid and practical (Jensen et al., 1986).

3.5.1.2 Sensory description of the pain

This questionnaire consists of seven descriptions representing the sensory dimensions of pain. Patients were required to give a description of their pain or sensation experienced at two-minute intervals during the duration of treatment.

3.5.2 Objective Measurements

3.5.2.1 The Algometer

According to Fischer (1987) the pressure algometer provides a measurement of pain tolerance by the subject to pressure exerted over an active myofascial trigger point. Reeves et al. (1986) conducted a study that demonstrated high inter and intra experiment reliability of the pressure algometer as a measure of myofascial trigger point sensitivity.

The algometer was used as follows (Schneider, 1994): myofascial trigger points were located in the rhomboid muscles. Pressure was slowly exerted onto the trigger point while the patient was instructed to say 'now' at the point of which they first perceived pain. The reading on the dial was recorded in kg/cm².

This procedure was repeated for each trigger point. These measurements were added together at the end of each consultation and an average score was calculated for that consultation.

3.5.2.2 The Myofascial Diagnostic Scale

The Myofascial Diagnostic Scale was designed and used to evaluate the clinical signs of Myofascial Pain Syndrome by Chettiar (2001). This scale is made up of four indicators. The first indicator is a representation of the 5 grades of soft tissue tenderness. Each grade was scored as follows:

Grade 0 – no tenderness = 0

Grade 1 - tenderness to palpation without grimace or flinch = 1

Grade 2 – tenderness with grimace and/or flinch to palpation = 2

Grade 3 – tenderness with withdrawal = 3

Grade 4 – withdrawal to non-noxious stimuli = 4

The second and third indicators represent the presence of a local twitch response and taut band respectively and are given a value of 4 each.

The fourth indicator represents the presence of referred pain and is given a value of 5.

3.6 STATISTICAL ANALYSIS

Statistical analysis was conducted using the SPSS (version 11.5) software suite as well as the Stata (version 9.0) software suite. Treatment effects for quantitative outcomes were analysed using repeated measures ANOVA. Profile plots were examined in order to determine in which direction the significance lay. Ordinal outcomes were examined for a treatment effect. This was done using ordinal logistic regression modeling. These models were also used to examine a time by group interaction as well as the main effects of time and group. Nonparametric Spearman's correlation coefficients were used to examine the intra-group relationships.

Chapter 4

ANALYSIS AND DISCUSSION OF RESULTS

4.1 Statistical methodology

SPSS version 11.5 (SPSS Inc, Chicago, Ill, USA) and Stata version 9.0 (Stata Corporation, Texas, USA) were used for analysis of data. Treatment effects for quantitative outcomes were analysed using repeated measures ANOVA. A significant time by group interaction ($p < 0.05$) indicated a significant treatment effect. Profile plots were examined in order to assess in which direction the significance lay. Ordinal outcomes were examined for a treatment effect using ordinal logistic regression modeling, with robust standard errors clustered on the patient file number. A time by group interaction, as well as the main effects of time and group were examined in these models. Nonparametric Spearman's correlation coefficients for ordinal data were used to examine intra-group relationships between changes in outcome variables.

Results

4.2 Demographics

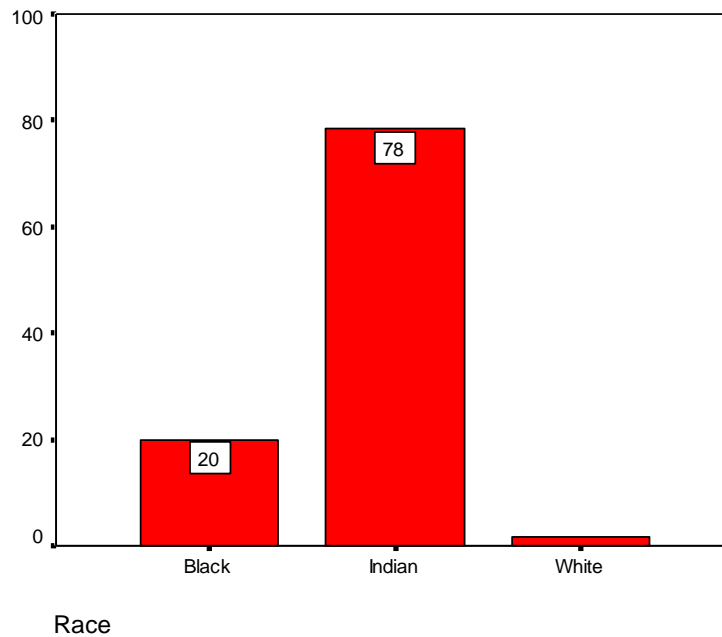
The study comprised 60 participants who were randomised into two treatment groups. The demographic composition of the sample is shown in this section. Age groups are shown in **Table 1**. The majority were in the 18-24 year old group (55%), and equal proportions were in the 25 to 30 year old group (21.7%) and the 31 to 35 year group (23.3%).

Table 1: Age group of participants (n=60)

	Frequency	Percent
18-24 yrs	33	55.0
25-30 yrs	13	21.7
31-35 yrs	14	23.3
Total	60	100.0

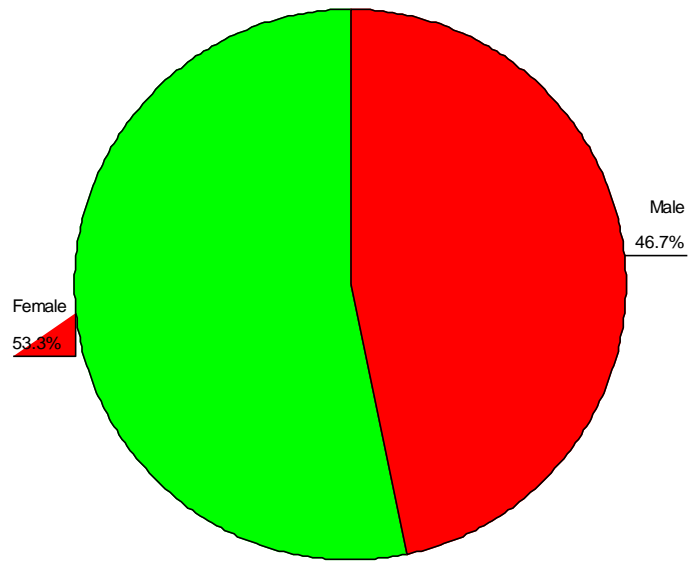
The vast majority of the sample was Indian (n=47). There were 12 Black and one White participant. The racial distribution is shown in **Figure 1**.

Figure 1: Racial distribution of sample (n=60)



There were a slightly higher percentage of females in the study than males, 28 males (46.7%) and 32 females (53.3%). The gender distribution is shown in **Figure 2**.

Figure 2: gender distribution of study sample (n=60)



Occupation of participants is shown in **Table 2**. The most common occupation was secretary (n=14) followed by student (n=13).

Table 2: Occupation of participants (n=60)

	Frequency	Percent
Student	13	21.7
Account	3	5.0
Engineer	2	3.3
Self-employed	5	8.3
IT	1	1.7
Admin	5	8.3
Cashier	3	5.0
Baker	1	1.7
Petrol attendant	5	8.3
Housewife	3	5.0
Welder	2	3.3
Secretary	14	23.3
Teacher	2	3.3
Locksmith	1	1.7
Total	60	100.0

Table 3 indicates that the majority of participants felt that their condition was work-related (n=22). Stress-related conditions were second most frequent (n=16), followed by posture-related (n=13). The other causes were infrequently reported.

Table 3: Activity to which the condition was attributed

	Frequency	Percent
Work-related	22	36.7
Stress	16	26.7
Posture	13	21.7
Cold weather	3	5.0
MVA	2	3.3
sport	4	6.7
Total	60	100.0

4.2.1 Discussion of demographic data

The age group chosen for the study was 18-35 years. The age group of greatest prevalence in this study was 18-24 years (55%) (**Table 1**). It is the opinion of the author that this was the age group of greatest prevalence as the majority of the participants were recruited within the framework of a tertiary education setting and from local medical centers predisposing to a slightly higher participation of students and young receptionists in the study.

Evaluation of the race groups represented in this study show the majority of patients to be Indian (n=47) (**Figure 1**). There were 12 Black and 1 White participant. This is largely due to the fact that the study was conducted in a predominantly Indian community.

Gender distribution of the study sample (**Figure 2**) revealed that there were a higher percentage of female participants (53.3%). This correlates with statements made by Han and Harrison (1997) and Travell, Simons and Simons

(1999), that Myofascial Pain Syndrome is more common in females than in males.

Of those patients who were accepted into the study, the most common occupations were secretaries (n=14) and students (n=13) (**Table 2**). This correlates with the high percentage of patients who attributed their condition to be due poor ergonomics at work and stress. Han and Harrison (1997) found that prolonged sitting at a desk might explain the high prevalence of the condition in these patients.

4.3 EVALUATION OF THE TREATMENT EFFECTS

Null hypothesis: there is no difference in the treatment effects of the two groups in terms of objective and subjective outcome measurements.

Alternative hypothesis: there is a difference in the treatment effects of the two groups in terms of objective and subjective outcome measurements.

4.3.1 Objective measurements

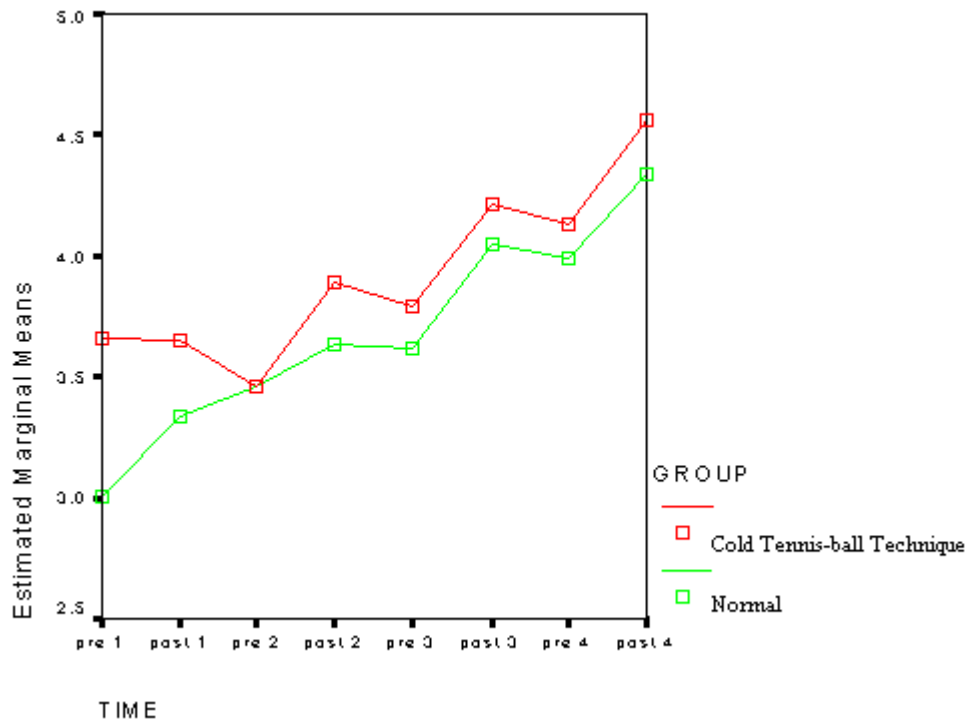
4.3.1.1 Algometer

In order to answer the question of which treatment works best, repeated measures ANOVA was performed. There was a statistically significant time effect which was regardless of treatment group ($p < 0.001$). However, there was no evidence of a treatment effect ($p = 0.281$). Figure 3 shows that both groups decreased in parallel over time. Thus, for the algometer reading, the treatment group did not make a difference and the rate of improvement was the same in both groups. The null hypothesis could not be rejected.

Table 4: within and between –subjects effects for algometer (n=60)

Effect	Statistic	P value
Time	Wilk's Lambda=0.344	<0.001
Time*group	Wilk's Lambda=0.853	0.281
Group	F=0.559	0.458

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



The statistically analysed data obtained from the algometer readings is found in **Table 4** and **Figure 3**.

The results showed a statistically significant improvement within each group, with the rate of improvement been the same for both groups. These results highlight the fact that ischaemic compression is an effective tool for the treatment of myofascial trigger points.

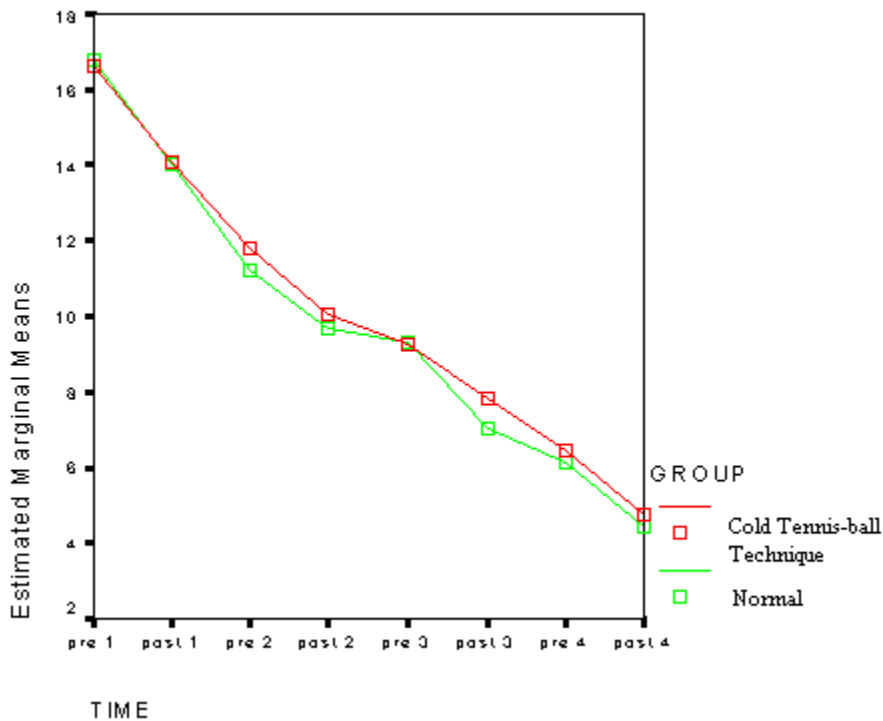
4.3.1.2 Myofascial Diagnostic Scale

For the second objective measurement, there was also a statistically significant decrease over time ($p < 0.001$) in both groups. There was no statistically significant difference in treatment effect between the groups ($p = 0.806$) and **Figure 4** shows almost identical profiles of the two groups. Thus the treatment group did not affect the rate of improvement for this outcome. The null hypothesis is not rejected.

Table 5: Within and Between –subjects effects for MDS Score (n=60)

Effect	Statistic	P value
Time	Wilk's Lambda=0.062	<0.001
Time*group	Wilk's Lambda=0.933	0.806
Group	F=0.247	0.621

Figure 4: Profile plot of mean Myofascial Diagnostic Scale Score over time by group



The statistically analysed data for the Myofascial Diagnostic Scale is found in **Table 5** and **Figure 4**.

Both groups showed a statistically significant decrease over time. This suggests that each score on the Myofascial Diagnostic Scale decreased indicating that both groups showed a reduction in clinical signs, as outlined in the Myofascial Diagnostic Scale, over the course of the study. It is in the opinion of the author that this may be partly due to the fact that the only difference in the treatment was that normal tennis balls were used for one group and cold tennis balls for the other, essentially both groups received ischaemic compression. These results

may also give an indication that the Myofascial is somewhat subjective, as suggested by Walker (2002).

4.3.2 Subjective measurements

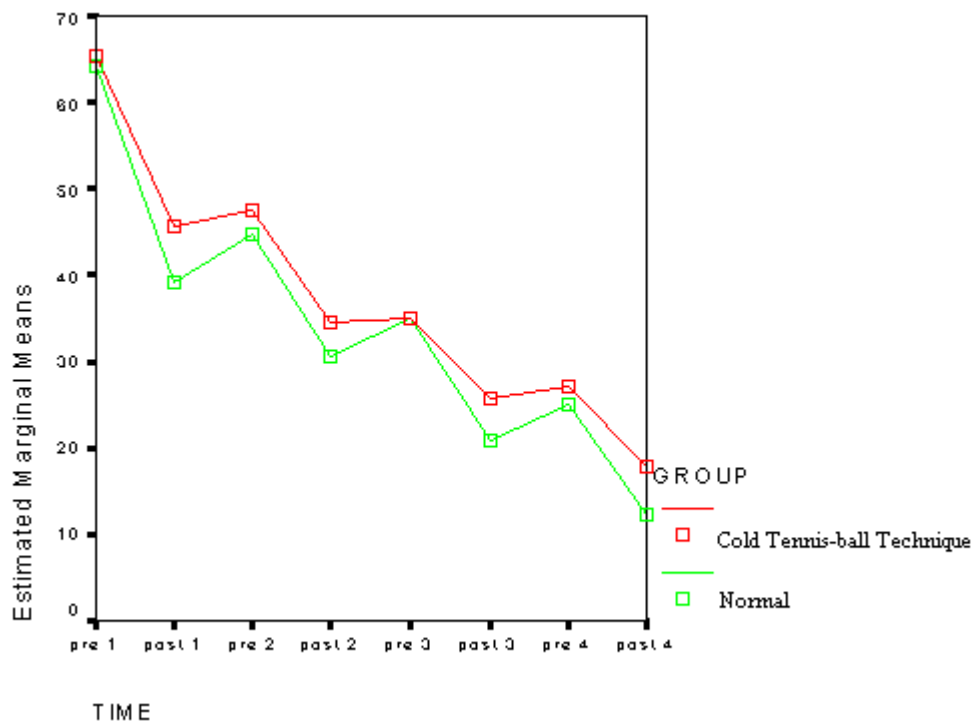
4.3.2.1 NUMERICAL PAIN RATING SCALE

According to Table 5 there was a highly statistically significant decrease over time in both groups ($p < 0.001$) but no difference in treatment effect between the groups ($p = 0.641$). Thus there was no evidence for a statistically significant difference in outcome between the groups according to NRS score. This is shown in **Figure 5**, where almost parallel profiles of the two groups are shown. The null hypothesis is not rejected.

Table 6 Within and Between –subjects effects for NRS (n=60)

Effect	Statistic	P value
Time	Wilk's Lambda=0.112	<0.001
Time*group	Wilk's Lambda=0.910	0.641
Group	F=0.622	0.433

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



The statistically analysed data obtained from the NRS, as found in Table 5 and **Figure 5**, revealed a statistically significant improvement in both groups. The rate of improvement was also shown to be almost proportional. This suggests that although the scores revealed a significant reduction in pain intensity, both treatments worked equally well.

4.3.2.2 Sensory description of the pain at two minute intervals

Since the outcomes were measured on a categorical ordinal scale (0 to 4), ordinal logistic regression was used to assess the effects in these models.

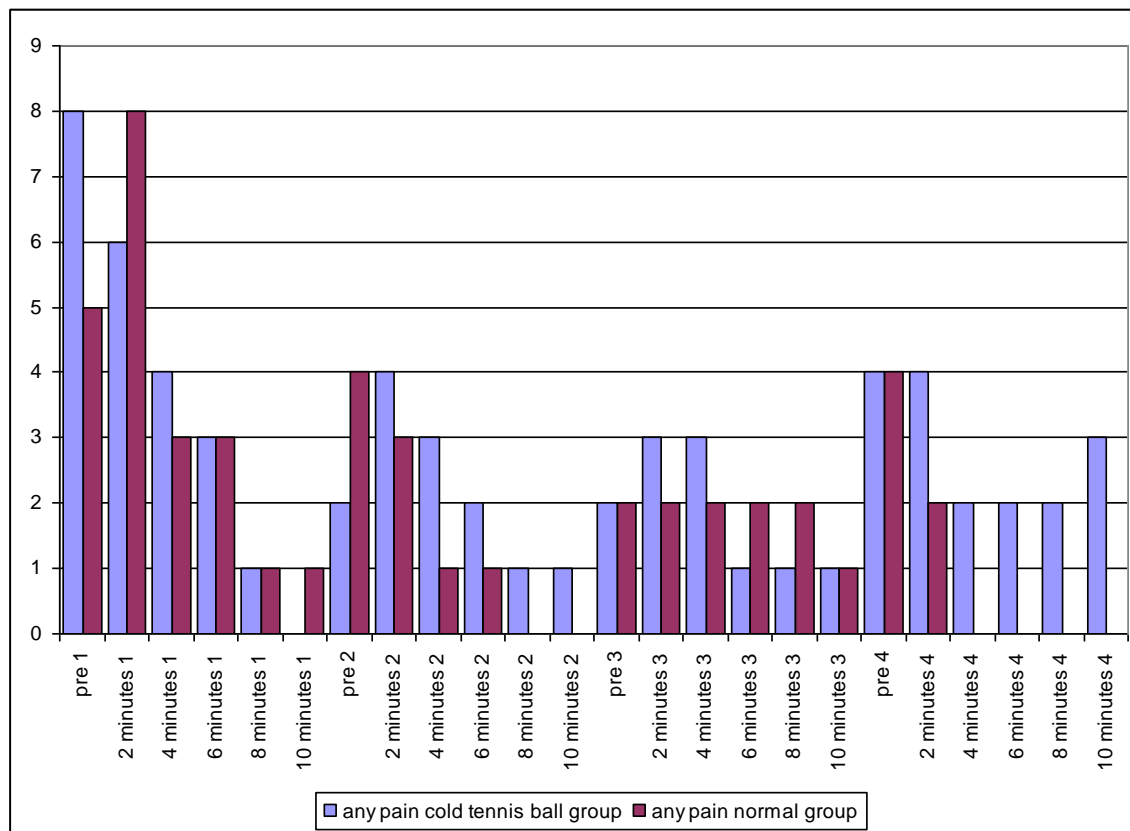
Throbbing

Table 7 shows that there was no evidence of a significant treatment effect for throbbing. Thus the null hypothesis was not rejected. **Figure 6** shows the number of participants at each time point that had a score for throbbing of greater than 0 (i.e. any throbbing pain). It can be seen that the pain decreased throughout the treatments. The normal group appeared to have a lower frequency of throbbing pain in general and to become pain free faster (at treatment 2 and 4). However, this trend was not statistically significant and the null hypothesis could not be rejected.

Table 7: Difference within and between subjects effects – Throbbing (n=60)

Effect	Odds ratio (95% CI)	P value
Time	1.01 (0.86 – 1.19)	0.856
Time*group	0.95 (0.86 – 1.04)	0.274
Group	1.24 (0.40 -3.87)	0.711

Figure 6: Number of participants per group with any throbbing pain at each time point



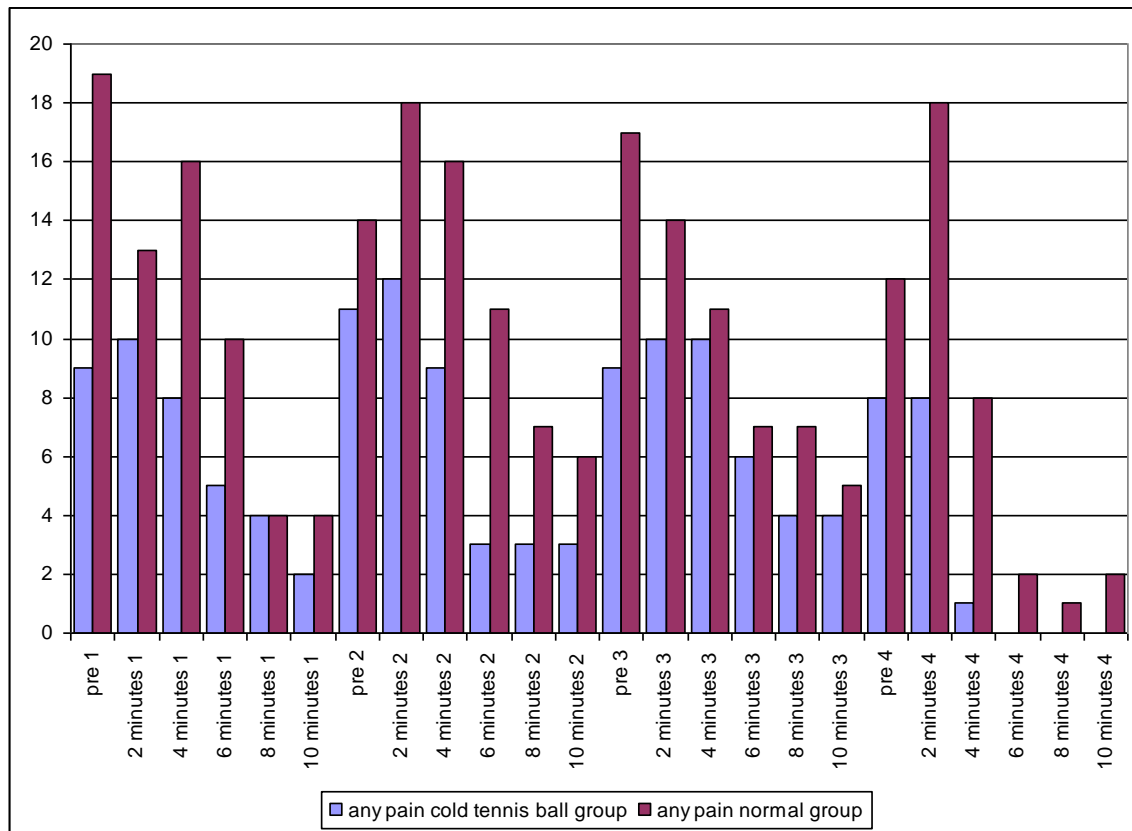
Aching

Aching showed a statistically significant group difference ($p=0.022$), which was irrespective of time. This means that there was a statistically significant difference between the proportions in each category by group. This is not the same as a treatment effect and could be due to baseline differences between the groups. There was no evidence of a treatment effect ($p=0.621$). The null hypothesis was not rejected. **Figure 7** shows that at all time points there was a higher number of affected subjects in the normal group than the cold tennis ball group, but trends were the same over time in both groups.

Table 8: Difference within and between subjects effects – Aching (n=60)

Effect	Odds ratio (95% CI)	P value
Time	0.95 (0.88-1.03)	0.221
Time*group	0.99 (0.94-1.04)	0.621
Group	2.55 (1.14-5.67)	0.022

Figure 7: Number of participants per group with any aching pain at each time point



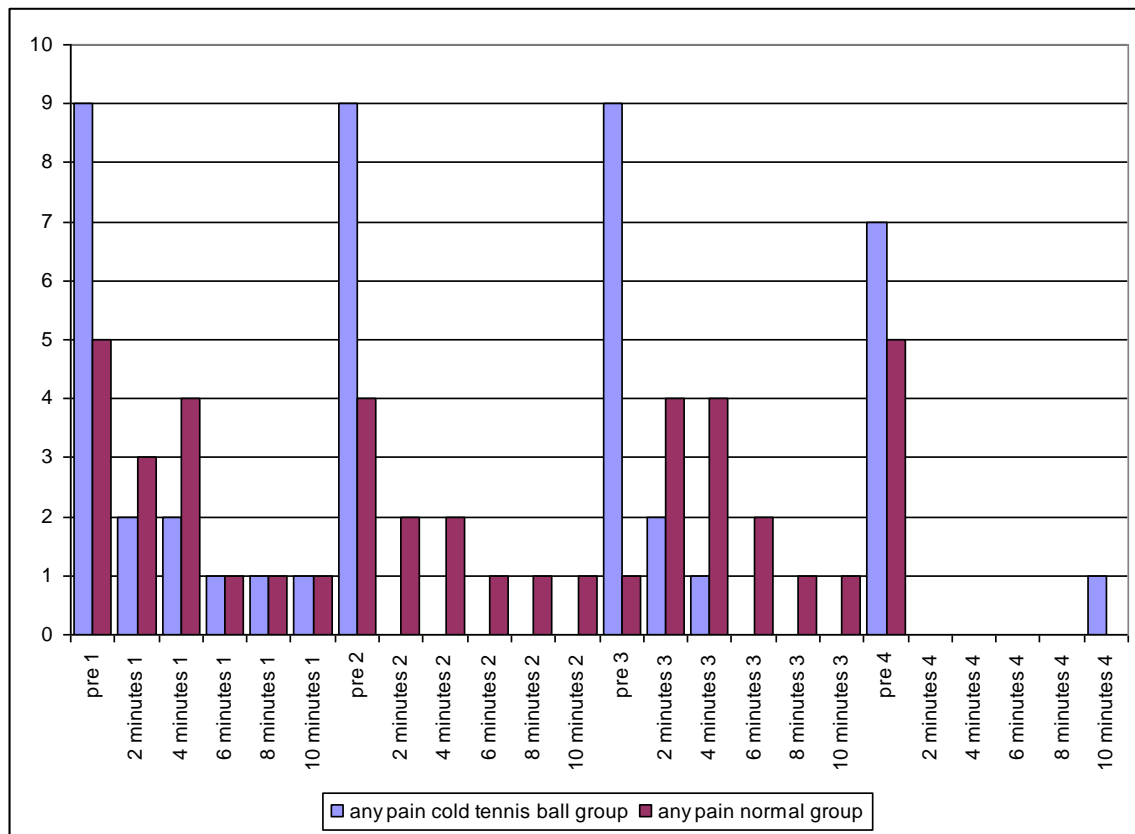
Sharp

With sharp pain there was no evidence of any treatment effect ($p=0.727$) and the null hypothesis is not rejected. **Figure 8** shows that there was a trend towards a better treatment effect in the cold tennis ball group compared with the normal group, but this trend was not statistically significant as the numbers who reported any sharp pain were low.

Table 9: Difference within and between subjects effects – Sharp (n=60)

Effect	Odds ratio (95% CI)	P value
Time	0.91 (0.80-1.03)	0.128
Time*group	1.01 (0.94-1.10)	0.727
Group	0.83 (0.31-2.24)	0.715

Figure 8: Number of participants per group with any sharp pain at each time point



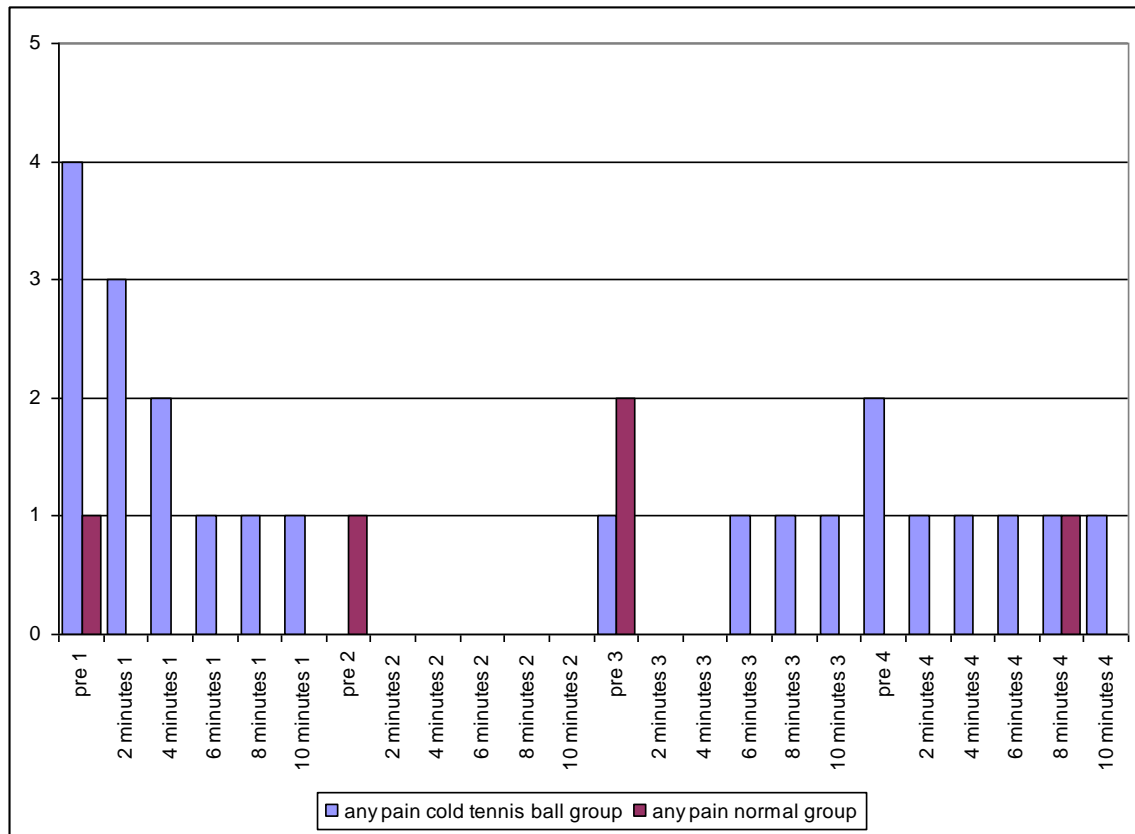
Cramping

There were very few participants who reported any cramping pain at any time point (see **Figure 9**). Thus there was no statistical evidence for a treatment effect for this outcome. The null hypothesis was not rejected.

Table 10: Difference within and between subjects – Cramping (n=60)

Effect	Odds ratio (95% CI)	P value
Time	0.94 (0.76 -1.15)	0.526
Time*group	1.02 (0.92-1.14)	0.691
Group	0.16 (0.03 to 0.85)	0.031

Figure 9: Number of participants per group with any cramping pain at each time point



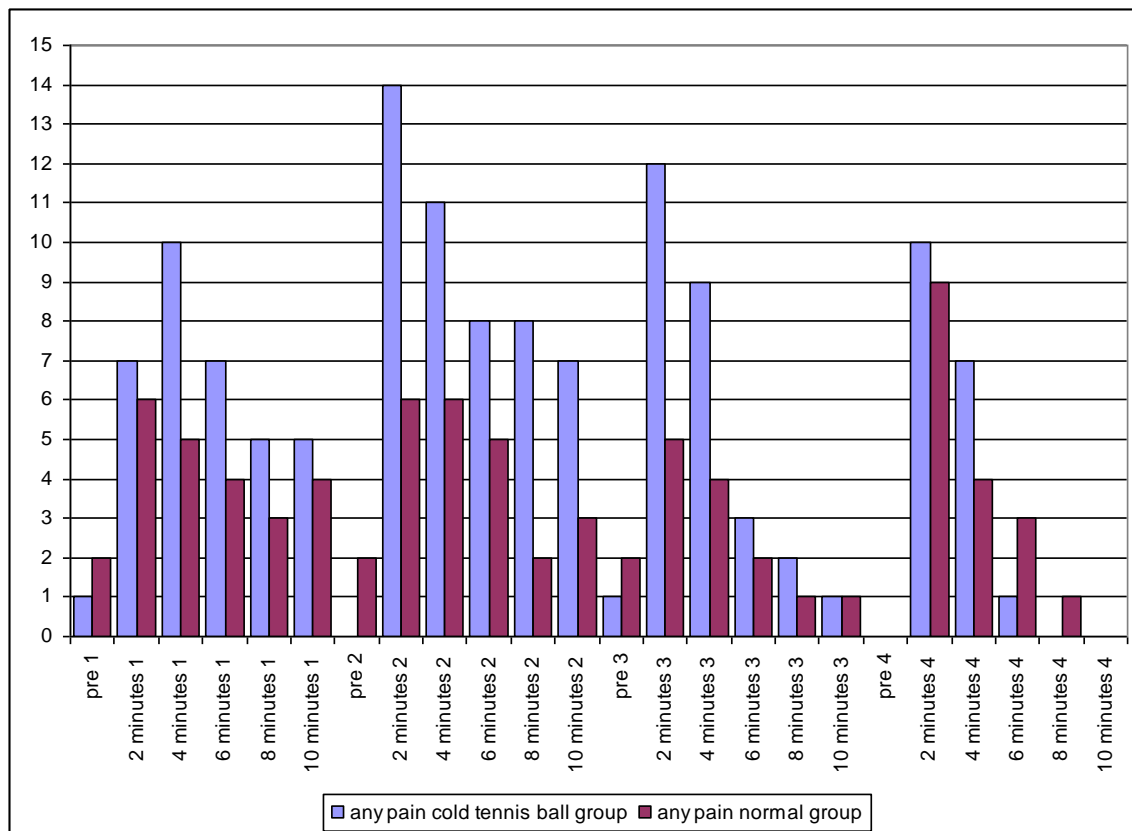
Shooting

Shooting pain did not show a statistically significant treatment effect between the groups ($p=0.579$). Thus, the null hypothesis was not rejected. **Figure 10** indicates that both groups showed a decrease in proportion affected over time.

Table 11: Difference within and between –subjects effects –Shooting (n=60)

Effect	Odds ratio (95% CI)	P value
Time	0.93 (0.86-1.02)	0.114
Time*group	1.02 (0.96-1.07)	0.579
Group	0.48 (0.19-1.21)	0.119

Figure 10: Number of participants per group with any shooting pain at each time point



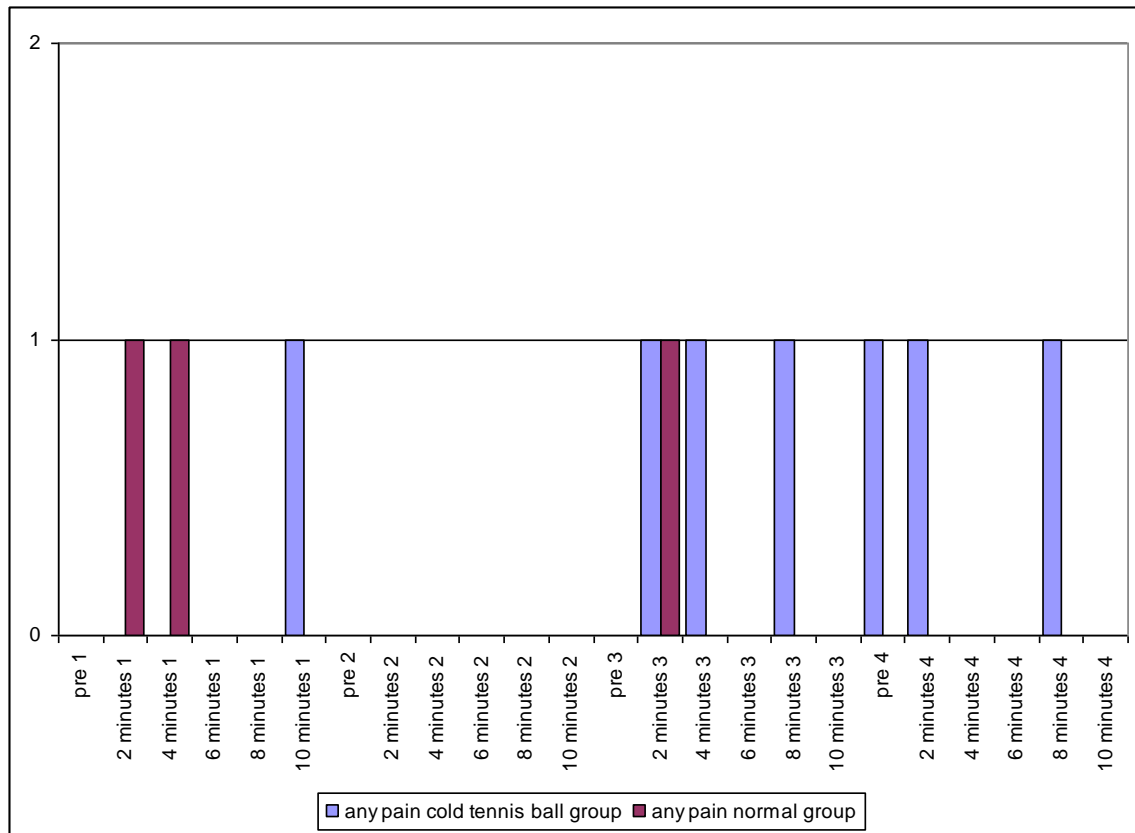
Burning

Although the time by group effect was statistically significant for burning pain ($p < 0.001$), this estimate should be interpreted with caution since as **Figure 11** shows, there was a maximum of one person per group who reported burning pain at any time point. Thus there was insufficient evidence for a treatment effect for this outcome. The null hypothesis was not rejected.

Table 12: Difference within and between –subjects effects –Burning (n=60)

Effect	Odds ratio (95% CI)	P value
Time	1.39 (1.19-1.61)	<0.001
Time*group	0.78 (0.72-0.84)	<0.001
Group	6.16 (0.33-126.65)	0.238

Figure 11: Number of participants per group with any burning pain at each time point



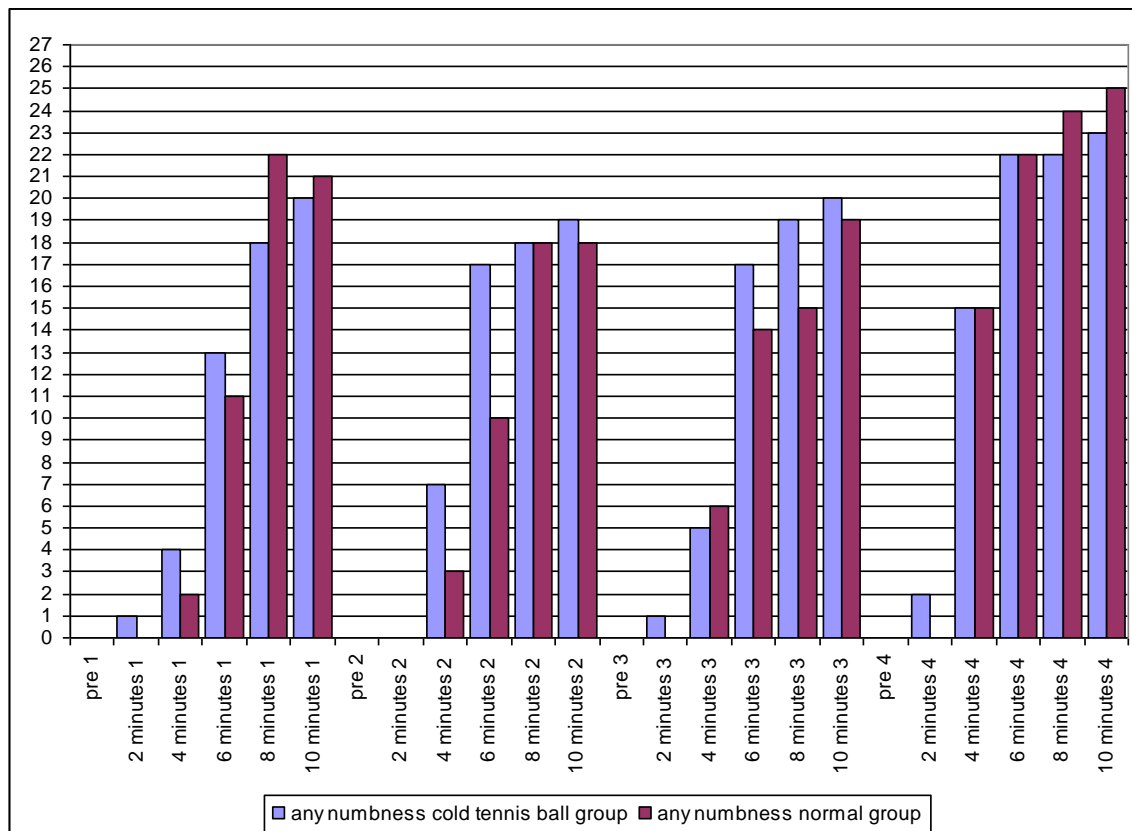
Numbness

Numbness increased over time significantly in both groups ($p=0.043$ – see **Figure 12**). However, the rate of numbness was not different between the groups ($p=0.701$). Thus, the null hypothesis was not rejected.

Table 13: Difference within and between –subjects effects –Numbness (n=60)

Effect	Odds ratio (95% CI)	P value
Time	1.07 (1.00 – 1.14)	0.043
Time*group	1.01 (0.97-1.05)	0.701
Group	0.79 (0.41- 1.50)	0.471

Figure 12: Number of participants per group with any numbness at each time point



The statistically analysed data from the patients' sensory description of their pain during treatment revealed that there was no statistically significant difference between both groups.

The findings, for patients in the Cold Tennis-ball Technique group, do not correlate with Olson and Stravino's (1972) 3-to-4 stage sensation of ice application. The rate at which patients experienced numbness did not differ between the groups and there was a maximum of one patient per group who experienced burning. Although the Cold Tennis-ball Technique did provide pain relief, there was no evident sequence of sensations experienced by the patient before the point of analgesia or numbness was reached.

It is proposed, by the author, that the tennis balls used to perform the Cold Tennis-ball Technique were not cold enough to produce any significant sequence of sensations as suggested by Olson and Stravino (1972).

4.4 Correlation between changes in objective and subjective measurements

Cold tennis ball group

Table 14 shows that there was a statistically significant positive correlation between change in NRS and change in MFDS ($\rho=0.508$, $p=0.004$) in the cold tennis ball group. As NRS score decreased so did MFDS score and vice versa. There was a statistically significant negative correlation between change in MFDS and Algometer ($\rho=-0.448$, $p=0.013$), although it was not a strong correlation. Thus algometer measurements increased as MFDS decreased. Throbbing and aching were negatively correlated ($\rho=-0.419$, $p=0.021$). Numbness and throbbing were significantly positively correlated ($\rho =0.377$, $p=0.030$). Aching and sharp pain were negatively correlated ($\rho=-0.415$, $p =0.023$).

Normal group

In the normal group similar relationships were found. Table 14 shows these relationships. MFDS and NRS ($\rho =0.541$, $p=0.002$), MFDS and algometer ($\rho=-0.466$, $p =0.010$), NRS and sharp pain ($\rho =0.460$, $p=0.011$), aching and throbbing ($\rho=-0.377$, $p=0.040$), numbness and aching ($\rho =-0.374$, $p=0.042$), and numbness and cramping ($\rho =0.415$, $p=0.023$) Additionally, Algometer and NRS were negatively correlated ($r=-0.461$, $p=0.010$). However, the strength of these correlation coefficients was low.

4.4.1 Discussion of the correlation effects

Although the Spearman's correlation coefficients displayed positive and negative relationships between certain sensory descriptions of pain, these relationships cannot be explained as the mean for these groups were zero. The participants of the study displayed varied responses to the treatment. With regards to each

outcome measure both techniques worked equally well. What is significant is the fact that the trends over time were approximately the same for both groups. The correlation between the MFDS, NRS and Algometer scores were the same for both, the Cold Tennis-ball Technique and the normal tennis ball groups. MFDS scores and the NRS scores were positively correlated. A decrease in MFDS scores revealed a decrease in the clinical signs exhibited by the patients whilst a decrease in NRS scores exhibited a decrease in the patients' pain levels. The MFDS and Algometer scores were negatively correlated. An increase in the Algometer scores indicated an increase in pressure threshold for each patient, which is indicative of an improvement in the patients' condition. Therefore, an increase in the Algometer scores correlates with a decrease in the MFDS and NRS scores.

Table 14: Spearman's correlation between changes in NRS, MFDS and Algometer measurements in the cold tennis ball group (n=30)

		Change in NRS	Change in MFDS	Change in Algometer	Change in Throbbing	Change in Aching	Change in Sharp	Change in cramping	Change in Shooting	Change in numbness
Change in NRS	Correlation Coefficient	1.000	.508(**)	-.331	-.079	.031	.155	-.194	-.083	.339
	Sig. (2-tailed)	.	.004	.074	.680	.871	.412	.304	.664	.067
Change in MFDS	Correlation Coefficient	.508(**)	1.000	-.448(*)	-.189	-.038	.064	.074	.136	.162
	Sig. (2-tailed)	.004	.	.013	.317	.842	.738	.699	.473	.393
Change in Algometer	Correlation Coefficient	-.331	-.448(*)	1.000	.088	-.037	-.001	-.114	.119	.091
	Sig. (2-tailed)	.074	.013	.	.644	.848	.995	.548	.530	.632
Change in Throbbing	Correlation Coefficient	-.079	-.189	.088	1.000	-.419(*)	-.154	-.196	.000	.377(*)
	Sig. (2-tailed)	.680	.317	.644	.	.021	.416	.300	1.000	.040
Change in Aching	Correlation Coefficient	.031	-.038	-.037	-.419(*)	1.000	-.415(*)	-.252	.000	-.164
	Sig. (2-tailed)	.871	.842	.848	.021	.	.023	.179	1.000	.388
Change in Sharp	Correlation Coefficient	.155	.064	-.001	-.154	-.415(*)	1.000	-.252	-.231	-.023
	Sig. (2-tailed)	.412	.738	.995	.416	.023	.	.179	.219	.906
Change in cramping	Correlation Coefficient	-.194	.074	-.114	-.196	-.252	-.252	1.000	.000	.008
	Sig. (2-tailed)	.304	.699	.548	.300	.179	.179	.	1.000	.968
Change in Shooting	Correlation Coefficient	-.083	.136	.119	.000	.000	-.231	.000	1.000	.000
	Sig. (2-tailed)	.664	.473	.530	1.000	1.000	.219	1.000	.	1.000
Change in numbness	Correlation Coefficient	.339	.162	.091	.377(*)	-.164	-.023	.008	.000	1.000
	Sig. (2-tailed)	.067	.393	.632	.040	.388	.906	.968	1.000	.

** Correlation is significant at the 0.01 level (2-tailed).

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

Table 15: Spearman's correlation between changes in NRS, MFDS and Algometer measurements in the normal (n=30)

		Change in NRS	Change in MFDS	Change in Algometer	Change in Throbbing	Change in Aching	Change in Sharp	Change in cramping	Change in Shooting	Change in numbness
Change in NRS	Correlation Coefficient	1.000	.541(**)	-.325	-.159	-.043	.460(*)	.054	-.248	.260
	Sig. (2-tailed)	.	.002	.080	.400	.823	.011	.777	.187	.165
Change in MFDS	Correlation Coefficient	.541(**)	1.000	-.466(**)	-.233	.051	-.007	-.022	-.074	.298
	Sig. (2-tailed)	.002	.	.010	.215	.788	.972	.909	.698	.110
Change in Algometer	Correlation Coefficient	-.325	-.466(**)	1.000	.056	-.062	.028	.311	-.041	.026
	Sig. (2-tailed)	.080	.010	.	.769	.743	.884	.094	.829	.892
Change in Throbbing	Correlation Coefficient	-.159	-.233	.056	1.000	-.377(*)	-.199	-.083	-.119	.032
	Sig. (2-tailed)	.400	.215	.769	.	.040	.293	.663	.531	.867
Change in Aching	Correlation Coefficient	-.043	.051	-.062	-.377(*)	1.000	-.254	-.326	-.291	-.374(*)
	Sig. (2-tailed)	.823	.788	.743	.040	.	.175	.079	.119	.042
Change in Sharp	Correlation Coefficient	.460(*)	-.007	.028	-.199	-.254	1.000	-.083	-.119	.024
	Sig. (2-tailed)	.011	.972	.884	.293	.175	.	.664	.531	.900
Change in cramping	Correlation Coefficient	.054	-.022	.311	-.083	-.326	-.083	1.000	-.050	.415(*)
	Sig. (2-tailed)	.777	.909	.094	.663	.079	.664	.	.795	.023
Change in Shooting	Correlation Coefficient	-.248	-.074	-.041	-.119	-.291	-.119	-.050	1.000	-.119
	Sig. (2-tailed)	.187	.698	.829	.531	.119	.531	.795	.	.530
Change in numbness	Correlation Coefficient	.260	.298	.026	.032	-.374(*)	.024	.415(*)	-.119	1.000
	Sig. (2-tailed)	.165	.110	.892	.867	.042	.900	.023	.530	.

** Correlation is significant at the 0.01 level (2-tailed).

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

4.5 Summary and conclusion

There was no statistical evidence for a different treatment effect for various objective and subjective outcomes for the cold tennis ball technique compared with the normal technique. Both techniques were equally beneficial. There were some relatively moderate correlations found between various outcomes.

Treatment with either of these techniques will cause a decrease in the NRS score, which corresponds with a decrease in the MFDS score, and an increase in the algometer reading.

The data suggests that treatment with either of these techniques is beneficial to the patient. A larger study is warranted to further confirm the suggested trends observed in this study.

CHAPTER 5

5.1 CONCLUSION

The results of this study revealed that cryo-ischaemic compression, using the Cold Tennis-ball Technique, is as effective as ischaemic compression, using tennis balls, in the treatment of rhomboid myofascial pain syndrome.

Evaluation of the statistical results showed that both groups responded favourably to the respective treatments in terms of the Myofascial Diagnostic Scale scores. Both groups experienced an improvement in pressure threshold as indicated by the objective algometer readings. The results also revealed a highly significant decrease of the NRS scores over time. Although both groups showed a significant improvement over time the results could provide no evidence of a treatment effect. The results, therefore, support both the hypotheses, as suggested by the researcher.

Hong *et. al.* (1993) has shown that deep pressure, where the palpable taut bands were firmly compressed to the extent the patient could tolerate, was more effective than in the treatment of myofascial trigger points than ultrasound, spray and stretch and heat. Garvey *et. al.* (1989) also found ischaemic compression to be an effective form of treatment. Therefore ischaemic compression has been established as a successful treatment for Myofascial Pain Syndrome.

According to the results of the study, cryo-ischaemic compression using the Cold Tennis-ball Technique can provide a simple, effective, non-invasive alternative if not adjunct to ischaemic compression in the treatment of Myofascial Pain Syndrome.

5.2 RECOMMEDATIONS FOR FUTURE STUDIES

The study population used in this research programme was 60 patients (30 patients in each group). A larger population may have highlighted smaller variances and reported more accurate results.

The ethnic distribution in this study did not represent the South African population. This problem should be addressed in any future studies by advertising to a broader community and in varied languages.

It is recommended that future studies look at performing treatments on consecutive days or alternate days, rather than over a period of two weeks. This may provide a clearer indication as to which method of treatment provides faster relief of symptoms.

Should the treatments be conducted on consecutive days, it will enable the examiner to mark of the location of the trigger points been treated with Henna or some other form of dye. This will provide more accurate results. This study relied purely on the examiners discretion in locating the rhomboid myofascial trigger points, which could have affected the results.

Due to the variable nature of Myofascial Pain Syndrome subsequent studies should consider methods of producing a more uniform sample group. Including only acute or chronic pain sufferers could provide a method for achieving this.

Since the Cold Tennis-ball Technique has been shown to be effective in treating Myofascial Pain Syndrome, further study suggestions include:

- Comparison of the Cold Tennis-ball Technique to other forms of treatment for Myofascial Pain Syndrome eg. dry needling
- Using the treatment as an adjunct to Chiropractic manipulation, stretching and education protocols

- Using the technique to treat other trigger points occurring in other muscle groups
- Investigating its effectiveness as a home treatment programme
- Tennis balls may not have been an adequate tool to investigate the effect of cryo-ischaemic compression. A tool or technique that is more flexible and that has greater potential to retain cold could be investigated

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Appendix A

LETTER OF INFORMATION

Dear Patient,

Title of Research study:

A pragmatic clinical investigation of the comparative effectiveness of ischaemic compression and cryo-ischaemic compression in the treatment of rhomboid myofascial pain syndrome.

Name of research student: Sholini Sookraj (2042205)
Name of Supervisor : Dr. T. MacDougall (2028991)
Name of Institution : Durban Institute of Technology

Introduction and purpose of study:

Myofascial pain syndrome is a common muscular pain syndrome resulting from myofascial trigger points. The rhomboid muscles play an important role in stabilizing and moving the shoulder blades. Due to their function the rhomboid muscles are susceptible to the formation of myofascial trigger points. This study involves research on 60 patients, to investigate the therapeutic effect of ischaemic compression versus the effect of cryotherapy in conjunction with ischaemic compression in the treatment of myofascial pain syndrome using the Cold Tennis-ball Technique.

Procedures:

First visit:

At the initial visit a full case history will be taken regarding your upper back pain and general health. A physical examination and thoracic spine regional examination will be conducted. You will be required to complete questionnaires regarding your pain level and measurements will be taken at each visit. The initial consultation will take approximately an hour and a half. You will then receive 4 treatments over a period of 2 weeks. Each of these treatments will take approximately half an hour.

Final visit:

At the final visit measurements will be taken to determine the effectiveness of the treatment.

Risks/Discomforts:

You may experience transient tenderness or bruising as a result of the ischaemic compression using a tennis ball.

Benefits:

The treatment is in line with normal clinic procedure and will be free of charge.

New findings:

You have the right to be informed of any new findings that are made.

Reasons why you may be withdrawn from this study:

- If you have any contraindications to cryotherapy. Cryotherapy involves the application of cold to an area to produce therapeutic results. Examples include Raynaud's disease, arterial deficiencies and hypersensitivity to cold.
- If you have signs and symptoms of fibromyalgia you will be excluded from this study.
- If you are on anti-inflammatories or any other form of analgesics you will need to allow for a wash-out period of 48 hours before you can be included in the study.
- If you are receiving any other forms of manual therapy, example physiotherapy or manipulation.
- Should you develop adverse reactions to the cryotherapy treatment will be discontinued however the results obtained will be used in the analysis of the study.

Remuneration:

Participation in the research is voluntary and therefore you will not receive any remuneration.

Confidentiality:

Patient information and results will be available to the supervisor. The staff at the Chiropractic Day Clinic will have access to the patient files should the need arise. The data collected will be analysed and published in a journal.

Persons to contact for problems or questions:

Should you experience any problems or have any queries you will be able to contact myself or Dr. MacDougall on the numbers listed above. Alternatively you can also contact the Durban Institute of Technology Research and Ethics Committee.

INFORMED CONSENT FORM

(To be completed by patient / subject)

Date _____ :

Title of research project	: A pragmatic clinical investigation of the comparative effectiveness of ischaemic compression and cryo-ischaemic compression in the treatment of rhomboid myofascial pain syndrome
Name of supervisor	: Dr T. MacDougall
Tel ☎	: 202 89911
Name of research student	: Shalini Soderoy
Tel ☎	: 204 2205

Please circle the appropriate answer

YES / NO

- | | | | |
|--|-----|-----|----|
| 1. Have you read the research information sheet? | Yes | No | |
| 2. Have you had an opportunity to ask questions regarding this study? | Yes | No | |
| 3. Have you received satisfactory answers to your questions? | Yes | No | |
| 4. Have you had an opportunity to discuss this study? | Yes | No | |
| 5. Have you received enough information about this study? | | Yes | No |
| 6. Do you understand the implications of your involvement in this study? | Yes | No | |
| 7. Do you understand that you are free to withdraw from this study?
at any time
without having to give any a reason for withdrawing, and
without affecting your future health care. | Yes | No | |
| 8. Do you agree to voluntarily participate in this study | Yes | No | |
| 9. Who have you spoken to? _____ | | | |

Please ensure that the researcher completes each section with you
If you have answered NO to any of the above, please obtain the necessary information before signing

Please Print in block letters:

Patient /Subject Name: _____	Signature: _____
Parent/ Guardian: _____	Signature: _____
Witness Name: _____	Signature: _____
Research Student Name: _____	Signature: _____

DURBAN INSTITUTE OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: _____ Date: _____

File # : _____ Age: _____

Sex : _____ Occupation: _____

Intern : _____ Signature _____

FOR CLINICIANS USE ONLY:

Initial visit _____ Signature : _____
Clinician: _____

Case History:

Examination: _____ Current: _____
Previous: _____

X-Ray Studies: _____ Current: _____
Previous: _____

Clinical Path. lab: _____ Current: _____
Previous: _____

CASE STATUS:

PTT:	Signature:	Date:
------	------------	-------

CONDITIONAL:
Reason for Conditional:
.....
.....
.....

Signature: _____ Date: _____

Conditions met in Visit No: _____ Signed into PTT: _____ Date: _____

Case Summary signed off: _____ Date: _____

Intern's Case History:

1. **Source of History:**
2. **Chief Complaint : (patient's own words):**

3. **Present Illness:**

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

4. **Other Complaints:**

5. **Past Medical History:**

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

6. **Current health status and life-style:**

- ▶ Allergies
- ▶ Immunizations
- ▶ Screening Tests incl. xrays

- ▶ Environmental Hazards (Home, School, Work)
- ▶ Exercise and Leisure
- ▶ Sleep Patterns
- ▶ Diet
- ▶ Current Medication
Analgesics/week:
 - ▶ Tobacco
 - ▶ Alcohol
 - ▶ Social Drugs

7. **Immediate Family Medical History:**

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

8. **Psychosocial history:**

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

9. Review of Systems:

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

- Pulses:**
- General Impression:
 - Radio-femoral delay:
 - Carotid:
 - Radial:
- Percussion:** - borders of heart
- Auscultation:** - heart valves (mitral, aortic, tricuspid, pulmonary)
- Murmurs (timing, systolic/diastolic, site, radiation, grade).
- Dorsalis pedis:
 - Posterior tibial:
 - Popliteal:
 - Femoral:

4. RESPIRATORY EXAMINATION

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

- Inspection**
- Barrel chest:
 - Pectus carinatum/cavinatum:
 - Left precordial bulge:
 - Symmetry of movement:
 - Scars:
- Palpation**
- Tracheal symmetry:
 - Tracheal tug:
 - Thyroid Gland:
 - Symmetry of movement (ant + post)
 - Tactile fremitus:
- Percussion**
- Percussion note:
 - Cardiac dullness:
 - Liver dullness:
- Auscultation**
- Normal breath sounds bilat.:
 - Adventitious sounds (crackles, wheezes, crepitations)
 - Pleural frictional rub:
 - Vocal resonance
 - Whispering pectoriloquy:
 - Bronchophony:
 - Egophony:

5. ABDOMINAL EXAMINATION

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

- Inspection**
- Shape:
 - Scars:
 - Hernias:
- Palpation**
- Superficial:
 - Deep = Organomegally:
 - Masses (intra- or extramural)
 - Aorta:
- Percussion**
- Rebound tenderness:
 - Ascites:
 - Masses:
- Auscultation**
- Bowel sounds:
 - Arteries (aortic, renal, iliac, femoral, hepatic)

Rectal Examination

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

6. G.U.T EXAMINATION

External genitalia:

Hernias:

Masses:

Discharges:

7. NEUROLOGICAL EXAMINATION

Gait and Posture

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

Higher Mental Function

- Information and Vocabulary:
- Calculating ability:
- Abstract Thinking:

G.C.S.:

- Eyes:
- Motor:
- Verbal:

Evidence of head trauma:

Evidence of Meningism:

- Neck mobility and Brudzinski's sign:
- Kernigs sign:

Cranial Nerves:

I Any loss of smell/taste:

Nose examination:

II External examination of eye:

- Visual Acuity:
- Visual fields by confrontation:
- Pupillary light reflexes = Direct:
- = Consensual:
- Fundoscopy findings:

III Ocular Muscles:

Eye opening strength:

IV Inferior and Medial movement of eye:

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

b. Motor - Masseter:
- Jaw lateral movement:

c. Reflexes - Corneal reflex
- Jaw jerk

VI Lateral movement of eyes

- VII a. Motor - Raise eyebrows:
 - Frown:
 - Close eyes against resistance:
 - Show teeth:
 - Blow out cheeks:
 b. Taste - Anterior two-thirds of tongue:

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

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

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

- XII Inspection of tongue (deviation):

Motor System:

- a. Power
 - Shoulder = Abduction & Adduction:
 = Flexion & Extension:
 - Elbow = Flexion & Extension:
 - Wrist = Flexion & Extension:
 - Forearm = Supination & Pronation:
 - Fingers = Extension (Interphalangeals & M.C.P's):
 - Thumb = Opposition:
 - Hip = Flexion & Extension:
 = Adduction & Abduction:
 - Knee = Flexion & Extension:
 - Foot = Dorsiflexion & Plantar flexion:
 = Inversion & Eversion:
 = Toe (Plantarflexion & Dorsiflexion):
- b. Tone
 - Shoulder:
 - Elbow:
 - Wrist:
 - Lower limb - Int. & Ext. rotation:
 - Knee clonus:
 - ankle clonus:
- c. Reflexes
 - Biceps:
 - Triceps:
 - Supinator:
 - Knee:
 - Ankle:
 - Abdominal:
 - Plantar:

Sensory System:

- a. Dermatomes
 - Light touch:
 - Crude touch:
 - Pain:
 - Temperature:
 - Two point discrimination:
- b. Joint position sense
 - Finger:
 - Toe:
- c. Vibration:
 - Big toe:
 - Tibial tuberosity:
 - ASIS:
 - Interphalangeal Joint:
 - Sternum:

Cerebellar function:

Obvious signs of cerebellar dysfunction:

- = Intention Tremor:
- = Nystagmus:
- = Truncal Ataxia:

Finger-nose test (Dysmetria):

Rapid alternating movements (Dysdiadochokinesia):

Heel-shin test:

Heel-toe gait:

Reflexes:

Signs of Parkinsons:

8. SPINAL EXAMINATION:(See Regional examination)

Obvious Abnormalities:

Spinous Percussion:

R.O.M:

Other:

9. BREAST EXAMINATION:

Summon female chaperon.

Inspection

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

Palpation

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

REGIONAL EXAMINATION - THORACIC SPINE

Patient: _____ File #: _____ Date: _____

Intern: _____ Signature: _____

Clinician: _____ Signature: _____

STANDING

Posture (incl. L/S & C/S):

Muscle Tone:

Skyline view - Scoliosis

Spinous Percussion

Breathing (quality, rate, rhythm, effort):

Deep inspiration

Scars:

Chest Deformity

(pigeon, funnel,

barrel):

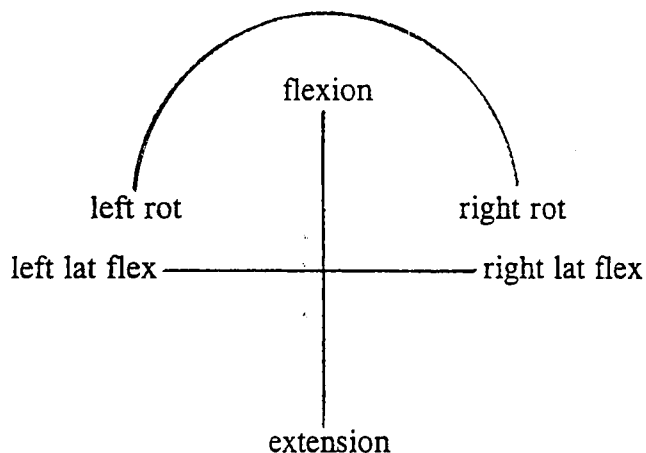
RANGE OF MOTION

Forward flexion 20 - 45 degrees (15cm from floor)

Extension 25 - 45 degrees

L/R Rotation 35 - 50 degrees

L/R Lateral Flexion 20 - 40 degrees



RESISTED ISOMETRIC MOVEMENTS: (in neutral)

Forward flexion

Extension

L/R Rotation

L/R Lateral Flexion

SEATED:

Palpate Auxillary Lymph Nodes

Palpate Ant/Post Chest Wall

Costovertabral Expansion (3 - 7cm diff. at 4th intercostal space)

Slump Test (dural stretch test)

SUPINE:

Rib Motion
Soto Hall Test (#, sprains)

SLR
Palpate Abdomen

PRONE:

Passive Scapular Approximation
Facet Joint Challenge
Vertebral Pressure (P-A central, unilateral, transverse)
Active Myofascial Trigger Points:

Rhomboid Major	Rhomboid Minor
Lower Trapezius	Spinalis Thoracic
Serratus Posterior	Serratus Superior
Pectoralis Major	Pectoralis Minor
Quadratus Lumborum	

COMMENTS: _____

NEUROLOGICAL EXAMINATION:

DERMATOMES												
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
Left												
Right												

Basic LOWER LIMB neuro: Myotomes:
Dermatomes: Reflexes:

KEMPS TEST:

MOTION PALPATION:

Ribs: Calliper:	Left:
	Right:
	Joint Play:
Bucket handle:	Left:
	Right:
	Joint Play:
Motion Palpation:	Left:
and Joint Play	Right:

Basic Lumbar Exam:
History:
ROM:
Neuro/Ortho:

Basic Cervical Exam:
History
ROM:
Neuro/ortho:

Appendix F

Patient name: _____

File no. : _____

The Numerical Pain Rating Scale (NRS)
(for completion by the patient)

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

0 _____ 100

(for researcher's use only)

Pre-treatment rating	Post-treatment reading



MYOFACIAL DIAGNOSTIC SCALE

Patients Name: _____

Muscle: _____

Treatment No: _____

Signs:

1. Soft tissue tenderness

Grade		0
0	No tenderness	0
i	Tenderness to palpation WITHOUT grimace	1
ii	Tenderness to palpation WITH grimace or flinch	2
iii	Tenderness with WITHDRAWAL (+ve "Jump sign")	3
iv	Withdrawal (+ve "Jump sign") to non-noxious stimuli (ie. superficial palpation, gentle percussion	4
	2. Snapping palpation of the trigger point evokes a local twitch response	4
	3. The trigger point is found in a palpable taut band.	4
	4. Moderate, sustained pressure on the trigger point causes or intensifies pain in the reference zone	5

Total out of 17 _____

Appendix H

Patient name: _____ File no.: _____
Date: _____ Treatment no. : _____

The Algometer Readings Sheet

Pre-treatment readings:

Muscle affected	Reading
1	
2	
3	
4	

Post-treatment readings:

Muscle affected	Reading
1	
2	
3	
4	

Appendix I

Patient name: _____

File no.: _____

Date: _____

Treatment no.: _____

Description of pain	Before treatment	2 mins	4 mins	6 mins	8 mins	10 mins
Throbbing						
Aching						
Sharp						
Cramping						
Shooting						
Burning						
Numbness						

Appendix J

Are you between the ages of
18 and 35
and suffering from

UPPER BACK PAIN

(Pain between the shoulder
blades)

Research is currently being carried
out at the Durban Institute of
Technology Chiropractic Day Clinic

FREE TREATMENT

Is available to those who
qualify to take part in this
study

For more information contact
SHOLINI SOOKRAJ

on

204 2205 / 2512