To investigate the effectiveness of proprioceptive neuromuscular facilitation combined with heat therapy as opposed to proprioceptive neuromuscular facilitation with cryotherapy in the treatment of mechanical neck pain caused by hypertonic posterior cervical muscles.

by

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I, Romona Francis,
do hereby declare
that this dissertation
represents my own work
both in conception and execution.

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DEDICATION

This dissertation is dedicated to:

Mum and Dad.
Thank you for all your love and support through the years. Both of you have dedicated your lives to my education and my future. I could never have achieved anything without you.

Taya and Riaz.
I could never have asked for a better sister and brother-in-law.
I wish you unconditional happiness in your future together.

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You are my strength and my security. Thank you for always taking care of me.
I can't wait to spend the rest of my life with you.

I LOVE YOU

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Abstract

Due to sustained partial neck flexion when operating a computer terminal for prolonged periods and by holding a stooped posture being proposed aetiologies for hypertonic posterior cervical muscles and subsequent mechanical neck pain, subjects for this research study were chosen according to their occupation and had to sit at a desk for more the three hours and less than eight hours a day.

The purpose of this study was to investigate the effectiveness of proprioceptive neuromuscular facilitation combined with heat therapy as opposed to proprioceptive neuromuscular facilitation combined with cryotherapy in the treatment of mechanical neck pain caused by hypertonic posterior cervical muscles.

This was a comparative, randomised, clinical trial consisting of two groups. Group A received proprioceptive neuromuscular facilitation (PNF) combined with heat therapy as their treatment protocol. Group B received proprioceptive neuromuscular facilitation combined with cryotherapy as their treatment protocol. Each group consisted of thirty people between the ages of 25 and 50 who were randomly allocated to their respective groups.

It was hypothesized that the analgesic properties related to cryotherapy would result in the treatment group that received PNF stretching combined with cryotherapy yielding better results in terms of objective clinical findings.
It was also hypothesized that the therapeutic effects of heat therapy would result in the treatment group receiving PNF stretching combined with heat therapy would yield better results in terms of subjective clinical findings and it is hypothesized that there is an association between the subjective and objective clinical findings between the cryotherapy and the heat therapy groups.

The treatment regimen consisted of each participant receiving three treatments over a period of one week and then a one-week follow-up consultation.

Subjective data monitored consisted of the Numerical Pain Rating Scale –101 (NRS-101) and the CMCC Neck Disability index. Objective data was collected using the Cervical Range of Motion goniometer (CROM) and the Algometer.

At the end of all treatment protocols, statistical (quantitative) analysis was performed to determine whether one treatment protocol was more effective than the other.

The analysis of the data collected showed that for all outcomes measured, either of the two treatments was effective overall. Trends suggested optimum treatments were dependent on the age of the patient. Age groups of 46-50 years old, 41-45 years old and the 31-35 years old responded best and improved the most with heat intervention, while age group of 36-40 years old responded best to the cryotherapy intervention. For the youngest age group of 25-30 years old, it did not make a difference whether they received heat therapy or cryotherapy as an intervention.

It would seem that the older the patient the more effective the application of heat therapy as a result of the effect of heat therapy on the collagen and elastin fibers within the muscle and its fascia which allowed for increased and sustained improvement of the majority of the age groups represented in this study. Conversely it would seem that the cryotherapy group had only immediate and unsustained effects in the long term, which suggests that the cryotherapy had only a pain relieving function that allowed for the improvement of patients in the study, which when removed resulted in regression to the initial clinical syndrome severity.

Most of the outcomes did not show a statistically significant interaction between time, age group and treatment group. The study was underpowered at the age group level, with only 12 subjects per age group.

Further studies with a larger sample size in each of the age groups are needed in order to determine whether age is a definitive factor in one treatment being preferred over the other.

TABLE OF CONTENTS

CHAPTER FOUR: RESULTS

CHAPTER FIVE: CONCLUSION AND RECCOMENDATIONS

REFERENCES

APPENDICES

LIST OF TABLES **PAGE**

LIST OF FIGURES **PAGE**

LIST OF APPENDICES

GLOSSARY

PNF Stretching: Proprioceptive Neuromuscular Facilitation

Mechanical neck pain: 'simple' or 'non-specific' neck pain.

Subjective Measures: Changes that are personally perceived by the patient i.e. how they feel with regard to pain and disability.

Objective Measures: Changes that are noted by the researcher i.e. physical changes noted by means of algometer and goniometer readings in regards to this study.

Goniometer: A 180 degree or 360 degree protractor with a mobile arm that is used to measure the amount of movement that occurs in a particular area of the body or joint.

Algometer: An instrument that measures pain pressure threshold by recording the amount of pressure that is applied to a painful area.

CHAPTER ONE

1.1 INTRODUCTION

Neck pain is a common complaint, with a point prevalence of nearly 13% and lifetime prevalence of nearly 50% (Akter et al. 1996). This is in congruence with Bland (1994:6) who reports that working individuals between 25 and 29 years of age have a 25% to 30% incidence of one or more attacks of stiff neck. This figure rises to 50% for those over 45 years of age and 45% of workingmen have at least one attack.

Mechanical neck pain can result from hypertonic posterior cervical muscles that may occur due to sustained partial neck flexion when reading, writing, operating a computer terminal for prolonged periods, sewing, by holding a stooped posture or by gross trauma (Travell and Simons; 1998).

Thus, as one of the proposed aetiologies of mechanical neck pain being hypertonic posterior cervical muscles, the treatment of these muscles could potentially reduce the occurrence of mechanical neck pain and serve as a treatment protocol for mechanical neck pain of this origin.

The symptoms related to mechanical neck pain which is caused by posterior cervical muscles[1] that are hypertonic or in spasm, are neck pain, marked restriction of head and neck flexion and restriction of neck rotation (Travell and Simons; 1998).

[1] The posterior cervical muscles of the cervical spine are made up by the semispinalis capitus, longissimus capitus, semispinalis cervicis, multifidi and rotators muscles collectively. The function of the posterior cervical muscles is primarily extension of the head and neck by the longer more superficial fibers and rotation by the deeper more diagonal fibers (Travell and Simons'-1998)

In order to address these clinical phenomena, proprioceptive neuromuscular facilitation (PNF) is described as a technique that develops or re-establishes proper functioning of joints and related structures (Surburg; 1981) by using neurological reflexes to assist the stretching technique (Redwood; 1997).

The indications for PNF stretching according to Liebenson (1996) are to treat the muscles, primarily to relax overactive muscles or stretch shortened muscles and fascia. Thomson et al. (1999) used PNF to initiate muscle contraction, to strengthen muscles and increase range of motion.

The effectiveness of PNF stretching is thought to result from its ability to increase muscle activity through actions on the muscle spindle and increasing contraction by applying resistance (Arnheim and Prentice; 1993) and the suggested effectiveness of PNF stretching has been shown by many researchers viz. McAtee (1993), Etnyre and Abraham (1986), Sady et al. (1982) and McCarthy et al. (1997).

According to MacDougall (1999:96) when comparing the relative effectiveness of PNF stretching as opposed to static stretching in the treatment of active myofascial trigger points, it was concluded that the PNF group showed a more significant clinical response than the group that was treated with static stretching.

To improve the clinical effects of PNF, cryotherapy and heat therapy are often utilised as adjunctive therapeutic modalities in the treatment of myofascial pain syndromes and hypertonic muscles.

The reasoning stems from the fact that the clinical effects of cryotherapy are reducing pain and muscle spasm, repair recovery and excitatory stimulus on inhibited muscles (Forster and Palastanga; 1985), which are thought to be synergistic with PNF. In comparison to this, the effects of heat therapy include increasing elasticity of collagen and muscle fibres, increasing blood supply to

muscles and reducing spasm (Basmajian and Wolf; 1990) thereby potentially increasing the clinical effect of PNF.

However, it is unknown whether the effects of PNF is augmented or negated by the utilisation of heat therapy or cryotherapy, as the use and effects of combined therapy remain of anecdotal origin. Nevertheless both may form part of the management protocol based on physiological concepts and clinical effects related to heat and cold.

Thus, for this purpose the next step in the research process would have to evaluate which of the clinical effects of these three different methods, in combination with each other would prove to be of greater benefit in relieving neck pain caused by hypertonic posterior cervical muscles. The aim of this research study having been to investigate the effectiveness of proprioceptive neuromuscular facilitation (PNF) combined with heat therapy as opposed to proprioceptive neuromuscular facilitation combined with cryotherapy in the treatment of mechanical neck pain caused by hypertonic posterior cervical muscles.

The study was therefore designed with the objectives being to compare the combination of PNF stretching with heat and cold therapy respectively and to thereby evaluate which yielded better clinical results in respect of decreasing pain and increasing range of motion with regard to inter-group improvements.

1.2 Aims and objectives

To investigate the effectiveness of proprioceptive neuromuscular facilitation (PNF) combined with heat therapy as opposed to proprioceptive neuromuscular facilitation with cryotherapy in the treatment of neck pain caused by hypertonic posterior cervical muscles.

The objectives of the study were therefore to compare objectively and subjectively these two treatment methods to determine which one is the most effective when treating hypertonic posterior cervical muscles in terms of objective and subjective clinical findings.

The ***first objective*** was to determine the effectiveness of proprioceptive neuromuscular facilitation combined with heat therapy as opposed to proprioceptive neuromuscular facilitation with cryotherapy in terms of objective clinical findings.

Hypothesis One: It is hypothesized that the analgesic properties related to cryotherapy would result in the treatment group that received PNF stretching combined with cryotherapy yielding better results in terms of objective clinical findings.

The ***second objective*** was to determine the effectiveness of proprioceptive neuromuscular facilitation combined with heat therapy as opposed to proprioceptive neuromuscular facilitation with cryotherapy in terms of subjective clinical findings.

Hypothesis Two: It is hypothesized that the therapeutic effects of heat therapy in the treatment group receiving PNF stretching combined with heat therapy would yield better results in terms of subjective clinical findings.

The ***third objective*** was to determine the presence of an association between the subjective and objective clinical findings in both the cryotherapy and heat groups.

Hypothesis Three: It is hypothesized that there is an association between the subjective and objective clinical findings between the cryotherapy and the heat therapy groups.

1.3 Rationale

1. The purpose of this research was to use these treatment methods not only in practice, but also as a means of patient education and self-rehabilitation.
2. The clinical effects of cold are reducing pain and muscle spasm, repair recovery and excitatory stimulus on inhibited muscles (Forster and Palastanga; 1985).
3. The clinical effects of heat are increasing elasticity of collagen and muscle fibres, increasing blood supply to muscles and reducing spasm (Basmajian and Wolf; 1990).
4. The clinical effects of PNF stretching are reducing muscle spasm, decreasing pain and strengthen muscles (Thomson et al. 1999).
5. Therefore, the next step would be to evaluate which of the clinical effects of these three different methods, in combination with each other would prove to be of greater benefit in relieving neck pain caused by hypertonic posterior cervical muscles.

1.4 Limitations

1. The subjective recording of responses by participants in respect of improvement or regression was received as honestly reflecting the patient's clinical parameters at the time of recording.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter covers the anatomy of the posterior cervical muscles, the causes, prevalence and incidence of neck pain. The chapter also discusses mechanical neck pain in terms of aetiologies, treatment and associated clinical features.

2.2 PREVALENCE / INCIDENCE OF NECK PAIN

Neck pain and low back pain are very common (www.Neurosciences.com; 2004). About three fourths of all people experience back pain at some point in their lives (www.Neurosciences.com; 2004). It is one of the biggest reasons for disability and sick leave. Both low back and neck pain have numerous causes, including compressed nerves, ruptured disks, strain, injured muscles, joints, ligaments or bones, degenerative diseases and changes in the shape of the spine (www.Neurosciences.com; 2004).

However, the more common causes of neck pain (www.Patient UK.htm; 2005) are whiplash injury due to motor vehicle accidents and acute primary torticollis ('wry neck'), where the former is commonly due to a minor injury and the latter due to poor sleep posture. These conditions result in one or more muscles on one side of the neck going into 'spasm' and leading to the head becoming twisted to one side, causing pain when the patient moves their head.

Other causes of neck pain are degeneration of the facet joints and the intervertebral discs with age resulting in changes related to the dysfunction, instability and stabilisation phases as alluded to by Kirkaldy-Willis and Burton

(1992). In addition, more serious pathology includes that of cervical radiculopathy, which occurs when a nerve is pressed on or is injured as it comes out from the spinal cord in the cervical region. This causes symptoms such as numbness, pins and needles, and weakness in areas that the nerve supplies (www.Patient UK.htm; 2005).

More serious causes of neck pain include rheumatoid arthritis and other arthritides, cancers, and serious traumatic injuries that damage the vertebrae, spinal cord or nerves in the neck (www.Patient UK.htm; 2005).

However, in respect of this research the patients included were limited to those with only mechanical involvement to their complaint and thus tried to limit the degree of joint pathology and serious pathologies in order to increase the sample group homogeneity (Mouton; 1996).

Thus, with respect to this mechanical nature, more than half of people develop a bout of neck pain at some time in their life. One survey done in the UK found that, of adults aged 45-75 years, about 1 in 4 women and about 1 in 5 men experienced neck pain at any given time (www.Patient UK.htm; 2005).

Mechanical pain causes (www.Patient UK.htm; 2005) acute bouts of neck pain and is commonly due to minor injuries or sprains to muscles or ligaments in the neck and bad posture. For example, neck pain is more common in people who spend much of their working day at a desk with a 'bent-forward' posture. Often the exact cause or origin of the pain is not known (www.Patient UK.htm; 2005).

It has therefore been calculated that the point prevalence of approximates 13% and lifetime prevalence nearly 50% (Akter et al. 1996). This is in congruence with Bland (1994:6) who reports that working individuals between 25 and 29 years of age have a 25% to 30% incidence of one or more attacks of stiff neck. This figure rises to 50% for those over 45 years of age and 45% of working men have at least one attack.

As a result, symptoms related to mechanical neck pain include: pain which develops in the neck and may spread to the base of the skull and shoulders, which is made worse with movement and better for remaining in a static position. If severe, the pain may spread down an arm to a hand or fingers. Some numbness or pins and needles may occur in part of the arm or hand as a result of neurovascular compromise in regions such as the scalene attachments on the first rib, where compromise of the subclavian vessels is common (www.Patient UK.htm; 2005).

These symptoms and the resultant mechanical neck pain can result from hypertonic **posterior cervical muscles** that may occur due to sustained partial neck flexion when reading, writing, operating a computer terminal for prolonged periods, sewing, by holding a stooped posture or by gross trauma (Travell and Simons; 1998).

Treatments of symptoms caused by posterior cervical muscle tightness include improved posture, adoption of ergonomic work practices as well as adjustment of eyeglasses, use of cervical pillow, stretches and ice (Travel and Simons; 1998).

However, to fully understand the effects of the treatment protocols, a discussion of the regional anatomy follows.

2.3 ANATOMY OF THE POSTERIOR CERVICAL MUSCLES

The posterior cervical muscle group of the cervical spine are consists of the

- semispinalis capitis,
- longissimus capitis,
- semispinalis cervicis,
- multifidi and
- rotatores muscles collectively.

The function of the posterior cervical muscles is primarily extension of the head and neck by the longer more superficial fibers and rotation by the deeper more diagonal fibers (Travell and Simons'; 1998).

In this respect the ***semispinalis capitis*** arises from the transverse processes of T1 to T6 vertebrae and inserts into the medial half of the area between the superior and inferior nuchal lines on the occipital bone. Bilaterally its function is to extend the neck. The semispinalis capitis is innervated by the dorsal rami of the cervical spinal nerves (Moore; 1992).

The ***longissimus capitis*** extends from the superior thoracic transverse processes and attaches to the mastoid process of the temporal bone. The muscle contributes to maintenance of posture and movements of the vertebral column and head (Moore; 1992). The longissimus capitis muscle is innervated by the cervical spinal nerves by branches of its posterior primary division (Travell and Simons'-1998).

Whereas the ***semispinalis cervicis*** passes superomedially from the transverse processes of the T1 to T6 thoracic vertebrae to the spinous processes of C2 to C5 cervical vertebrae superiorly (Travell and Simons'-1998). The muscle is innervated by the dorsal rami of the cervical spinal nerves and function to extend the cervical and thoracic regions of the vertebral column (Moore; 1992).

In addition the ***multifidi*** pass superomedially from the vertebral arches to the spinous processes of cervical vertebrae C2 to C5 (Travell and Simons'-1998) spanning one to three vertebrae (Moore; 1992). Below the multifidi attaches with the rotatores to the articular processes of the last four cervical vertebrae and are innervated by the branches of the posterior primary divisions of the cervical spinal nerves (Travell and Simons'-1998). Unilaterally its function is to flex the

trunk laterally and rotate it to the opposite side. Acting bilaterally the multifidi extend the trunk and stabilize the vertebral column (Moore; 1992).

The ***rotators*** arise from the transverse process of one vertebra and insert into the base of the spinous process of the vertebra superior to it. They are innervated by the dorsal rami of the spinal nerves and function to rotate the superior vertebra to the opposite side and to stabilize it as well (Moore; 1992).

The above muscles have been implicated in producing symptoms related to mechanical neck pain as a result of spasm within the posterior cervical muscles producing clinical changes related to neck pain, marked restriction of head and neck flexion, and restriction of neck rotation (Travell and Simons; 1998).

Treatment for mechanical neck pain includes pain medications, anti-inflammatory drugs, steroid injections, application of heat or cold, rest, traction, support, massage and physical therapy which incorporates exercises such as walking and swimming to stretch and strengthen muscles to help prevent further problems as well maintaining good posture reduces occurrences of neck pain (www.Neuroscience.com; 2004).

2.4 PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) STRETCHING

Proprioceptive neuromuscular facilitation or PNF is a technique that develops or re-establishes proper functioning of joints and related structures (Surburg; 1981) by using neurological reflexes to assist the stretching technique (Redwood; 1997). The effectiveness of PNF stretching results from its ability to increase muscle activity through actions on the muscle spindle and increasing contraction by applying resistance (Arnheim and Prentice; 1993).

Thus, the indications for PNF stretching according to Liebenson (1996) are to treat the muscles, primarily to relax overactive muscles or stretch shortened muscles and fascia. In contrast Thomson et al. (1999) used PNF to initiate muscle contraction, to strengthen muscles and increase range of motion.

When reviewing the study by MacDougall (1999) who utilised a prospective comparative clinical trial where she compared the relative effectiveness of PNF stretching as opposed to static stretching in the treatment of active myofascial trigger points, the objectives were to compare two treatment groups:

- One receiving Contract-Relax-Agonist-Contract (CRAC), a component of PNF stretching and
- The other receiving static stretching to determine which is more effective in the treatment of active myofascial trigger points of the shoulder girdle and neck muscles.

In order to achieve an outcome, a sample of thirty patients diagnosed with active myofascial trigger points were randomly allocated to one of the two groups. Subjects then received five treatments over two weeks with a one-month follow-up consultation. The McGill Pain Questionnaire, the CMCC Neck Disability Index and the Numerical Rating Scale – 101 was used to obtain subjective data and the Algometer and Goniometer was used to obtain objective data. The subjective data and objective data were completed at the initial, fifth and one-month follow-up consultations and results concluded that both groups had a significant improvement between the first and fifth follow-up consultations. The PNF stretching group however, showed a more significant clinical but not statistical response to treatment. It was noted that both treatment protocols are reliable interventions in the treatment of active myofascial trigger points (MacDougall; 1999).

In addition, several studies have shown that PNF stretching techniques cause a greater increase in flexibility when compared to static or ballistic stretching

(Bonnar et al. 2004). Also, it has been noted that there are several PNF stretching techniques namely contract-relax, hold-relax, and slow-reversal hold-relax, which have developed with time. Even though all of these PNF stretching techniques incorporate alternating periods of contraction and relaxation of the agonist and antagonist muscles, the slow-reversal-hold-relax is an isometric contraction of the antagonist followed by a contraction of the agonist muscle is provided in different manners and for different lengths of time.

This is shown by Winters et al. 2004 who conducted a randomised clinical trial to determine whether there is a difference between active and passive stretching as a treatment protocol for patients suffering from hip flexor tightness. It was concluded that the results of the research study supported the use of either an active or passive stretching program to increase range of motion by increasing the flexibility of tight hip flexors in patients with low back pain and lower-extremity complaints. Forty five patients between the ages of 18 and 65 suffering with lower back pain and lower extremity injuries with decreased hip extension range of motion and hip flexor tightness were randomly assigned to either an active home stretching group or a passive home stretching group. Patients presented with a Positive Thomas Test due to tight hip flexor muscles and range of motion was measured with a modified Thomas Test position. Measurements were taken at baseline, 3 weeks and 6 weeks after commencement of the study, with the limb with the greatest amount of decreased motion used for the study.Measurements included the universal goniometer and the passive stretching group performed a modified lunge exercise and a prone static stretch. Ten repetitions were done a day, with each stretch held for 30 seconds and an 8 second rest period between repetitions. The active stretch group performed prone leg lifts with the knee straight and bent for 10 repetitions a day. Each stretch held for 30 seconds with a 30 second rest period between repetitions.

The study concluded that both passive and active stretching increased flexibility of tight hip flexor muscles and thereby increased range of motion however, no significant difference was found between the two treatment protocols.

Whereas Schuback et al. 2000 conducted an experimental research study with the objectives being to compare the effectiveness of a self-stretch, which incorporated PNF components versus a PNF 'Slow Reversal Hold Relax' technique applied by a physiotherapist versus no intervention. The results showed no significant difference between the two groups receiving PNF type exercises, but a significant difference when compared to the control group receiving no PNF. The study consisted of two experimental groups of 42 subjects that were randomly allocated into 3 groups. Group one performed a self-stretch consisting of an active straight leg raise and group two received a PNF treatment by a physiotherapist and group three received no intervention. Measurements were taken before and after interventions in groups one and two and without intervention in group three using the goniometer to measure differences in range of motion in right hip flexion.

The results showed that both stretching regimens incorporating proprioceptive neuromuscular facilitation components resulted in a significant increase in hamstring flexibility when applied once for 2 minutes.

Other than effects on the muscle, Topp et al. (2002), who conducted a randomised clinical trial in patients with osteoarthritis of the knee, concluded that both dynamic and isometric resistance training decreased perceived knee joint pain with dynamic training decreasing perceived functional limitations and the control group perceptions remaining unchanged. This consequently suggested that exercise interventions reduce pain and improve functional ability (Topp et al. 2002).

Furthermore, in a research study conducted by Sakakima and Yoshida (2003) sciatic nerve injury which was induced in rats by applying cold directly to the right sciatic nerve (causing denervation of the nerve) which resulted in muscular atrophy. However, the area of the type I muscle fibres were significantly larger in the stretching group and the results suggested that the atrophy was inhibited by stretching, when bilateral soleus muscles stretches where applied to maximally

stretch these muscles in the dorsiflexion posture for forty minutes a day and for six times a week (compared to a group of non-stretched rats with the same nerve injury).

This type of injury is also seen in cast immobilization, unloading and spinal injuries (Sakakima and Yoshida; 2003). Thus, it is recommended by such research that specific types of PNF stretches are effective in reducing atrophy and that the mechanical stimuli provided by short duration static stretching can delay the atrophy of type I fibers in the denervated muscle over a short period, and short-duration static stretching affected the re-innervated muscle fiber-type composition during the four weeks after nerve injury.

With respect to the above results and other than the contentions around the use of PNF in different situation and for different clinical conditions, there is also a debate as to the time of application of the PNF stretch. Therefore, Bonnar et al. (2004) conducted research to evaluate the optimal duration of isometric contraction hold-time when performing the hold-relax PNF stretching technique. For the purpose of the study 3, 6 and 10-second isometric contraction hold times were used, to establish which produced the greatest gain in hip range of motion. The findings of the research suggested that clinicians could choose any of the hold-times and produce the same results to the patient's hip joint flexibility.

Sixty active individuals without history of knee or hip injury were randomly assigned to a 3-second, 6-second or 10-second group. The subjects were passively taken to end range of motion 3 times and thereafter performed a hold-relax PNF stretch. The stretch was repeated three times with a hold time dependent on their group allocation. Passive hip flexion was measured with the knee extended using the goniometer. Measurements were taken at baseline, after the subject was passively taken to the end range of motion and after the

isometric contraction was performed. An average of the three measurements was calculated.

The results indicated that all the PNF hold-relax stretching techniques with 3, 6 or 10-second isometric contraction hold-times all produced positive results in respect of improving hamstring flexibility and increasing hip range of motion. Although the results seemed to suggest that a 3-second isometric contraction hold time would be the most efficient choice for the clinician because of time constraints and patient motivation to respond to shorter contraction time as well as a steeper gradient in the graphic representation of the improvements over time.

Thus, even though each of these PNF techniques applied in each of the settings as discussed has proven effective in increasing flexibility of the measured outcome of the research, the efficacy of PNF stretching techniques are still questioned in research generally due to the variances in application of the technique as well as the inconsistencies in the measures utilised in the various protocols (Bonnar et al. 2004).

In summary, PNF stretching seems to allow for:

- Increased muscle contraction by applying resistance (Arnheim and Prentice; 1993) and
- Strengthening of muscles by initiating sustained contraction (Thomson et al. 1991 and Sakakima and Yoshida; 2003).

Irrespective of exercise interventions that included dynamic or isometric stretching, both resulted in reduced pain and improved functional ability (Topp et al. 2002).

In addition,

- Active or passive stretching increases flexibility and range of motion (Winters et al. 2004) and, PNF stretching relaxes overactive muscles and stretches shortened muscles and fascia (Liebenson; 1996) therefore achieving similar aims.

- However, stretching regimens incorporating proprioceptive neuromuscular facilitation components increase flexibility of muscles such as hamstrings more significantly when compared to treatment groups receiving no PNF stretching (Schuback et al. 2000). PNF stretching techniques such as contract-relax, hold-relax, and slow-reversal hold-relax have all proved effective in increasing flexibility (Bonnar et al. 2004) and MacDougall (1999) noted the stretching effects of PNF stretching when PNF proved to be a reliable intervention in the treatment of active myofascial trigger points, however it had an equivalent effectiveness when compared to static stretching.

2.5 CRYOTHERAPY

In essence cryotherapy refers to a process whereby there is a lowering of tissue temperature by withdrawal of heat from the body to achieve a therapeutic objective (Low and Reed; 1996).

Thus cryotherapy is another intervention that is utilised in the clinical setting, where it has been used for the treatment of acute soft-tissue injuries. The aim of cryotherapy is primarily to reduce the total amount of tissue damage, muscle spasm, swelling, and pain and to reduce the disability time and allow faster rehabilitation after injury (Knight; 1995).

The effects of the therapy are thought to be based on the physiological effects of cryotherapy according to Schafer and Faye (1990), who note and include:

- Decrease in local metabolism,
- an initial constriction of blood vessels and thereafter replenishing blood supply as vessel dilation occurs and
- a more long-term effect in the reduction of nerve excitability, as well as the reduction and decrease of blood histamine release in an inflammatory cycle.

Forster and Palastanga (1985) agree and indicate the therapeutic effects of cryotherapy, which could occur in 30 seconds due to inhibitory changes at the anterior horn cells include:

- Reduction in muscle tone, which can result in an increase in range of motion,
- reduction of pain in congruence with Melzack and Wall (1965) and
- decrease of muscle spasm.

Therefore it could be extrapolated that the clinical goals are to constrict blood vessels thereby reducing local metabolism. This leads to a decrease in nerve excitability and conduction, reducing the amount of histamine to the area resulting in pain relief (Schafer and Faye; 1990). The relief from pain results in a reduced muscle tone which releases the muscle spasm creating an increase in the range of motion (Forster and Palastanga; 1985).

Uchio et al. 2003 conducted an experimental research study to investigate the influences of cryotherapy on the anteroposterior (AP) laxity and the joint position sense of the knee. Twenty subjects between the ages of 21 and 28 with no complaints of knee pain, discomfort around the knee, history of knee injury or pathological conditions of the musculoskeletal and neurological systems received an intervention whereby a cooling pad was applied to 1 knee for 15 minutes with the temperature maintained at 4°C. The subject's skin temperature over the anteromedial aspect of the knee was measured at 0, 5, 10 and 15 minutes of cooling and again 15 minutes later. The joint position sense was evaluated before and after cooling by using a modified Skinner's method and AP displacement and anterior terminal stiffness (ATS) of the knee were obtained with using a knee arthrometer. Two days after the initial treatment the same intervention was applied to the opposite knee with the temperature recorded again.

Knee laxity and position sense was measured at baseline, immediately after the cooling intervention and 15 minutes later and a mean value was then calculated.

The results showed that the average skin temperature of the anteromedial aspect of the knee before the cooling intervention was approximately 26°C and the skin temperature dropped to approximately 21.3°C during cooling and gradually increased after the cooling pad was removed. Fifteen minutes later, skin temperature had returned to the pre-cooling level.

The side-to-side difference of total displacement was reduced by 1.0mm and anterior displacement decreased by 0.8mm after the cooling intervention. The average ATS increased significantly by 21N/mm after cooling and returned to the pre-cooling level 15 minutes later.

After 15 minutes of cooling of the knee joint, the ability to accurately reproduce the target angle decreased, that is the accuracy of the position sense was increased. Although no significant difference in inaccuracy was detected between the pre-cooling level and the level at 15 minutes post-cooling, the level of inaccuracy did not return to pre-cooling level, showing an increase of 0.9° over the pre-cooling.

The study documented the quantitative changes in AP laxity and the position sense of the healthy knee after 15 minutes of cooling intervention. Cooling for 15 minutes made knee joints stiffer and lessened the subject's position sense and this should be considered in therapeutic programmes that involve exercise immediately after a period of cooling.

Therefore, it could be implied that cryotherapy could potentially be counter-productive in terms of clinical outcomes with respect to treatment of joint conditions. By inference this could imply that cryotherapy would not be synergistic when combined with PNF stretching.

2.6 HEAT THERAPY

The effects of heat have been indicated as increasing elasticity of collagen and muscle fibres, increasing blood supply to muscles and reducing spasm (Basmajian and Wolf; 1990). In this respect it is hypothesised that the physiological effects of heat are related to (Melzack and Wall; 1982):

- Increased elasticity of collagen fibres,
- increased activity and efficiency of muscle fibres,
- the therapeutic effect on relieving muscle spasm (via the skin) and
- the inducing relaxation (thought to be due to cortical responses and peripheral responses (Melzack and Wall;1982).

According to Nadler et al. 2003 the therapeutic benefits of heat have been identified as:

- Increasing pain relief.
- Reducing muscle stiffness.
- Reducing disability.
- Increasing flexibility.

Therefore the clinical goals for the practitioner should be to:

- Increase range of motion,
- decrease pain and spasm,
- increase flexibility and
- strengthen weak muscles

In congruence with this, heat therapy is commonly used to relieve pain and muscle spasm and, additionally, to increase blood flow and facilitate tissue healing (Rennie and Micholvitz; 1996). It would therefore be possible to expect that through superficial heat application that these outcomes are met, although it has not been researched in terms of time of application and which conditions are and are not contra-indicated according to the principles above. This is as a result

of heat having been used for decades to relieve pain, either alone, or in combination with multi-modal analgesic therapeutic regimens, it has been noted that the scientific evidence for its effectiveness is, at present, limited (Chandler et al. 2002). However, two recent studies impressively document the effectiveness of superficial heat in the management of pain compared to ibuprophen and acetaminophen for the treatment of low back pain and menstrual pain.

In the first study, continuous low-level topical heat applied via an air-activated heat wrap, placed directly on the area of discomfort, was found to be as effective as ibuprophen in the treatment of menstrual pain (Atkin et al. 2001).

The second study evaluated continuous low-level topical heat wrap therapy for treatment of acute low back pain (Nadler et al. 2002). For four days, participants were randomized to heat wrap, acetaminophen, ibuprophen, placebo, or un-warmed heat wrap. It was found that for all four days, pain relief with the heat wrap was significantly higher than with ibuprophen or acetaminophen. In addition, the heat wrap group experienced improved lateral trunk flexibility, reduction in muscle stiffness, and reduced disability overall. In all respects, the heat wrap performed better than either ibuprophen or acetaminophen.

Furthermore Nadler et al. (2003) evaluated the efficacy of eight hours of continuous heat wrap therapy for the treatment of acute non-specific lower back pain of non-traumatic origin. The study was a randomised, placebo-controlled, single-blinded trial using subjects between 18 and 55 years. The four groups of subjects were stratified according to pre-treatment pain intensity and gender. Group one used a wearable heat wrap, which heated up to 40 degrees and retained this temperature for at least eight hours. Group two received an oral placebo consisting of 2 tablets, 3 times a day taken 6 hours apart. Group three received an oral analgesic, ibuprophen 200mg consisting of 2 tablets, 3 times a day taken 6 hours apart. Group four received an unheated heat wrap. Baseline measures were completed using the Roland-Morris Disability Questionnaire in order to assess any improvements. The independent variables included pain

relief, muscle stiffness, lateral trunk flexibility, and disability, with the most important variable being pain relief. Subjects who used back wraps or oral treatment and kept diaries for recording pain relief and muscle stiffness measurements at specified times. Treatments were administered immediately after this visit. Visit 2 occurred on the same afternoon as the initial treatment, approximately 8 hours after the initiation of treatment.

The results of the study found that the level of pain relief was significantly higher in the heated wrap group over the 3-day treatment period and a comparison of the heat wrap group with the small oral ibuprofen group indicated a statistically significant decrease in the level of pain relief in the group that received a warmed heat wrap intervention. Continuous low-level heat wrap therapy was shown to provide significant therapeutic benefits in patients with acute non-specific LBP, as indicated by increased pain relief and trunk flexibility, and it provided decreased muscle stiffness and disability when compared with placebo.

In summary, heat increases the elasticity of collagen fibers (Basmajian and Wolf; 1990). This allows lengthening of the muscle fibers leading to an increase in the muscle's flexibility, and efficiency to reduce muscle spasm and induce relaxation thereby resulting in pain relief and increase range of motion. Heat therapy increases blood flow and facilitates tissue healing (Rennie and Micholvitz; 1996).

Due to research acknowledging the effectiveness of all types of stretching, and then going further to report the effectiveness of strengthening as well as the positive results obtained in respect of gains in flexibility and range of motion using proprioceptive neuromuscular facilitation as a treatment protocol in various conditions, the use of PNF stretching to treat hypertonic posterior cervical muscles in order to curb mechanical neck pain seems like an advised treatment.

The physiological and clinical effects of cryotherapy has resulted in the use of cold treatments being a common choice amongst clinician in the treatment of a variety of conditions including myofascial syndromes but we must not forget the

therapeutic effects of heat therapy in conjunction with its physiological and clinical effects, which in this respect leads to both heat and cold having their own advantages. The next question to be asked is: which of these two treatment protocols would be more beneficial when combined with an already widely used treatment method like PNF stretching?

It was not known whether the effects of PNF stretching is augmented or negated by the utilisation of heat therapy or cryotherapy, both of which may form part of the management protocol based on physiological concepts related to heat and ice.

It is therefore proposed to conduct an investigation to help determine this and to evaluate which of the clinical effects of these three different methods, in combination with each other would prove to be of greater benefit in relieving a common condition such mechanical neck pain caused by hypertonic posterior cervical muscles.

2.7 Conclusion

In conclusion it can be seen that PNF stretching, heat and cryotherapy are beneficial for different reasons. However, it would seem plausible, based on the above physiological mechanisms, that there could be a synergistic or antagonistic relationship between these different physiological mechanisms to ease, worsen or even have no effect on posterior cervical muscle spasm. Therefore, research was required in order to determine whether this was clinically manifested.

Thus, this research was aimed at investigating the effectiveness of proprioceptive neuromuscular facilitation combined with heat therapy as opposed to proprioceptive neuromuscular facilitation with cryotherapy in the treatment of mechanical neck pain caused by hypertonic posterior cervical muscles.

Chapter 3

MATERIALS AND METHODS

3.1 INTRODUCTION

This chapter discusses the design of the research study, the advertising process, and sample group together with the inclusion and exclusion criteria and includes the interventions, measurements and statistical procedures.

3.2 STUDY DESIGN

The study was designed to be a comparative, randomised, clinical trial. The objective of the study was to compare two treatment methods: PNF stretching combined with heat therapy Vs PNF stretching combined with cryotherapy and thereafter to assess for inter-group improvement. At the end of all treatment protocols, statistical (quantitative) analysis was performed to determine whether one treatment protocol was more effective than the other.

3.3 ADVERTISING

The research study was then advertised and subjects were gained through advertising around Durban Institute of Technology and businesses around Durban and surrounding areas.

Participants were invited to enrol in a clinical trial, which involved the treatment of neck pain and any individual between the ages of 25 and 50 years old, who suffered from neck pain would be considered as a candidate for the research study (Appendix I).

3.4 TELEPHONIC INTERVIEW

As potential candidates started responding to the advertisements, the researcher used the following questions as a guideline to telephonically screen the potential research participants to determine whether or not the individual would fall within the research criteria and by this decreased the necessity of patients attending the clinic. Potential participants with any of the exclusion criteria (3.8 below) were not suitable for the research study and were excluded immediately.

- Do you have pain and stiffness in the back of your neck?
- Do you find it difficult and painful to touch your chin to your chest? (Flexion of head and neck)
- Do you find it difficult and painful when checking your blind spot when driving or turning your head? (Rotation of neck)
- Do you feel tender spots when you apply pressure (press) the back of your neck over the muscles?
- When did the pain begin?
- How did the pain come about?
- Have you been in any motor vehicle accidents?

3.5 THE SAMPLE GROUP

Sustained partial neck flexion when operating a computer terminal for prolonged periods and holding a stooped posture are proposed aetiologies for hypertonic posterior cervical muscles and subsequent mechanical neck pain (Travell and Simons; 1998), the study targeted subjects that sat at a desk for more than three hours and less than eight hours a day, such as clerical staff and computer technicians. Subjects were between the ages of 25 and 50 and of any gender.

The sample size consisted of two groups of 30 subjects in each group with a total number of 60 subjects.

The subjects were also stratified:

Years of age	25-30	31-35	36-40	41-45	46-50
No. Of subjects	12	12	12	12	12

The subjects were randomly assigned to 2 groups.
This was achieved by placing 30 letter "A's in an envelope and 30 letter "B's in the same envelope. Each subject was allowed to draw one paper thereby indicating which group they were allocated to.

Group A = Heat therapy combined with PNF Stretching
Group B = Cryotherapy combined with PNF Stretching

3.6 CLINICAL PROCEDURE

A case history (Appendix C), physical examination (Appendix D), cervical regional examination (Appendix E) and a SOAPE note (Appendix F) were completed on all participants prior to any treatment.

A set of inclusion and exclusion criteria were established to narrow the parameters and allow for more accurate results to be obtained from the study.

3.7 INCLUSION CRITERIA

The inclusion criteria were as follows:

1. Participants had to be between the ages of 25 and 50. From the age of 50 up, the prevalence and incidence of systemic disorders played a greater role in patient presentation and hypertonicity of muscles related thereto would have been more chronic and difficult to treat as well as participants being less able to give accurate clinical feedback with decreased sensitivity (Youdas; 1991).
2. A history of gradual onset mechanical neck pain as a result of chronic overload of the posterior cervical muscles. See exclusion – trauma (acute onset).
3. Restriction of head and neck flexion and restriction of neck rotation due to muscle action (Travell and Simons; 1998).
4. Complaint of hypertoncity (stiffness) of the posterior cervical muscles.
5. Myofascial indicators (Travell and Simons; 1998):
   - Taut palpable band within posterior cervical muscles
   - Spot tenderness of a nodule in a taut band
   - Painful limit to full stretch range of motion
6. Informed consent – Appendix A needed to be signed by participant at initial visit.
7. Participants that sat at a desk for more than 3 hours and less than 8 hours a day.

3.8 EXCLUSION CRITERIA

The exclusion criteria were as follows:

1. Participants older than 50, as there was an increased potential for systemic conditions to co-exist and potentially be a cause or could mimic the neck pain and younger than 25 as there is an increased prevalence of neck pain after 25 due to occupational hazards.
2. Participants who displayed any neurological signs and symptoms.
3. Participants who displayed signs and symptoms of acute myofascial trigger points as according to Travell and Simons (1998):
    - History of pain resulting shortly after acute overload or trauma.
    - Pattern of referred pain from the trigger point that is characteristic for that muscle in which it is found.
    - A local twitch response to snapping palpation of the trigger point.
4. Any participant with any other traumatic causes of mechanical neck pain such as whiplash.
5. Participants who suffered with local pathology such as inflammation of a non-mechanical in origin or systemic pathology such as rheumatoid arthritis if determined from examination.
6. Participants were not allowed to consume any kind of anti-inflammatory medication or receive any other form of manual therapy during the one-week treatment period or before the one-week follow up.
7. Trauma.
8. Surgery that had the potential to affect the data collected.
9. Pregnancy – due to ligament laxity.
10. Informed consent – Appendix A not signed.
11. Need for further clinical assessment with regard to special tests (x-rays, blood tests etc).

12. Contraindications for cryotherapy:
    - Chilblains
    - Coma
    - Cryesthesia
    - Paroxysmal cold hemoglobinuria
    - Raynaud's phenomenon or disease
    - Rheumatoid or Gouty arthritis

13. Contraindications for heat therapy
    - Impaired circulation
    - Areas of recent bleeding or haemorrhage
    - Lack of local thermal sensation
    - Devitalised tissue e.g. after deep X ray therapy
    - Open wounds
    - Impaired circulation of the part to be treated

3.9 THE INTERVENTIONS

Group A: Heat therapy combined with PNF stretching

1. The subject was treated with 5 minutes of heat therapy by placing a heated hot pack behind the neck (starting temperature = 60º C). Care was taken to mould the hot pack to the contour of the subject's cervical spine.
2. The subject then received a PNF treatment which entailed the following:
    a. The treatment was limited to a flexion PNF.
    b. The subject was positioned supine.
    c. The researcher was positioned behind the patient.
    d. The researcher then crossed her forearms and placed them under the subject's neck.
    e. The subject's neck was placed in a relaxed and neutral position.
    f. The subject was then instructed to tuck the chin in.
    g. From this position, the researcher raised her hands and passively stretched the subject's neck, which resulted in stretching of the posterior cervical muscles.
    h. The neck was then taken up to about 40 degrees flexion and then held for 15 seconds. Research has shown that any stretching of more than 20 seconds shows no greater benefit (Voss et al. 1985).
    i. The subject was then instructed to push back against the researcher for 8 seconds and then ask to relax for 10 seconds (Voss et al. 1985).
    j. This entire sequence was repeated 3 times.

Group B: Cryotherapy combined with PNF Stretching

1. The subject was treated with 5 minutes of cryotherapy by placing a special non-freeze cold pack over the back the neck (starting temperature = 0º C). Care was taken to mould the cold pack to the contour of the subject's cervical spine.
2. The subject then received a PNF treatment which entailed the following:
    a. The treatment was limited to a flexion PNF.
    b. The subject was positioned supine.
    c. The researcher was positioned behind the subject.
    d. The researcher then crossed her forearms and placed them under the subject's neck.
    e. The subject's neck was placed in a relaxed and neutral position.
    f. The subject was then instructed to tuck their chin in.
    g. From this position, the researcher raised her hands and passively stretched the subject's neck, which resulted in stretching of the posterior cervical muscles.
    h. The neck was then taken up to about 40 degrees flexion and held for 15 seconds. Research has shown that any stretching of more than 20 seconds shows no greater benefit (Voss et al. 1985).
    i. The subjects were then instructed to push back against the researcher for 8 seconds and then ask to relax for 10 seconds, (Voss et al. 1985).
    j. This entire sequence was repeated 3 times.

3.10 INTERVENTION FREQUENCY

The intervention frequency consisted of three treatments in the first week of the initial consultation and a one-week follow up consultation, which took place two weeks after the initial consultation.
The treatment interval was at most 2 days between treatments and the one-week follow had to occur between 4 to 7 days after the participant's third visit to the clinic.

3.11 MEASUREMENTS

Subjective and objective data where collected at intervals before and during the treatment protocols.

3.11.1 SUBJECTIVE MEASURES

The subject's progress was monitored subjectively by using the:

- Numerical Pain Rating Scale –101 (NRS-101) - Appendix H. The scale was simple and easy to understand and its validity and reliability, when providing subjective information about the levels of pain perceived by the patient, was established by Jensen et al. (1986).
- The CMCC Neck Disability index – Appendix G was also used to demonstrate subjective information regarding the extent to which the patient's lifestyle was affected by the pain experienced and was developed by Vernon and Mior (1991) and, in a study of its reliability and validity, it was found to demonstrate a high degree of test - retest reliability and consistency.

3.11.2 OBJECTIVE MEASURES

The objective data was obtained by:

- Measuring cervical range of motion using the cervical range of motion goniometer (CROM) – Appendix J - which has demonstrated to produce good to excellent intra-tester and inter-tester reliability in measuring cervical ranges of motion (Youdas et al. 1991) and the CROM goniometer is highly reliable when compared to cervical range of motion measurements using different techniques such as universal or visual estimation (Youdas et al. 1991).

  STEPS OF THE CROM READING:

  1. The participant was positioned in a seated posture.
  2. The plastic frame of the instrument was placed on the nose-bridge and ears and was fastened in this position using the Velcro straps.
  3. The 3 orthogonally arranged dials were set to zero.
  4. Flexion, extension, bilateral lateral flexion and bilateral rotation were assessed with a compass goniometer.
  5. Flexion was measured by asking the participant to tuck their chin to their chest.
  6. Extension was measured by asking the participant to put their head as far back as possible.
  7. Lateral flexion was measured by asking the participant to put their left or right ear to their left or right shoulders respectively.
  8. Rotation was measured by asking the participant to look over their left and right shoulders.

- Using the Algometer – Appendix J - that is an instrument that uses kg/cm to show pressure threshold (pain threshold) in an area of tautness or tenderness. This method was proved reliable by Fischer (1986).

STEPS OF ALGOMETER READING:

1. The dial was set to zero
2. The steel disc was placed over the area of greatest tautness.
3. The participant was instructed to verbally express at which point pain was perceived.
4. Pressure was applied and increased every second by approximately 1kg.
5. The reading in kg/cm2 was recorded.

- The temperature of the skin / application interface was measured using a digital thermometer.

STEPS OF TEMPERATURE READING

1. The cold gel or heat hot pack was applied and moulded to participant's neck.
2. A digital thermometer was inserted between the neck and the cold or hot pack.
3. A period of 30 seconds was allocated for the thermometer to read the temperature.
4. The thermometer was then removed and the temperature recorded.

- The cervical spine of all subjects was motion palpated before and after the initial consultation and at the one-week follow-up consultation.

3.12 MEASUREMENT FREQUENCY

All readings were completed in the initial, second and one week follow up consultations so that any improvements could be recorded and assessed.

3.13 STATISTICS

All data was collected as per Data collection (Appendix K).

Statistical analysis included the repeated measures ANOVA over three time points was used to examine the effect of the treatment. Age group and treatment group were used as factors. A significant time effect indicated treatment effect irrespective of treatment group or age group. An interaction between time and treatment group indicating a treatment group effect irrespective of age group, and a three-way interaction between time, treatment group and age group indicating an age-dependant treatment effect. Treatment group, stratified by age group, generated profile plots from the estimated marginal means for each outcome over time. Thus, different treatment effects in different age groups were examined.

The research questions asked here were:

1. Was there any effect of treatment (heat or cryotherapy)? That is, did the values for all participants (irrespective of group) change significantly over time?
2. Was there a difference in treatment effect between the groups? That is, did one group improve at a faster rate than the other group?
3. Was the treatment effect age-dependant? That is, did the difference between the treatment groups depend on age group?

A p value of 0.05 or less was considered as statistically significant.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 DEMOGRAPHICS

Sixty participants were randomly allocated to two equal groups consisting of 30 participants each. There were 12 participants in each age group overall, but the proportions of participants in each age group differed by treatment group (p = 0.01). This is shown in Table 1. There was a tendency for the older participants towards the heat therapy treatment group. Therefore age may be a confounder in association between treatment group and outcome measurement. All subsequent analysis was controlled for the effect of age group.

Table 1: Treatment group by age group

			Treatment group		Total
			COLD	**HOT**	
Age group	25-30	Count	10	2	12
		Row %	83.3%	16.7%	100.0%
	31-35	Count	6	6	12
		Row %	50.0%	50.0%	100.0%
	36-40	Count	4	8	12
		Row %	33.3%	66.7%	100.0%
	41-45	Count	8	4	12
		Row %	66.7%	33.3%	100.0%
	46-50	Count	2	10	12
		Row %	16.7%	83.3%	100.0%
Total		Count	30	30	60
		Row %	50.0%	50.0%	100.0%

Chi square value 13.333, p = 0.010

4.2 NUMERICAL RATING SCALE (NRS)

NRS was measured at two time points, pre and post treatment. The average of the worst and least pain was used at each time point.

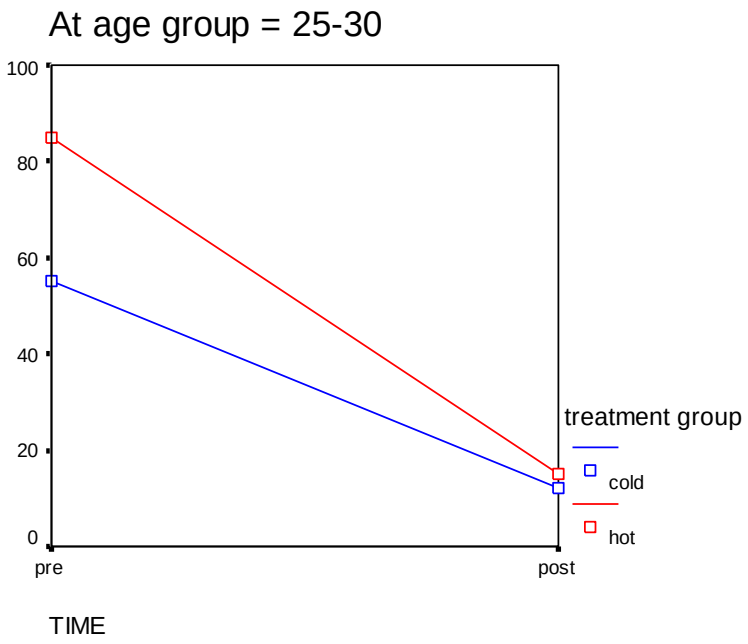
Table 2: Repeated measures ANOVA within-subjects effects for NRS

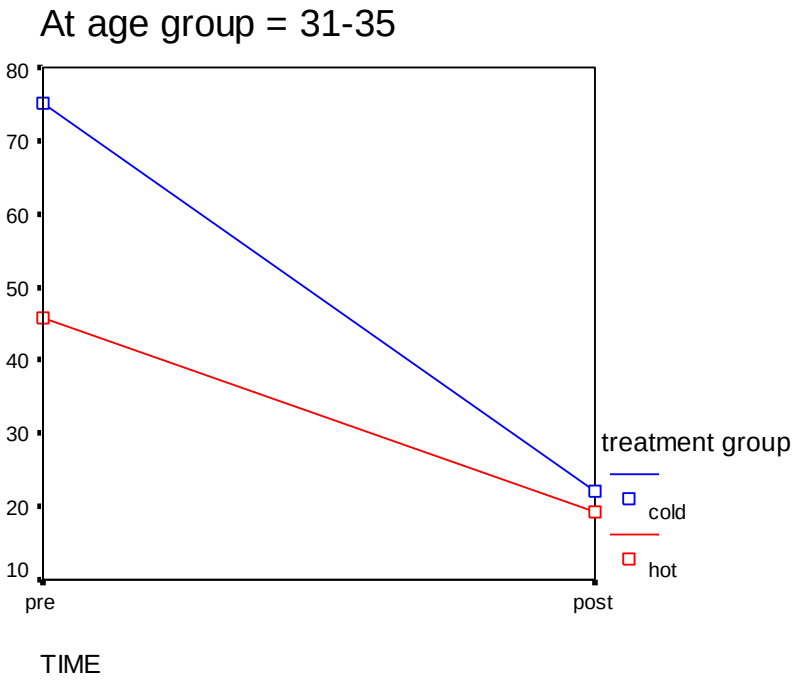
	Wilk's lambda	p value
Time	0.167	<0.001
Time* treatment group	0.985	0.384
Time* treatment group * age group	0.779	0.013

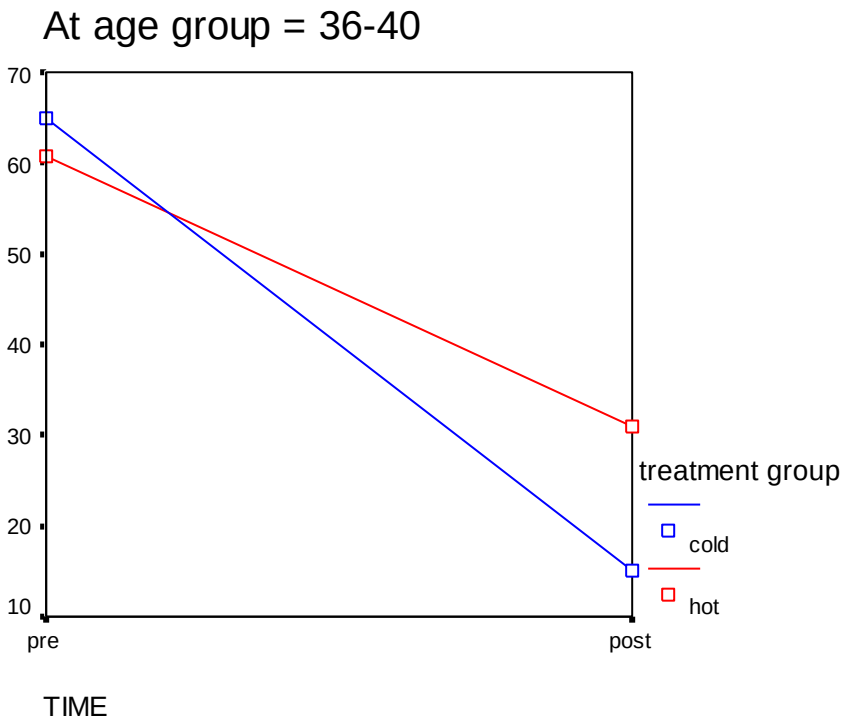
Table 2 shows that there was a significant 3-way interaction between time, treatment group and age group. In the presence of an interaction, the main effects of time cannot be interpreted, thus even though there was a significant effect of time ($p<0.001$), this was dependant on age group and treatment group, accordingly we cannot say that all subjects showed a significant change over time, irrespective of treatment and age group.

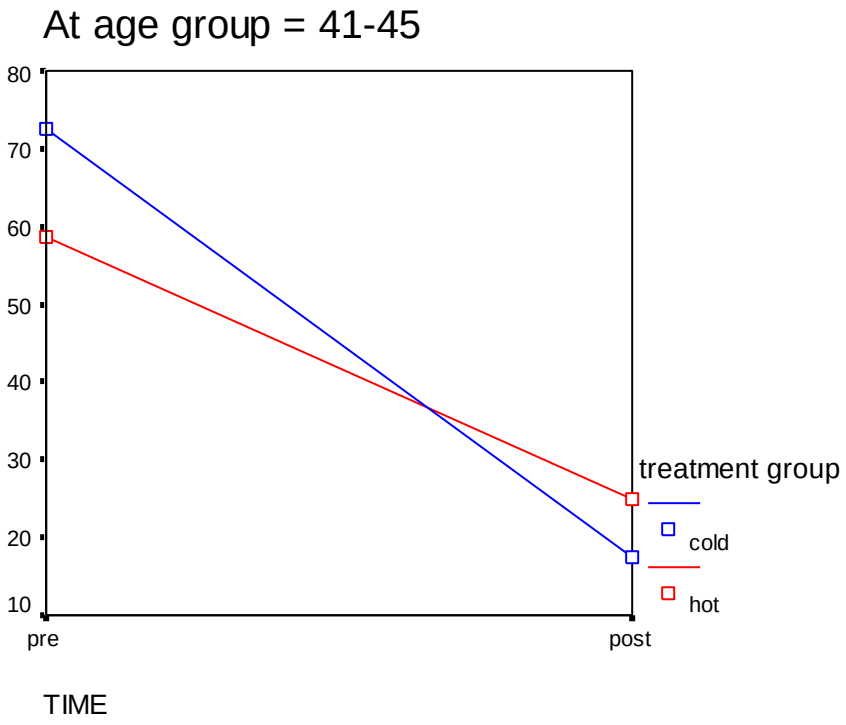
Figures 1 a - e below show that the effect of the treatment was different in the different age groups. Figure 1 a shows that in the youngest age group consisting of participants between the ages of 25 and 30 who received the PNF stretching combined with the heat therapy showed the steepest rate of descent in respect of NRS rating, while the next three age groups (Figures 1 b to d), which received cryotherapy combined with PNF stretching improved faster than the heat therapy treatment group. In the oldest age group consisting of participants between of 46 and 50, the treatment group that received heat therapy combined with PNF stretching improved faster than the treatment group that received cryotherapy and PNF stretching. Therefore it is shown that the effect of treatment was dependant on the age group being treated.

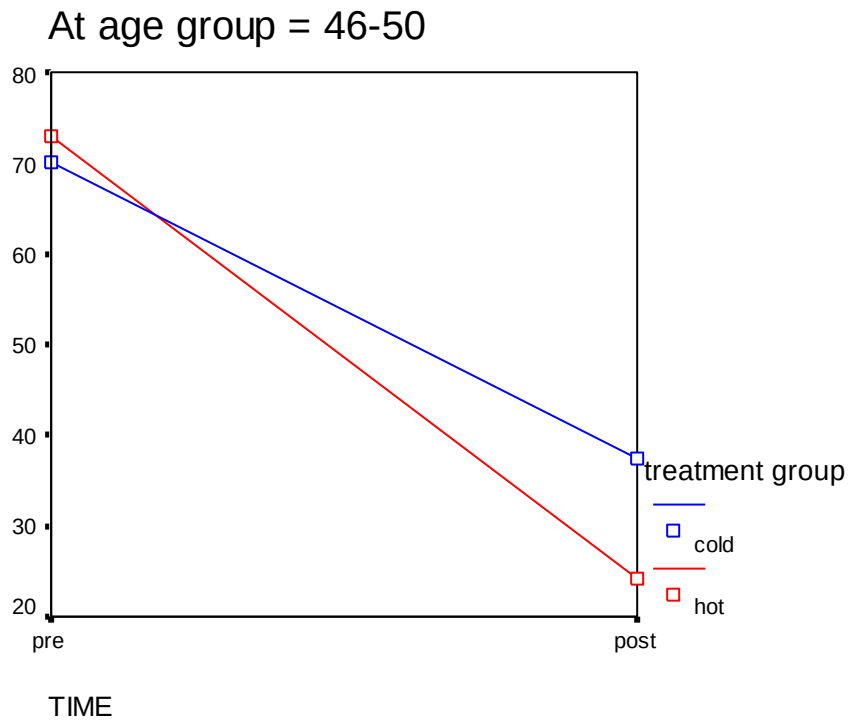
Figures 1(a-e): Profile plots of mean NRS over time by treatment group, stratified by age group






At age group = 36-40
70
60
50
40
30
20
10
pre
post
TIME
treatment group
cold
hot


At age group = 41-45
80
70
60
50
40
30
20
10
pre
post
TIME
treatment group
cold
hot



For the numerical rating scale the outcomes were dependent on the age factor only. There are potential reasons for this outcome, which include but are not necessarily limited to:

- The youngest group improved faster with the heat therapy because the collagen fibers and muscle fibers are still fairly elastic at a young age (White et al. 1990) and the heat helped renew this elasticity and cause lengthening of the muscle fibers thereby reducing muscle spasm and inducing relaxation (Basmajian and Wolf; 1990)

- The oldest group responded better to the heat therapy because of the relaxing effect of heat (Melzack and Wall; 1982) and due to it probably being the more comforting modality. Older participants would have responded to the relaxation (Melzack and Wall; 1982), which eased their perception of the pain, resulting in the group having a higher threshold for pain (Melzack and Wall, 1965).

4.3 CMCC NECK DISABILITY INDEX

As was evident in terms of the CMCC Neck Disability Index all participants had pain when working but not to the extent that it was debilitating. Participants acknowledged that there was slight difficulty when turning their neck to a particular side or to a particular degree. This differed from patient to patient and was subsequently indicated by the other modes of measurements.

4.4 ALGOMETER

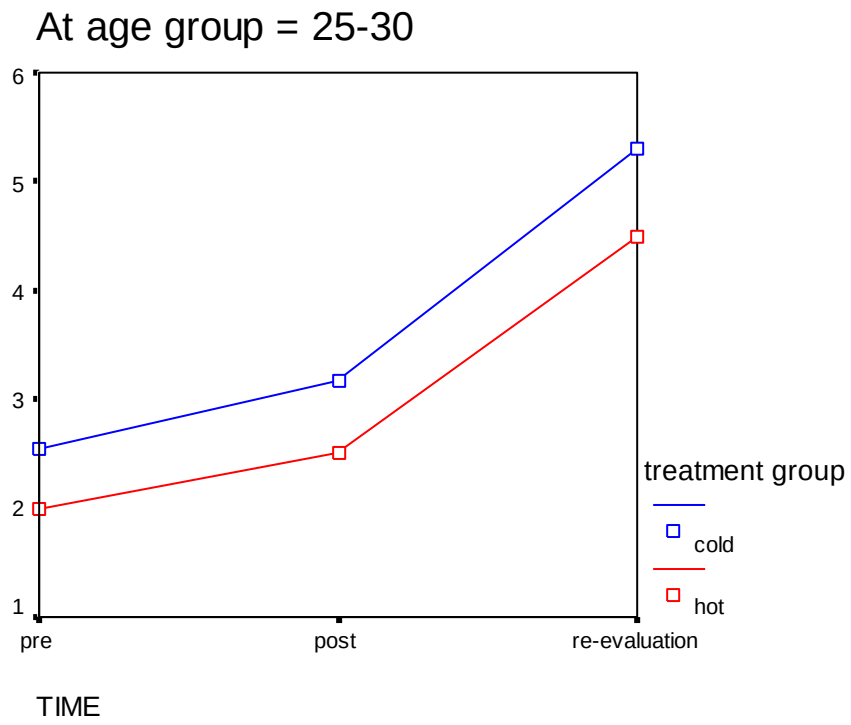
Table 3: Repeated measures ANOVA within-subjects effects for Algometer

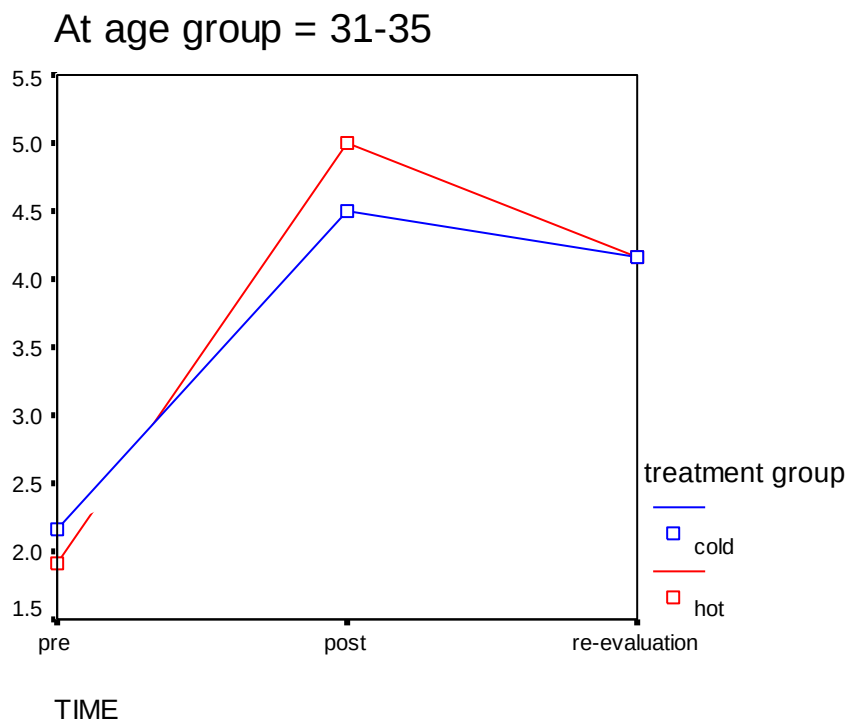
	Wilk's lambda	p value
Time	0.200	<0.001
Time* treatment group	0.999	0.974
Time* treatment group * age group	0.930	0.885

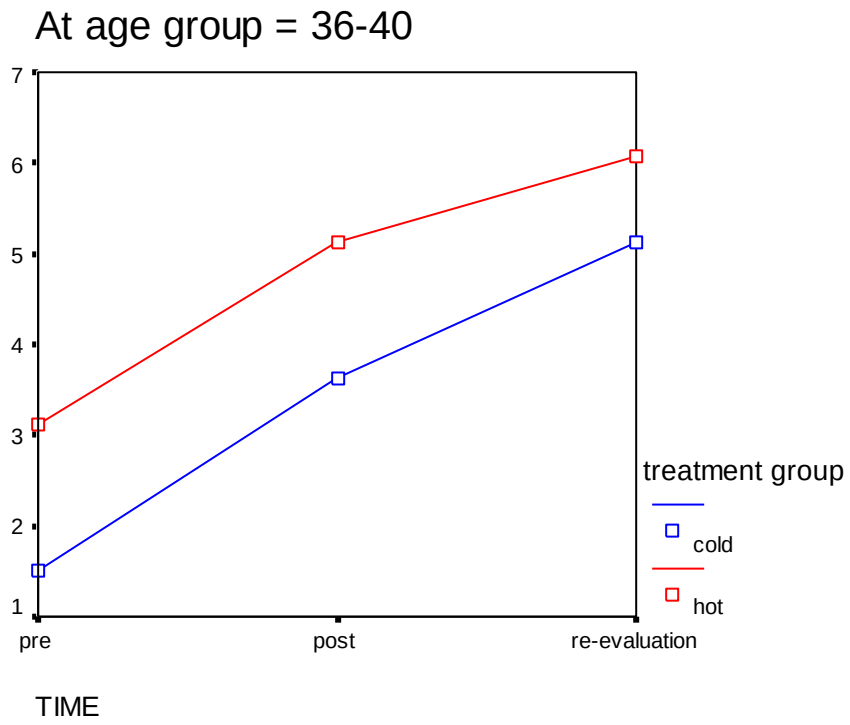
There was a significant time effect for algometer ($p<0.001$). There was no significant interaction between time and treatment group, or time, treatment group and age group. Therefore change over time was not dependant on treatment group or age group. This is shown in Figures 2 a-e.

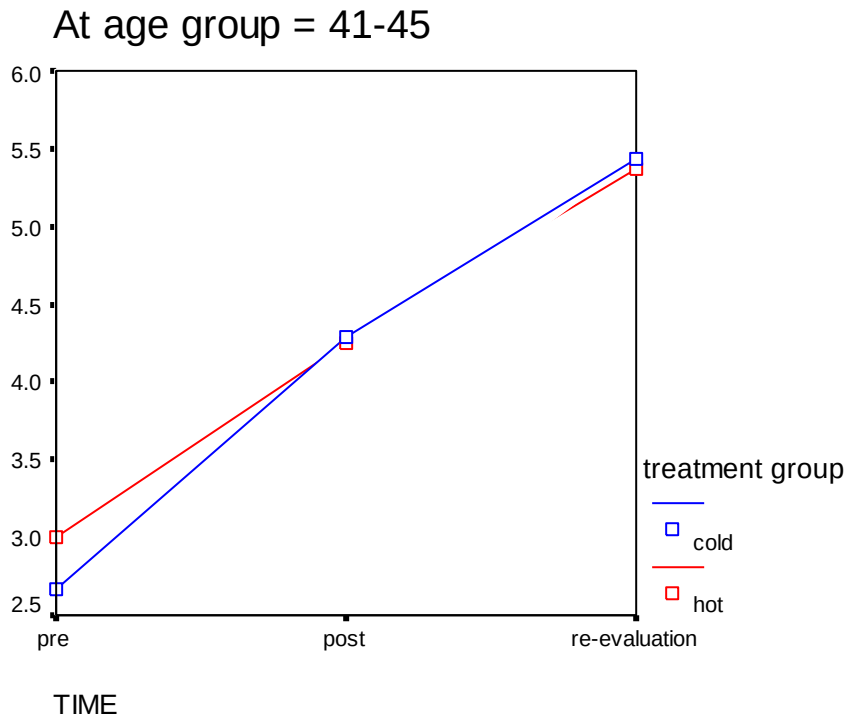
Within each age group the change over time is constant in the both treatment groups (slopes of the lines are parallel). There was a general increase in Algometer measurements over time, irrespective of age group or treatment group.

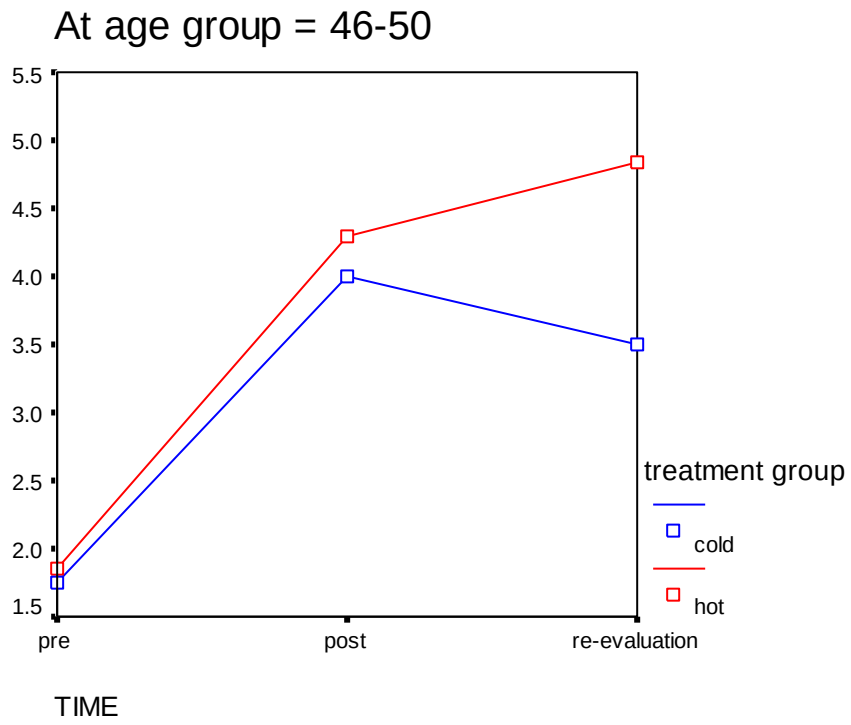
Figures 2 a-e: Profile plots of mean algometer measurements over time by treatment group, stratified by age group






At age group = 36-40
7
6
5
4
3
2
1
pre
post
re-evaluation
TIME
treatment group
cold
hot


At age group = 41-45
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
pre
post
re-evaluation
TIME
treatment group
cold
hot



The algometer results were not dependent on age group. All the treatment groups responded positively to both cryotherapy and heat therapy improving steadily over time with treatment.

However, in the age group 31-35, the participants initially showed an improvement but at the one-month follow-up regressed. A possible reason for this outcome was that most of the participants within this age group consisted of women, with the ratio of women to men being 9:3. The majority of women in the treatment group had external factors related to an increased likelihood of increased severity of their clinical presentation:

- Being mothers and having children, especially toddlers where picking up or carrying the babies could have lead to micro-trauma and muscle overload causing the formation of taut bands within the muscle referred to as a trigger point (Auleciems; 1995).
- The group could have been exposed to other perpetuating factors that could have resulted in trigger point formation. These factors include

changes in nutrition, injuries (Rosen; 1993), viral or bacterial infections, psychogenic stresses and environmental factors (Rubin; 1981)

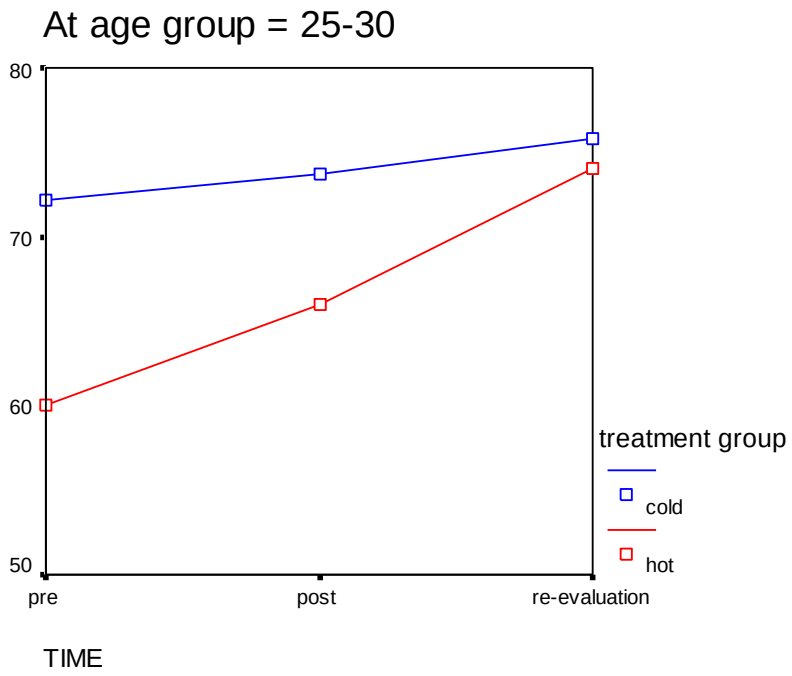
4.5 FLEXION RANGE OF MOTION AS MEASURED BY CROM GONIOMETER

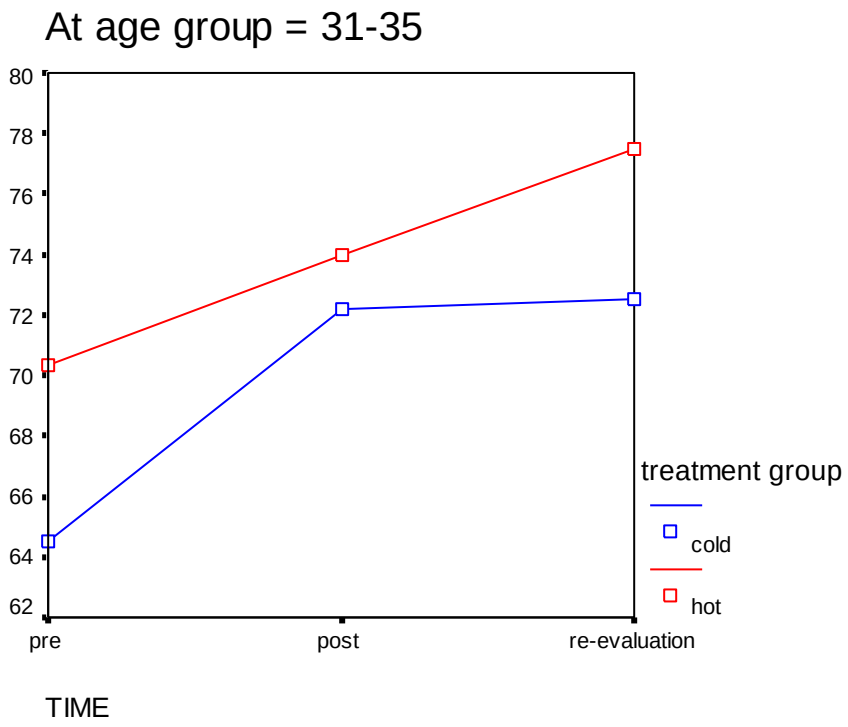
Table 4: Repeated measures ANOVA within-subjects effects for Flexion

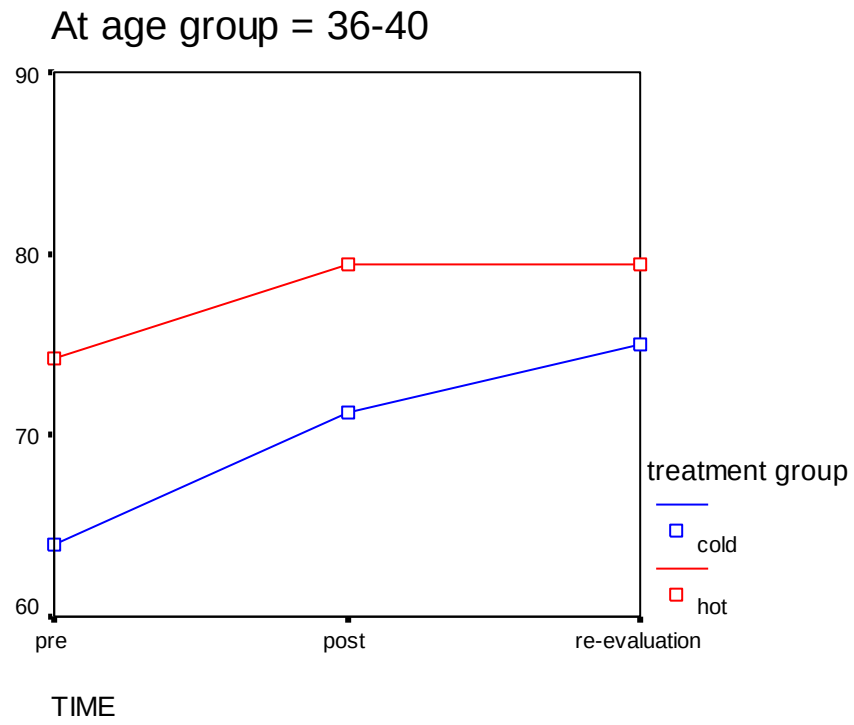
	Wilk's lambda	p value
Time	0.490	<0.001
Time* treatment group	0.974	0.525
Time* treatment group * age group	0.749	0.067

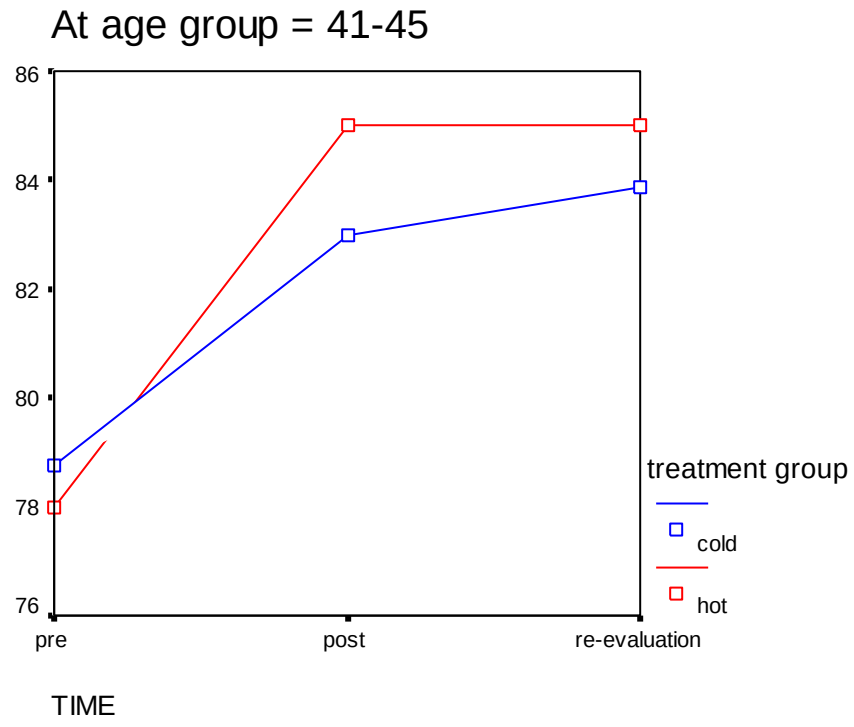
Table 4 shows that there was a borderline significant interaction between time, treatment group and age group (p = 0.067). This showed that the age group had an effect on the outcome of the treatment. With examination of the profile plots in Figures 3 a to d, for ages 25 to 45, the heat therapy treatment shows a faster increase in flexion over time. However, in the oldest age group (46-50 years) the cryotherapy treatment group showed better results. It is evident that the response to treatment was age dependant in terms of flexion range of motion.

Figures 3 a- e: Profile plot of mean flexion over time by treatment group, stratified by age group






At age group = 36-40
90
80
70
60
pre
post
re-evaluation
TIME
treatment group
cold
hot


At age group = 41-45
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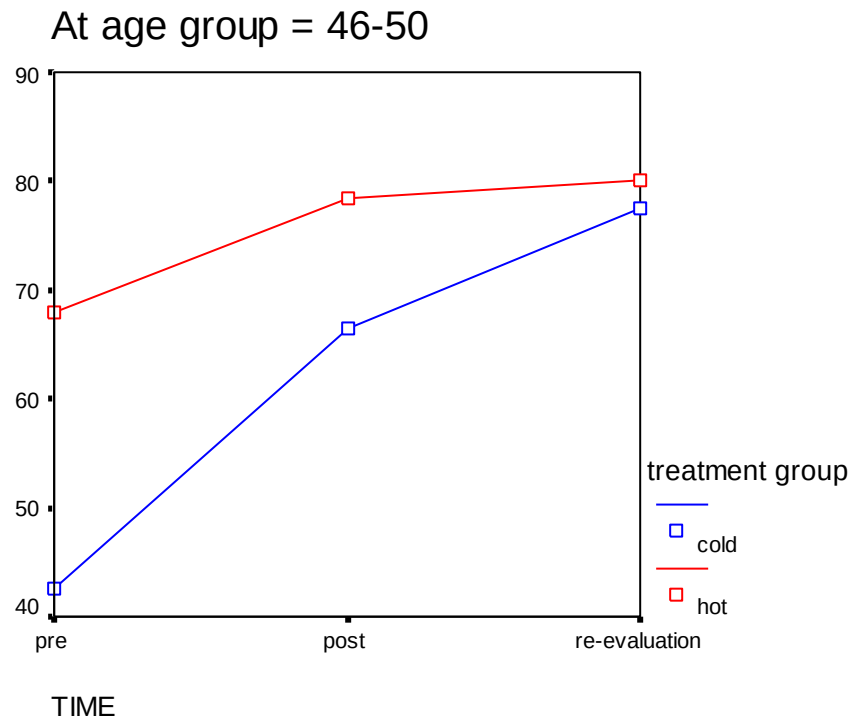
84
82
80
78
76
pre
post
re-evaluation
TIME
treatment group
cold
hot



The increase in flexion range of motion of the cervical spine could be due to PNF stretching causing lengthening of the posterior cervical muscle fibers thereby reducing the muscle spasm and increasing range of motion (Redwood; 1997).

It is also noted that with increasing age there seems to be a tendency towards the patients responding better to cold therapy. However, muscle fibers lose their elasticity and stiffen with age (Basmajian and Wolf; 1990). Lengthening of the fibers which occurs with flexion of the cervical spine is however possible Travell and Simons; 1998).

However the analgesic effects of the cold (Schafer and Faye; 1990) would result in flexion being more tolerable by decreasing the pain perception, which would allow the muscles to be lengthened to a greater degree resulting in a greater amount of flexion (Redwood; 1997).

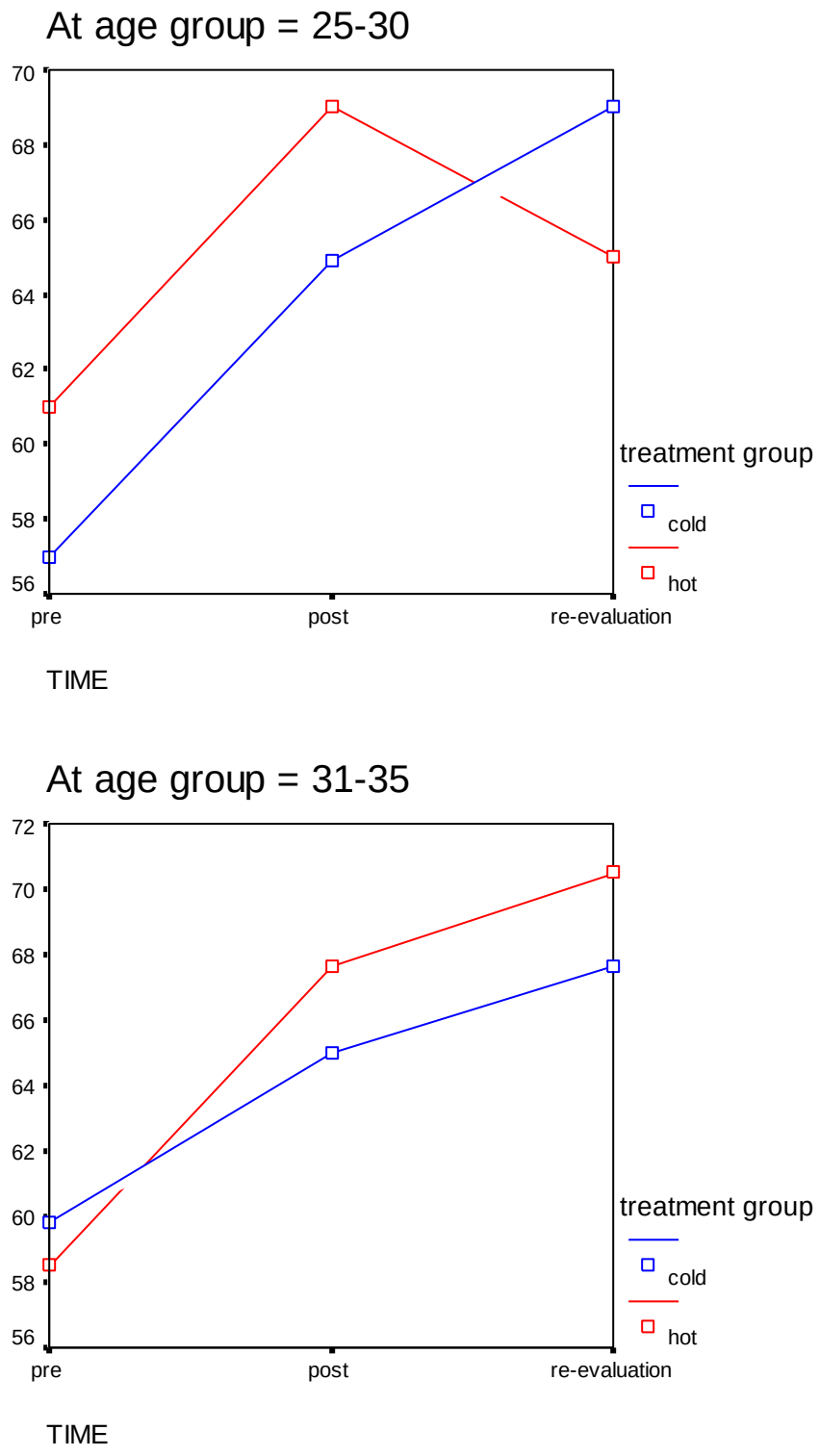
4.6 EXTENSION RANGE OF MOTION AS MEASURED BY CROM GONIOMTETER

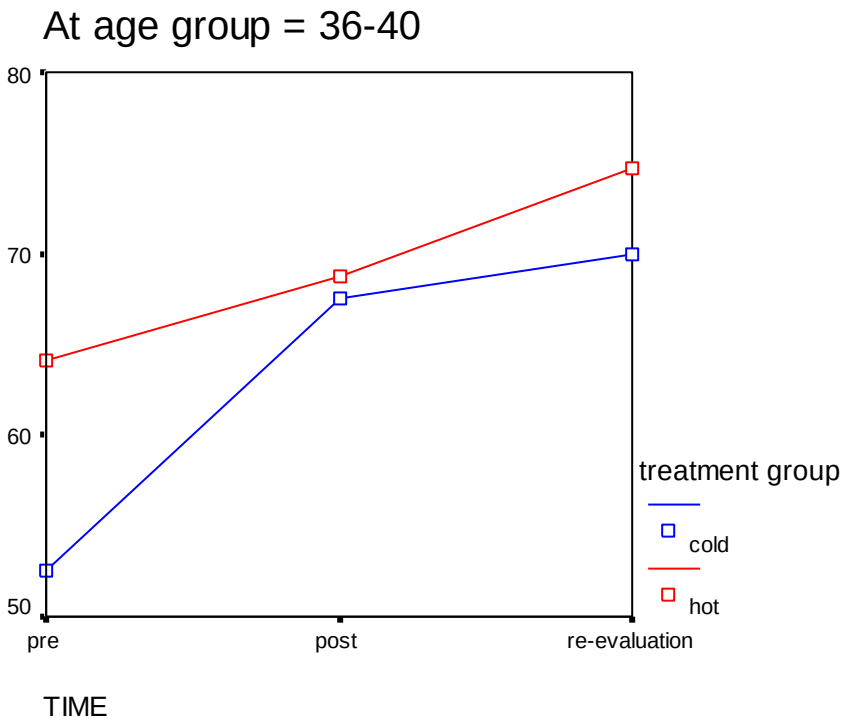
Table 5: Repeated measures ANOVA within-subjects effects for Extension

	Wilk's lambda	p value
Time	0.493	<0.001
Time* treatment group	0.999	0.996
Time* treatment group * age group	0.759	0.084

The 3-way interaction between time, treatment group and age group (p = 0.084) was not significant. However there was a significant change over time irrespective of treatment group or age group (p<0.001). Thus, all subjects showed improvement over time, which was not dependant on treatment or age. This is shown in Figures 4 a-e. Figure 4 a expressing the results of participants between the ages 25 to 30, there is a trend towards the greater improvement in the cryotherapy treatment group evident after the post measurement, the heat therapy group showed a decrease in mean extension, while the cryotherapy treatment group continued to increase over time. The other age groups showed a slightly better improvement in the heat therapy treatment group, except for age group 36-40, where the cryotherapy group showed a faster improvement in extension when compared to the heat therapy group (Figure 4 c). However, treatment group and age group did not significantly affect the change over time.

Figures 4 a- e: Profile plot of mean extension over time by treatment group, stratified by age group




At age group = 36-40
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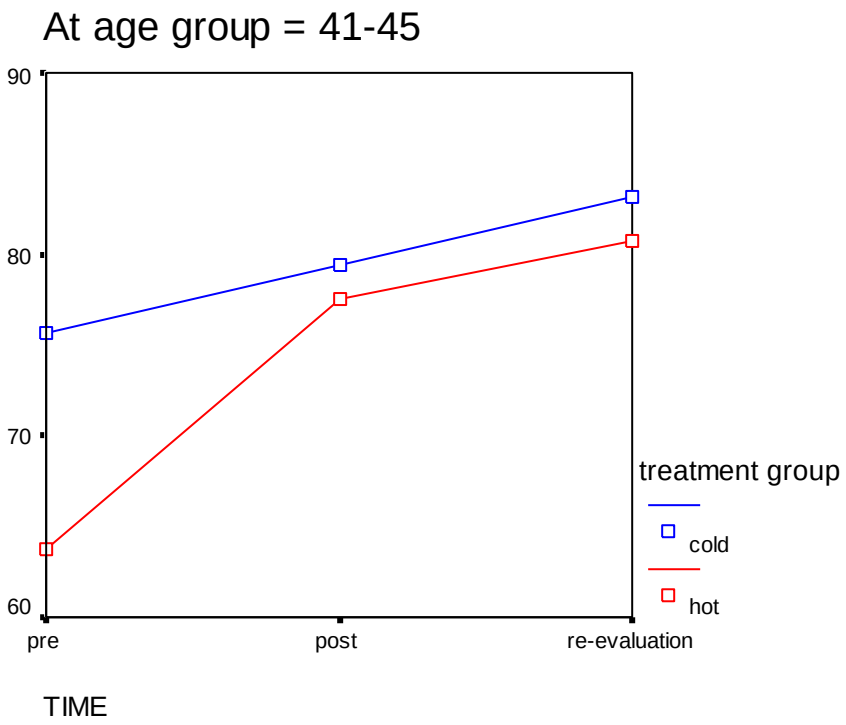
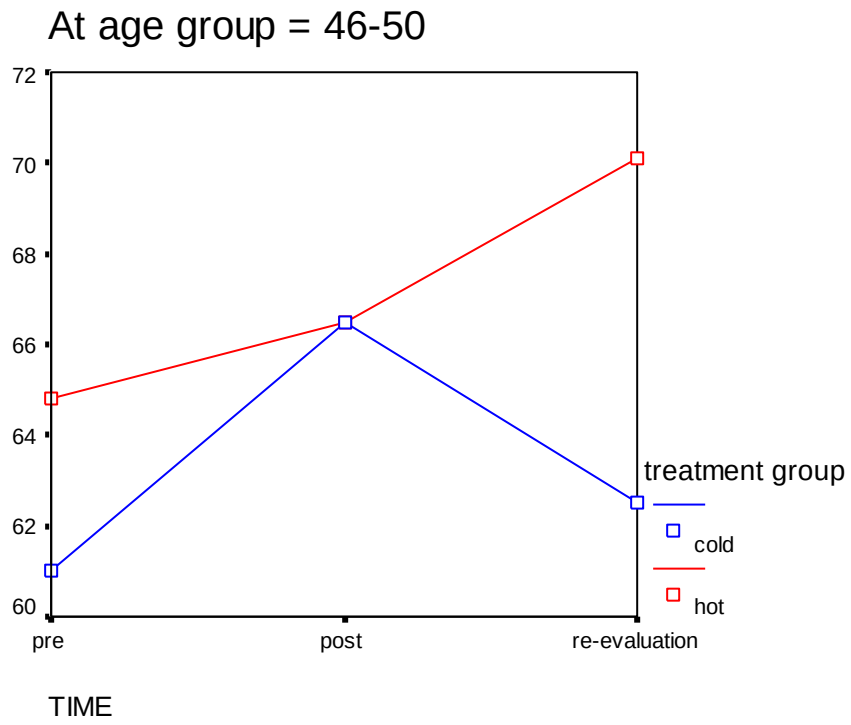
70
60
50
pre
post
re-evaluation
TIME
treatment group
cold
hot


At age group = 41-45
90
80
70
60
pre
post
re-evaluation
TIME
treatment group
cold
hot



Extension of the head and neck is the primary function of the posterior cervical muscle (Travell and Simons; 1998) so it was possible that treatment of this muscle group would have a positive effect on extension with regard to increasing the extension range of motion.

This assertion proved correct and results were positive in all age groups. Although both treatment groups showed an increase in extension it was evident that the cryotherapy intervention showed a more positive response with regards to increasing substantially over time in most of the age groups. The exception to the positive results produced by the cryotherapy treatment occurred in the 46 to 50 year old age group.

The data therefore suggest that with cryotherapy and PNF stretching the participants showed positive results. However, the week after cessation of treatment there was a rapid regression of the group's condition.

This explanation would be congruent with the analgesic effects of cold (Schafer and Faye; 1990), which allowed a greater pain relieving effect within the muscle, thereby restoring and sustaining to a degree an asymptomatic muscle bulk (Thomson et al. 1999), which would have artificially increased the optimal muscle functioning. This argument is further enhanced by the fact that with the follow up measurements a decrease in the extension ability was noted, thereby indicating that there was a return to the previous dysfunctional state of the muscle. With this implication it could be stated that the effects of the cryotherapy were to mask the symptoms and not effect the muscle in terms of a treatment effect.

The improvement in the 46 – 50 year age group further supports this argument as these patients condition may principally be based on the lack of muscle pliability and therefore decreased contractile function (Liebenson; 1996). This would only respond to the effects of heat therapy as opposed to the cryotherapy as the condition is not necessarily painful but related to the age changes of the collagen in the muscle and surrounding fascia (Basmajian; 1990).

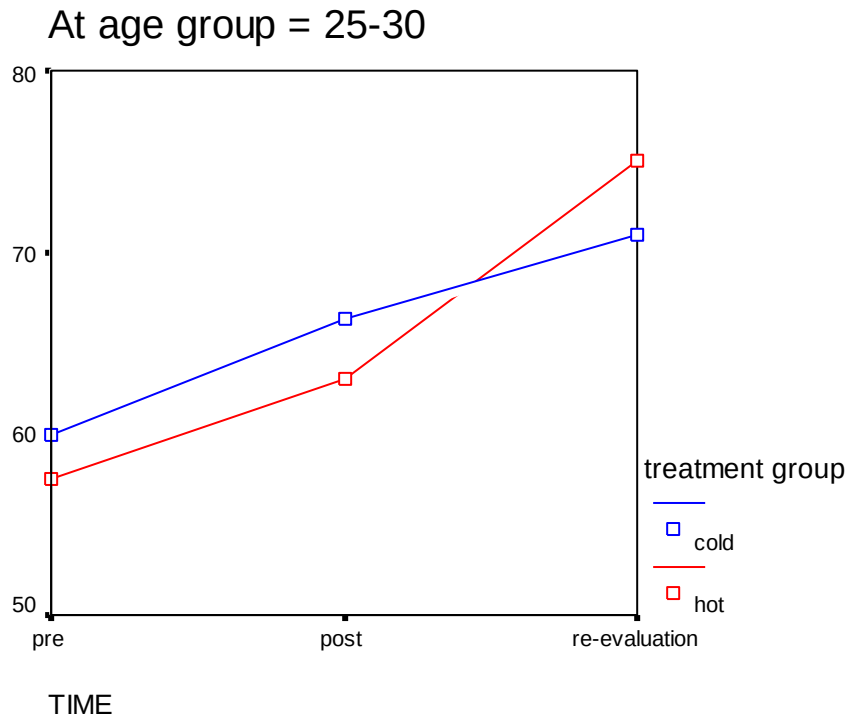
4.7 RIGHT ROTATION AS MEASURED BY THE CROM GONIOMETER

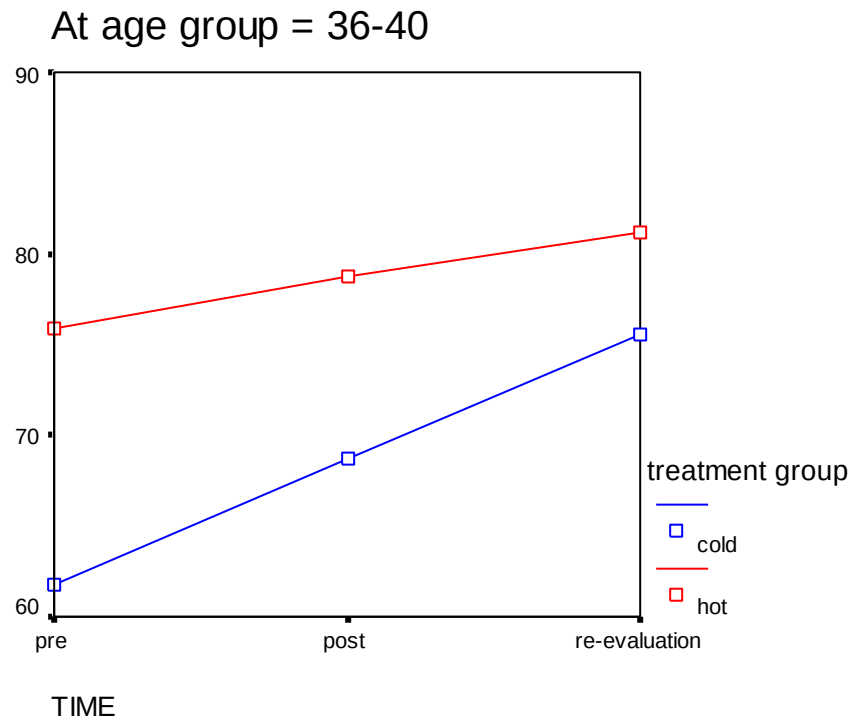
Table 6: Repeated measures ANOVA within-subjects effects for Right Rotation

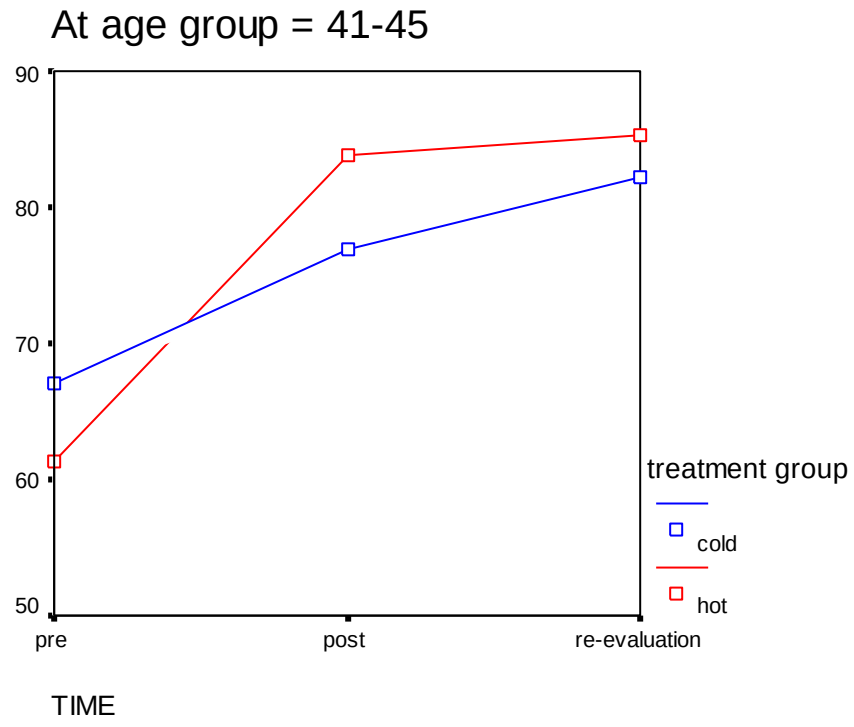
	Wilk's lambda	p value
Time	0.518	<0.001
Time* treatment group	0.988	0.752
Time* treatment group * age group	0.786	0.145

Table 6 shows that the effect of time was significant ($p<0.001$) and that neither treatment group nor age group significantly influenced the change in values over time. Figures 5 a to e did not show parallel lines in the treatment groups, thus there were trends towards differential effects in the treatment groups, but this was not statistically significant.

Figures 5 a- e: Profile plot of mean right rotation over time by treatment group, stratified by age group




At age group = 36-40
90
80
70
60
pre
post
re-evaluation
TIME
treatment group
cold
hot


At age group = 41-45
90
80
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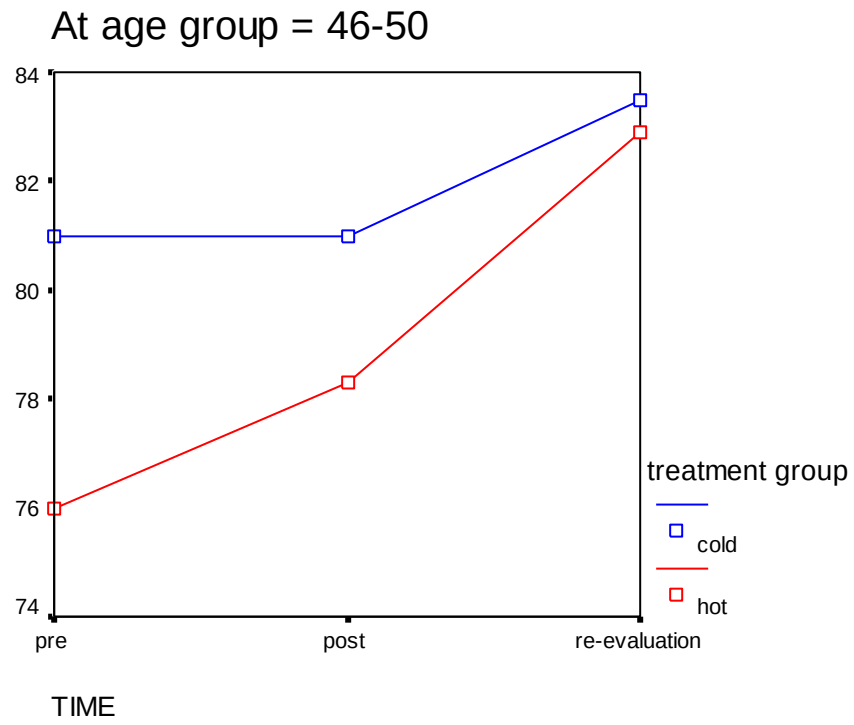
60
50
pre
post
re-evaluation
TIME
treatment group
cold
hot



There was an overall increase in right rotation within all the treatment groups with the cryotherapy once again showing more positive results especially in the younger age groups. This argument is congruent with that presented with the extension range of motion, whereby the cold serves to mask the symptoms of pain and allow for normal muscle contractility (Schafer and Faye; 1990).

Heat is once again more favorable in the older age groups reiterating the statement that the presenting condition could be more related to the fact that the older the patient the more likely it is to have the condition related to stiffness (decreased collagen flexibility) as opposed to pain (Basmajian; 1990).

Once again there was a regression in the condition in the age group 31-36 in the week after cessation of treatment, which is not noted in the other groups and therefore it is suggested that:

- Being mothers and having children, especially toddlers where picking up or carrying the babies could have lead to micro-trauma and muscle

overload causing the formation of taut bands within the muscle referred to as a trigger point (Auleciems; 1995).

- The group could have been exposed to other perpetuating factors that could have resulted in trigger point formation. These factors include changes in nutrition, injuries (Rosen; 1993), viral or bacterial infections, psychogenic stresses and environmental factors (Rubin; 1981

These factors would lead to a greater regression especially related to cold therapy when the effect of masking of the symptoms has been removed. It must be noted that the heat therapy in this group did respond as well and a follow up study in this regard with an increased period of follow up time or more follow up readings may have shown that the heat therapy for these patients would have been more beneficial in the long term.

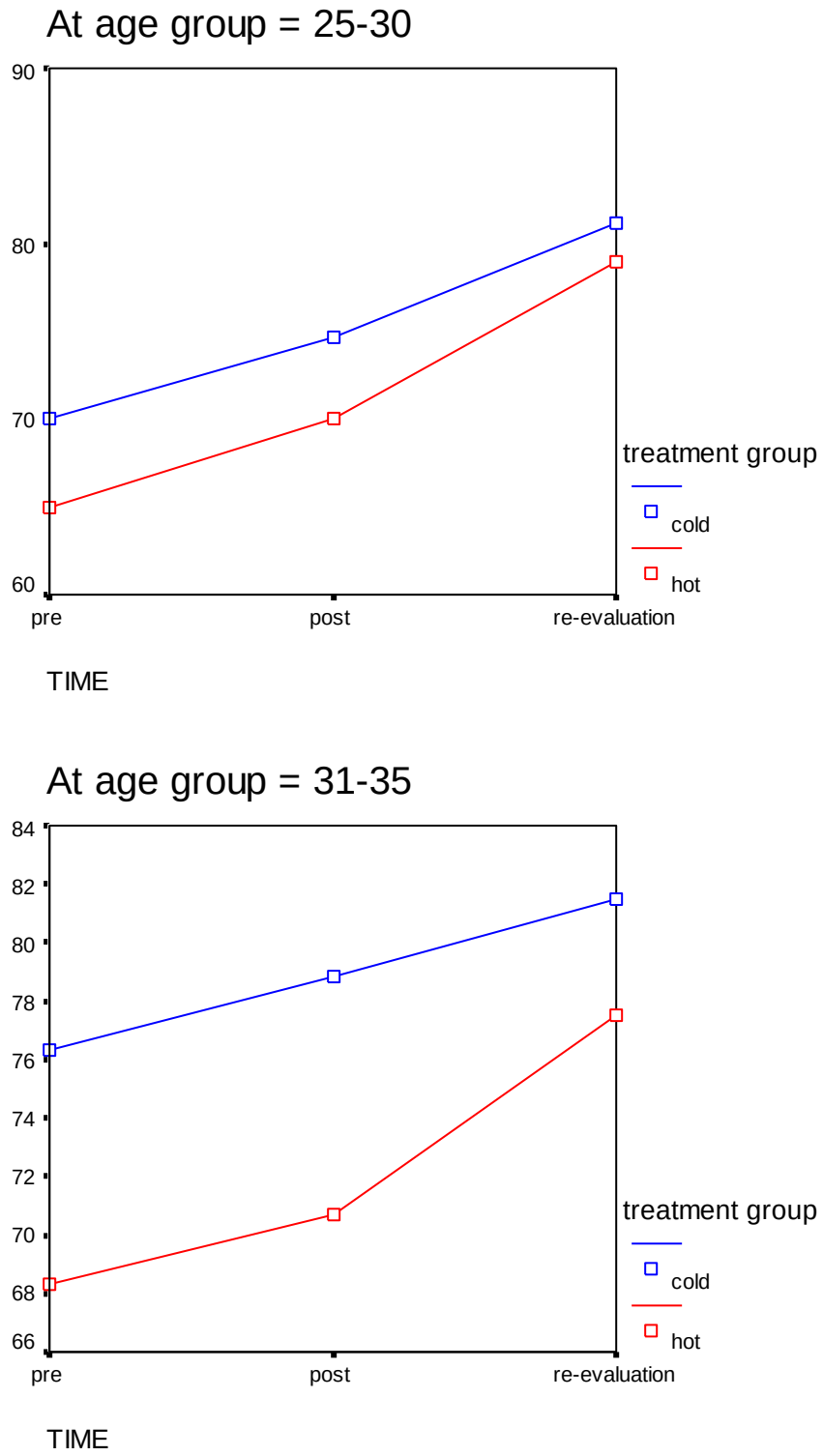
4.8 LEFT ROTATION AS MEASURED BY THE CROM GONIOMETER

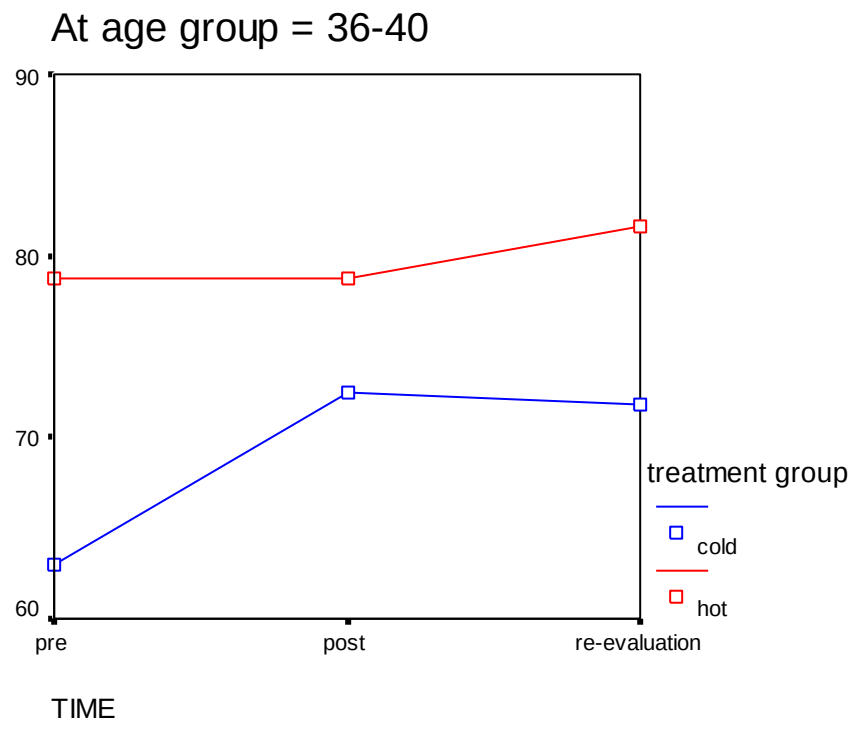
Table 7: Repeated measures ANOVA within-subjects effects for Left Rotation

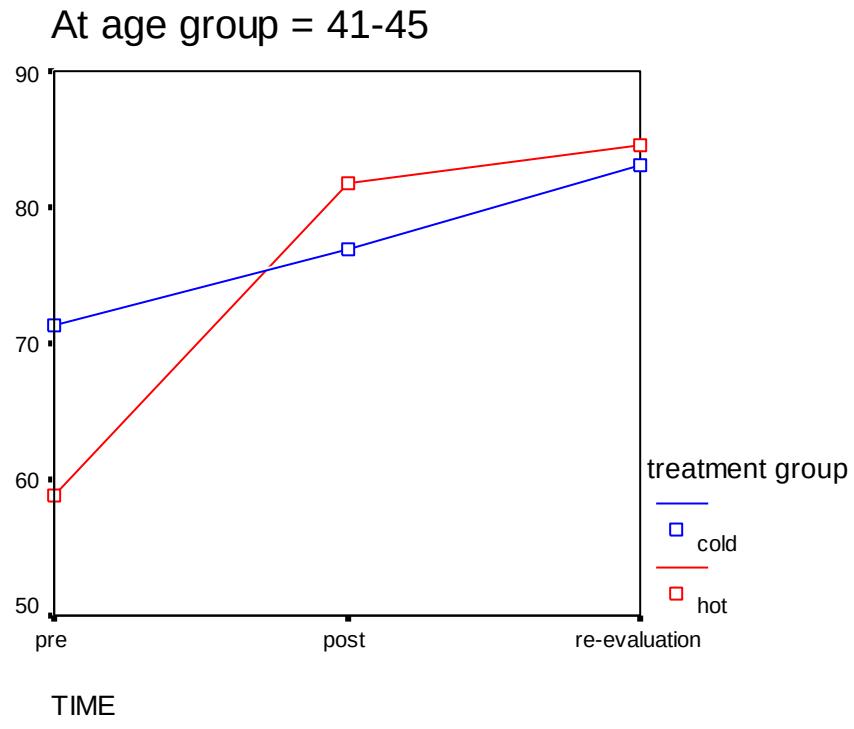
	Wilk's lambda	p value
Time	0.589	<0.001
Time* treatment group	0.967	0.434
Time* treatment group * age group	0.741	0.057

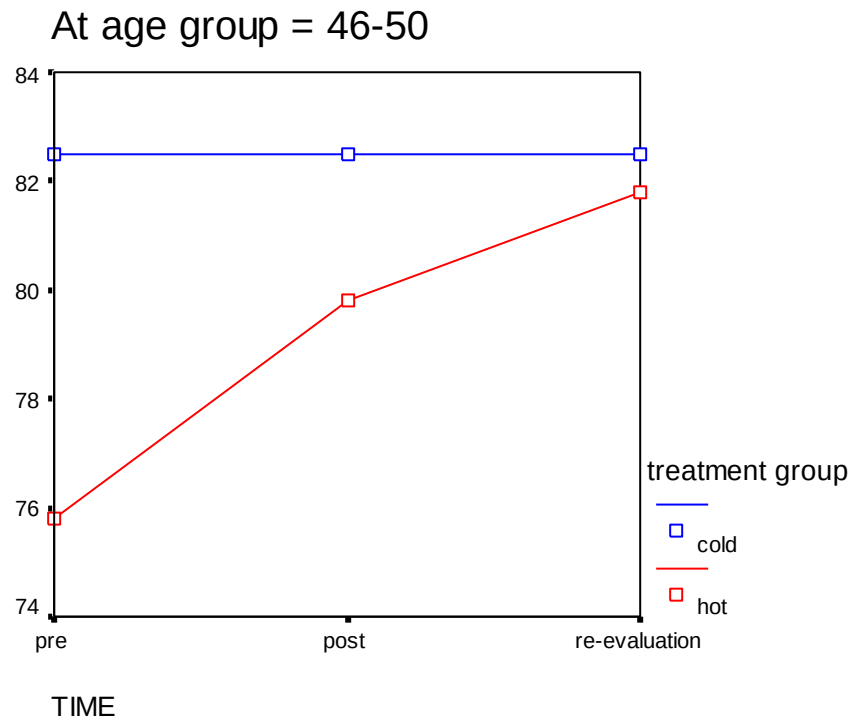
There was a borderline significant effect of treatment and age group on the mean left rotation values (p= 0.057). This means that the effect of treatment was dependant on the age group treated. Examination of the profile plots in Figures 6 a) to e) shows that the heat therapy treatment group showed faster improvement in mean left rotation in the 31 to 35 year age group, 41 to 45 year age group and 46 to 50 age group. The opposite is true for the 36 to 40 year age group and the 25-30 year age group who showed similar results in both treatment groups.

Figures 6 a- e: Profile plot of mean left rotation over time by treatment group, stratified by age group




At age group = 36-40
90
80
70
60
pre
post
re-evaluation
TIME
treatment group
cold
hot


At age group = 41-45
90
80
70
60
50
pre
post
re-evaluation
TIME
treatment group
cold
hot



Left rotation showed positive responses in both treatment groups. Once again the oldest age group responded better to heat therapy and the younger age group responded better to the cryotherapy, which is in congruence with the assertion made in this study that the cryotherapy groups seem to have had their condition masked as opposed to the heat therapy group which responded favorably in terms of a true treatment effect.

In addition to this the movement of left rotation, it must also be said that the majority of participants were right hand dominant. This would result in the muscles on the right side potentially having a worse clinical presentation at the outset resulting in an increased likelihood for improvement.

It must further be noted that the movement of rotation is related to a complex interaction of a number of muscles unlike the extension and flexion discussed earlier. The effects of other untreated muscles in terms of the presence of tightness, pain or other limiting factors could also have confounded these

readings. Therefore it is suggested that future studies evaluate and record changes in these muscles even though they are not treated in order to ascertain whether these improvements / lack thereof could have been different in this light.

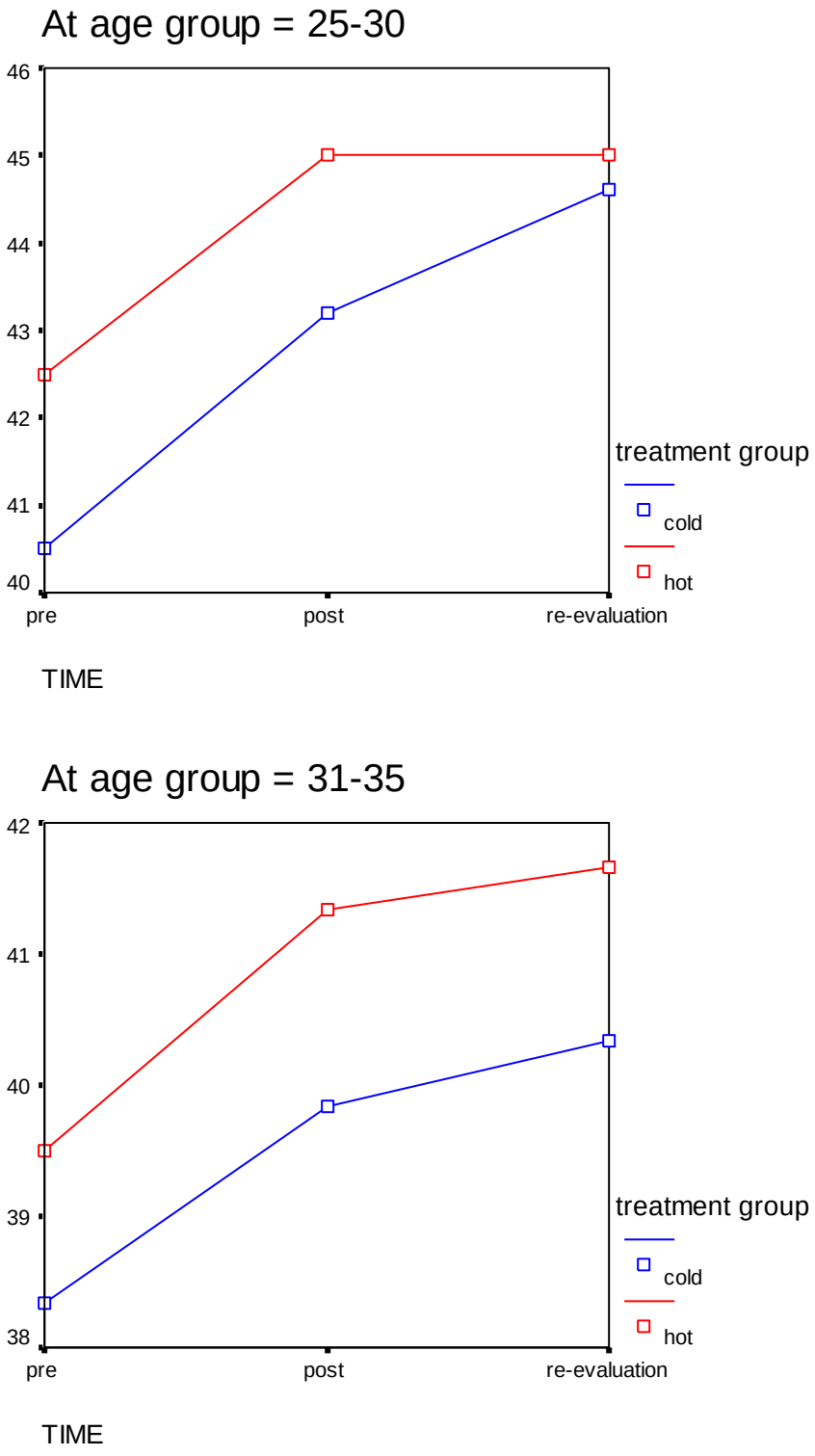
4.9 RIGHT LATERAL FLEXION AS MEASURED BY THE CROM GONIOMETER

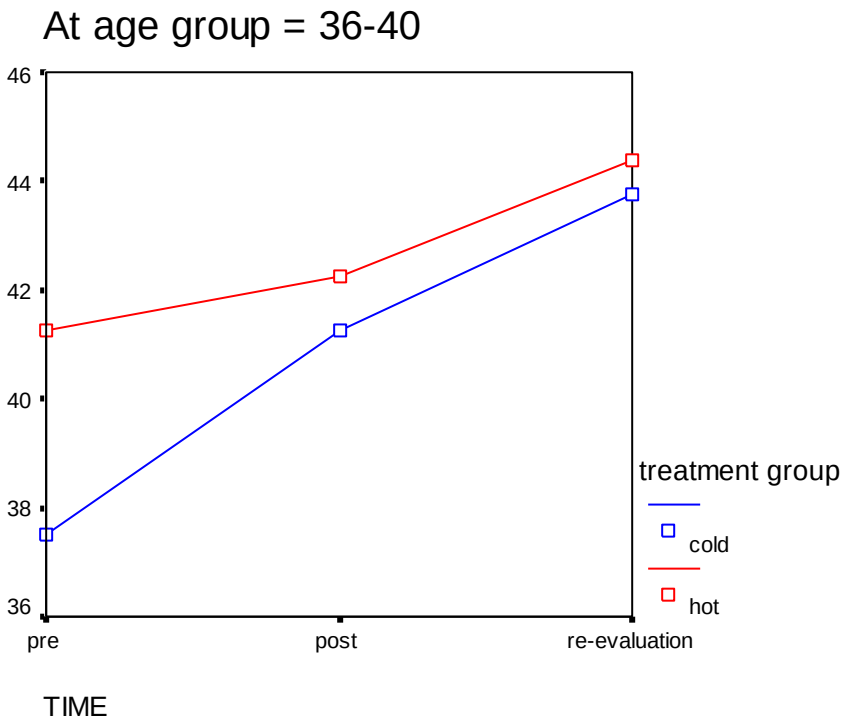
Table 8: Repeated measures ANOVA within-subjects effects for Right Lateral Flexion

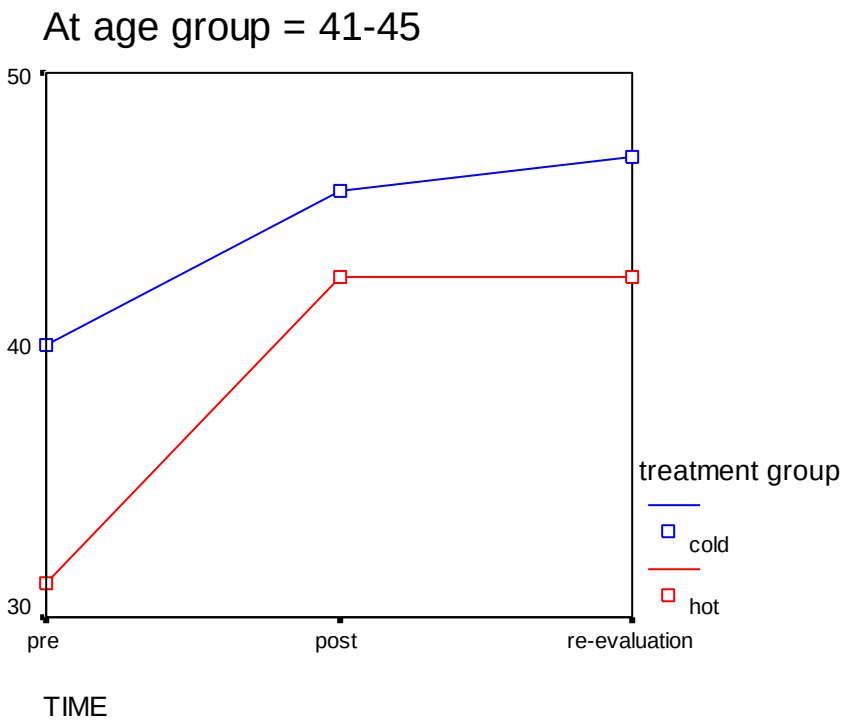
	Wilk's lambda	p value
Time	0.744	0.001
Time* treatment group	0.986	0.706
Time* treatment group * age group	0.909	0.775

For right lateral flexion there was no significant treatment group effect or age group effect. There was a significant time effect (p = 0.001), meaning that all subjects who received one of the treatments improved over time significantly. This improvement was not dependant on age group or treatment group. Even though this interaction was not statistically significant, age group-related treatment trends emerged from figures 7 a to e, especially in the oldest age group, where the cryotherapy group did not improve but the heat therapy group improved.

Figures 7 a- e: Profile plot of mean right lateral flexion over time by treatment group, stratified by age group




At age group = 36-40
46
44
42
40
38
36
pre
post
re-evaluation
TIME
treatment group
cold
hot


At age group = 41-45
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40
30
pre
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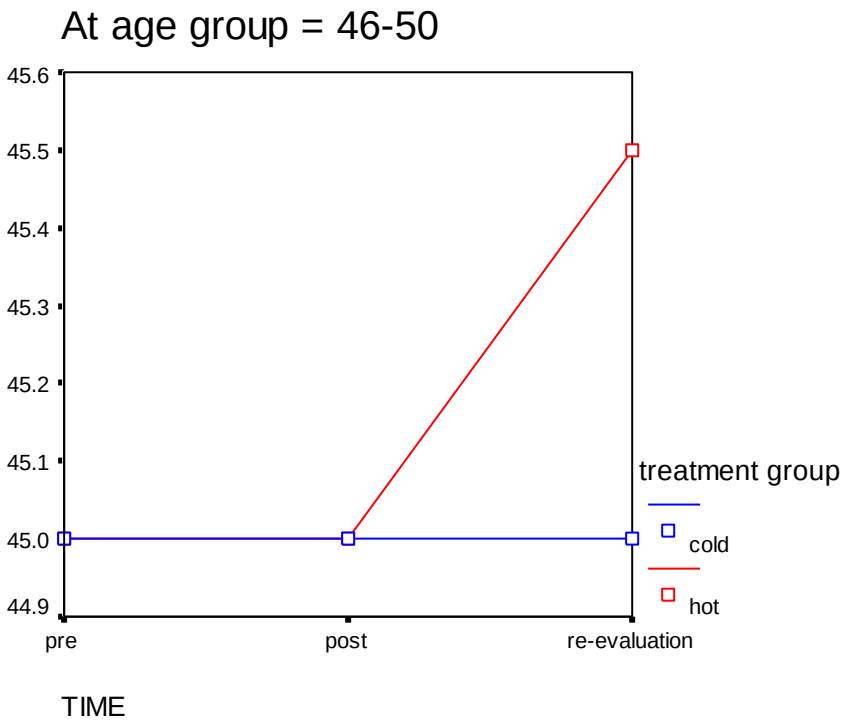
re-evaluation
TIME
treatment group
cold
hot



Right lateral flexion range of motion showed a positive response to both treatment methods. Once again the younger participants responded better to the cryotherapy and the older participants responded to the heat therapy indicating that the assertion related to the effects of heat therapy and cryotherapy due seem to be reiterated and supported here.

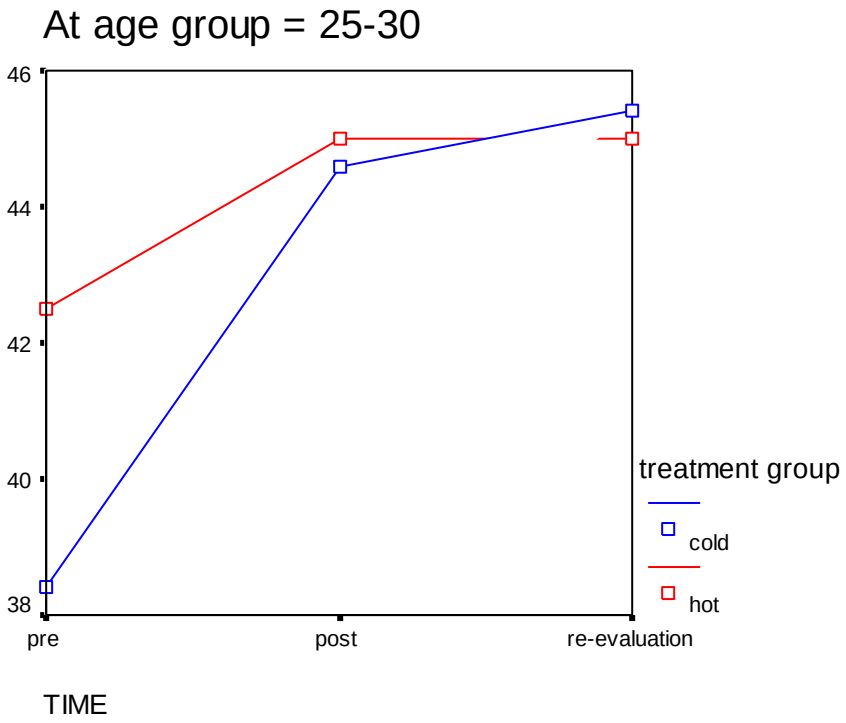
4.10 LEFT LATERAL FLEXION AS MEASURED BY THE CROM GONIOMETER

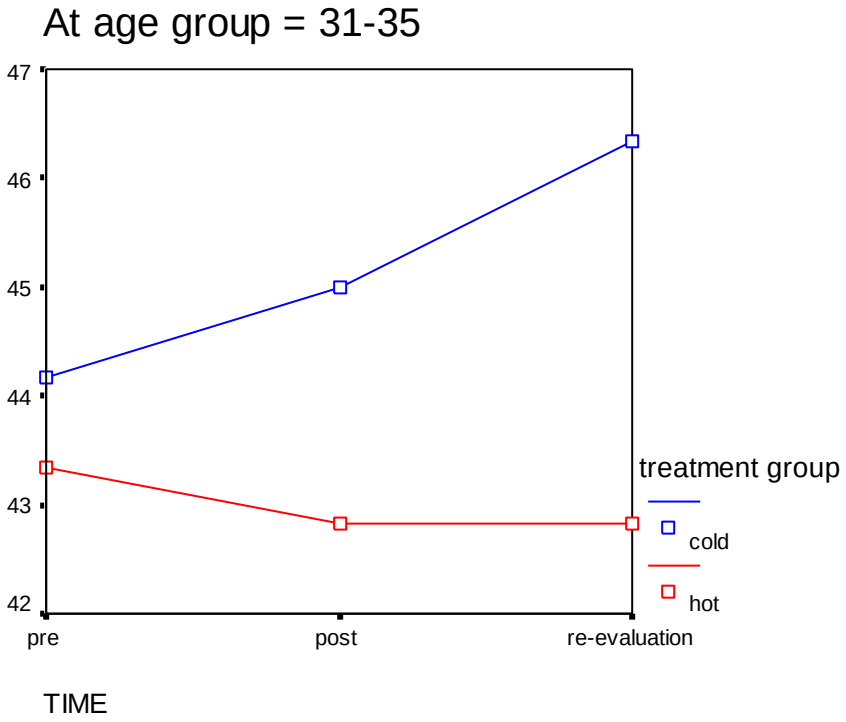
Table 9: Repeated measures ANOVA within-subjects effects for left lateral flexion

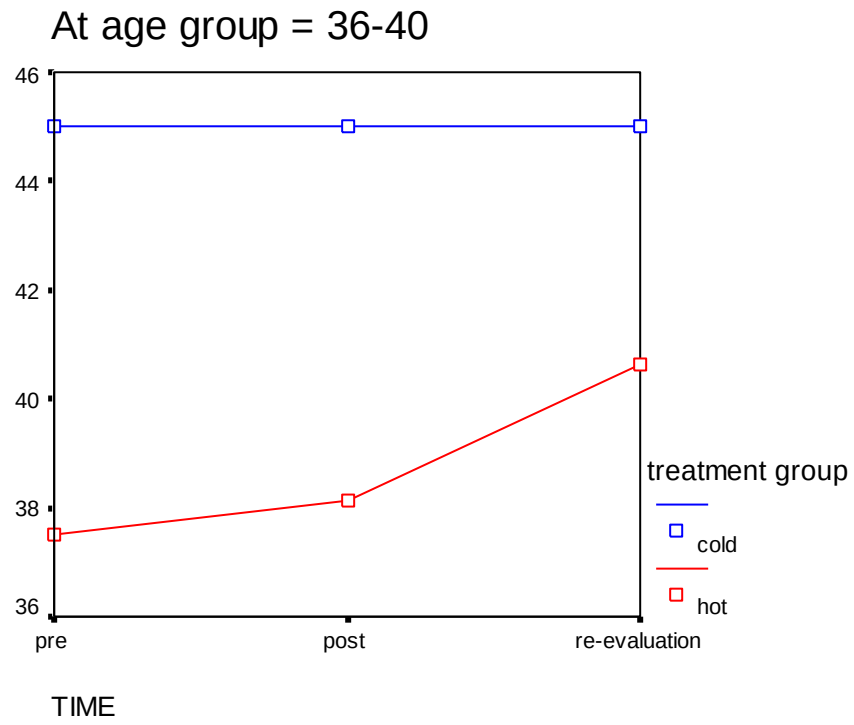
	Wilk's lambda	p value
Time	0.831	0.011
Time* treatment group	0.989	0.771
Time* treatment group * age group	0.909	0.726

The effect of time was significant (p = 0.011) and there was no significant benefit to either treatment group or age group. However, trends are apparent from Figures 8 a to e, where in the first two age groups cryotherapy treatment appeared to show faster improvement and in the last three age groups responded better to heat treatment.

Figures 8 a- e: Profile plot of mean left lateral flexion over time by treatment group, stratified by age group






At age group = 36-40
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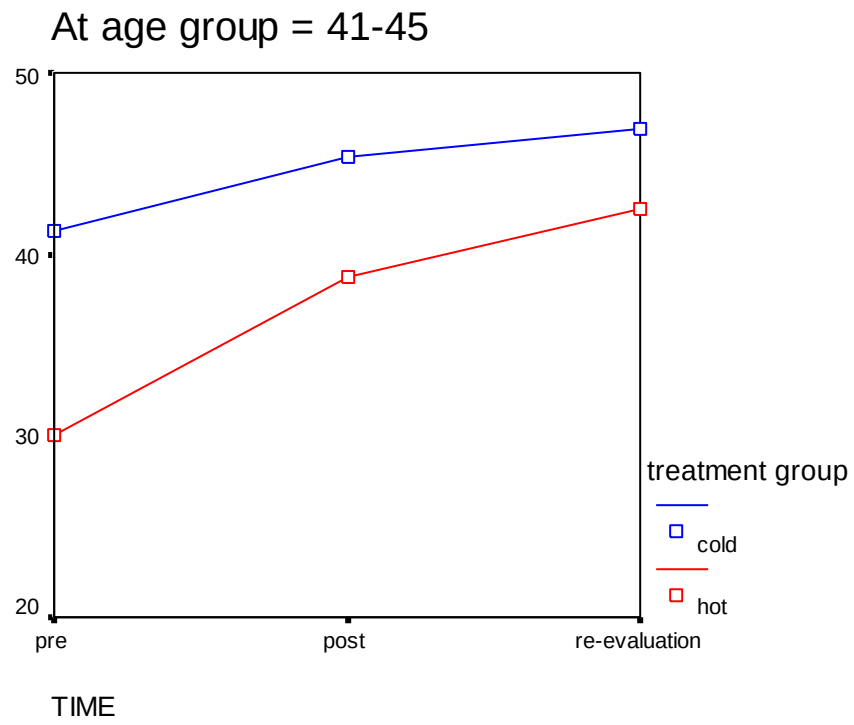
44
42
40
38
36
pre
post
re-evaluation
TIME
treatment group
cold
hot


At age group = 41-45
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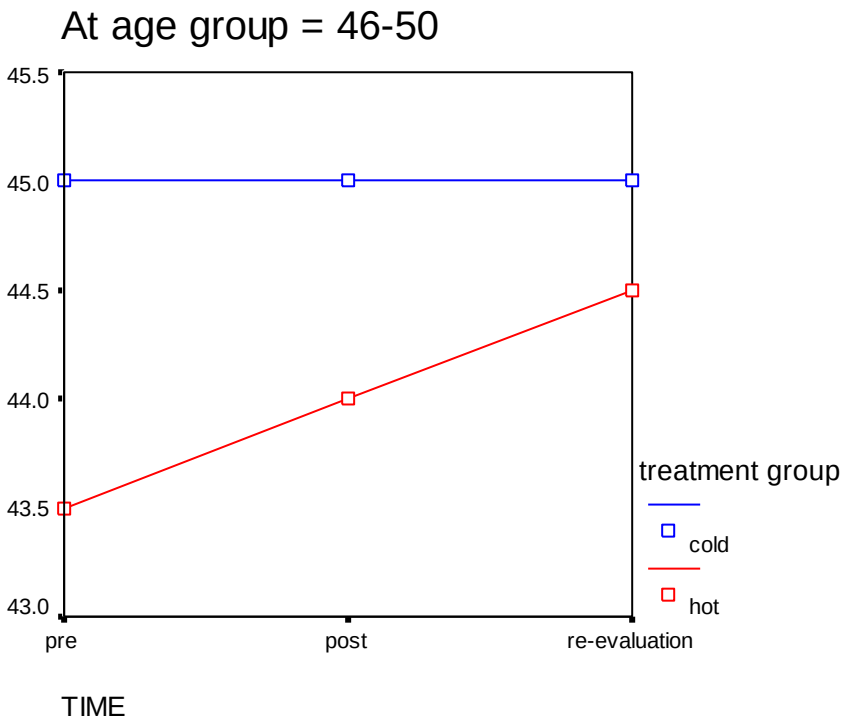
40
30
20
pre
post
re-evaluation
TIME
treatment group
cold
hot



Left lateral flexion increased in both treatment groups and within all the age groups. Once again the younger participants responded more positively to the cryotherapy and the older participants responded better to the heat therapy treatment.

It must further be noted that the movement of lateral flexion is related to a complex interaction of a number of muscles unlike the extension and flexion discussed earlier. The effects of other untreated muscles in terms of the presence of tightness, pain or other limiting factors could also have confounded these readings. Therefore it is suggested that future studies evaluate and record changes in these muscles even though they are not treated in order to ascertain whether these improvements / lack thereof could have been different in this light.

4.11 SUMMARY AND RECOMMENDATIONS

This clinical trial showed that for all outcomes measured, either of the two treatments was effective overall. However, there were trends suggesting optimum treatments were dependent on the age of the patient. Table 10 shows the trends that emerged. In general the oldest age group of 46-50 years old, the 41-45 year group and the 31-35 year group responded best and improved the most when they received the heat intervention, while the 36-40 year age group responded to cryotherapy. For the youngest age group it did not seem to make a difference whether they received hot or cold treatment (Table 10).

Table 10: Optimum treatment per outcome and age group

Outcome	**Age group**				
	25-30	31-35	36-40	41-45	46-50
NRS*	hot	Cold	cold	cold	hot
Algometer	same	Hot	cold	cold	hot
Flexion	hot	Hot	cold	hot	cold
Extension	cold	Hot	cold	hot	hot
Right rotation	hot	Hot	cold	hot	hot
Left rotation	hot	Hot	cold	hot	hot
Right lateral flexion	cold	Hot	cold	hot	hot
Left lateral flexion	cold	Cold	hot	hot	hot

* statistically significant difference in treatment group effect by age group

Most of the outcomes did not show a statistically significant interaction between time, age group and treatment group. Thus it is suggested that the study was underpowered at the age group level, with only 12 subjects per age group. The role of chance is high in a small study, thus these results could have been observed purely by chance.

A higher-powered study may have given statistical evidence to the trends observed here and provided more definitive answers to whether:

- The cryotherapy is indeed just a therapy that allows for amelioration of the symptoms without removing the underlying condition.
- The heat therapy's principle role is related to the effect on the collagen and elastin responses to the therapy thereby showing effects as indicated in this study.
- Whether or not confounding variables such as other non-treated muscles and / or hand dominance could have played a more significant role in the improvement or regression of the condition in the patients seen in this research.

Thus in respect of the hypotheses made at the outset:

Hypothesis One: It is hypothesized that the analgesic properties related to Cryotherapy would result in the treatment group that received PNF stretching combined with cryotherapy yielding better results in terms of objective clinical findings.

This is ***accepted with caution*** as it is implied in this research that the patients in this treatment group seemed to improve only under treatment and not with long term follow up, indicating an ameliorating effect not related to treatment but to masking of the symptomatology.

Hypothesis Two: It is hypothesized that the therapeutic effects of heat therapy would result in the treatment group receiving PNF stretching combined with heat therapy would yield better results in terms of subjective clinical findings.

This ***hypothesis is accepted.***

Hypothesis Three: It is hypothesized that there is an association between the subjective and objective clinical findings between the cryotherapy and the heat therapy groups.

This ***hypothesis is accepted with caution*** as there is an initial commonality between the responses overall, but this seems to change with time and further measurements post conclusion of the study in order to determine long term effects of the intervention would be needed to conclusively accept or reject this hypothesis.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSION

From the results obtained, it can be concluded that both treatment groups responded to their respective treatment protocols showing an improvement in terms of subjective and objective clinical findings. Participants mostly responded in the first week of treatment by receiving interventions 3 times a week. There was a tendency of participants to remain the same or worsen once all interventions had come to an end. This is evident by the plateaus and decreases between the last treatment intervention and the one-week follow-up.

Overall, it was shown, that heat therapy and cryotherapy both were beneficial in treating hypertonic posterior cervical muscles. The benefits of both interventions were echoed in the results. A greater percentage of the sample group showed positive results receiving cryotherapy in terms of subjective data. In terms of objective data there was no significant difference between the two treatment protocols.

Heat therapy yielded more positive results in most participants in terms of objective data collected by the CROM.

A longer lasting effect to treatment was showed overall in the cryotherapy groups with many subjects maintaining their pain relief and range of motions after the one-week follow up.

The evidence was not significant enough to determine whether age of participants had an effect on the treatment.

5.2 RECOMMENDATIONS

It is recommended that there should be a larger sample size in each of the age groups in order to determine whether age is a definitive factor in one treatment being preferred over the other. This would help the trends in the data to be more apparent.

For future research studies, a greater time period for the completion of study (8 treatments over 3 weeks) is recommended in order to establish whether the treatments are effective in providing long lasting relief from the condition.

Further to the above, it is recommended that external factors (e.g. small children, significant grievances, emotional trauma and sudden changes from normal work or social activity routines) which confound the outcome of clinical trials such as this one, should be noted and controlled for within the statistical analysis in order to improve or depress significant findings.

It is recommended that the combined treatments of PNF and heat therapy or PNF and cold therapy be compared to one of the therapies alone. It cannot be assumed that the synergistic effect of the combined therapy is any better than any one of the therapies alone.

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DURBAN INSTITUTE of TECHNOLOGY

APPENDIX A

INFORMED CONSENT FORM

(To be completed by patient / subject)

Date **:**

Title of research project **:** To investigate the effectiveness of proprioceptive neuromuscular facilitation combined with heat therapy as opposed to proprioceptive neuromuscular facilitation with cryotherapy in the treatment of mechanical neck pain caused by hypertonic posterior cervical muscles.

Name of supervisor **: Dr C. Korporaal**
Tel **:** (031) 204 2611

Name of research student **: Romona Francis**
Tel **:** 082 6633225

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:_____

APPENDIX B

Dear Patient

Thank you for considering enrolling in this research program. Outlined below is a brief explanation of what the research entails as well as what would be expected of you as the patient.

Title of Research

To investigate the effectiveness of proprioceptive neuromuscular facilitation combined with heat therapy as opposed to proprioceptive neuromuscular facilitation with cryotherapy in the treatment of mechanical neck pain caused by hypertonic posterior cervical muscles.

Principle Investigators

Romona Francis – Researcher Tel: 031 2042205
Dr. C. Korporaal – Supervisor Tel: 031 2042611

Study Design

The study is designed to treat neck pain in individuals between the ages of 25 and 50. If you chose to participate in this research program you will undergo a full case history, relevant physical examination and a full neck examination on your initial consultation. This will enable the researcher to ascertain whether or not you are eligible for the study. If you are not eligible for the study the researcher has the right to decline your participation in the study.

Purpose of the Study

Is to investigate the effectiveness of stretching when combined with heat or cold therapy in the treatment of neck pain caused by tight muscles at the back of the neck. In order to determine whether heat or cold results in stretching being more clinically effective or not.

Risks or Discomforts

You may feel transient discomfort due to stretching that will abate shortly after treatment.

Time Constraints

The initial appointment will take approximately 3 hours and thereafter each follow-up consultation will be 30 minutes.

Benefits

You will receive a comprehensive assessment and then also research related treatment, based on the protocols set out. Therefore, all patients will ultimately receive some form of treatment.

Reasons why you may be Withdrawn from the Study

- Consuming any form of new medication during the study.
- Receiving any form of manual therapy other than that at each consultation.
- If you have any trauma at any time during the study.
- If you perform any self-stretching exercises at home.

Re-numeration and Cost of the Study

There is no cost to you as the patient to participate in this study.

Confidentiality

Confidentiality will be maintained between the researcher and the clinician on duty on the day of your consultation. The clinician is a full time doctor of Chiropractic and will therefore assist should any problems arise. If you are unsatisfied with the ethics of the study a written complaint can be sent to the Department of Chiropractic at Durban Institute of Technology via the research supervisor or alternately to the Faculty Research Committee (Ethics), Mr Singh on (031) 2042701.

Many thanks for taking the time to consider participating in this study.

_____

Romona Francis (Research student)

_____

Dr. C. Korporaal (Research supervisor)

APPENDIX C

DURBAN INSTITUTE OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: _____ Date: _____

File # : _____ Age: _____

Sex : _____ Occupation: _____

Intern : _____ Signature _____

FOR CLINICIANS USE ONLY:

Initial visit

Clinician: Signature :

Case History:

Examination:

Previous: Current:

X-Ray Studies:

Previous: Current:

Clinical Path. lab:

Previous: Current:

CASE STATUS:

PTT:	Signature:	Date:

CONDITIONAL:

Reason for Conditional:

Signature: Date:

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

Intern's Case History:

1. **Source of History:**

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

3. **Present Illness:**

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

4. **Other Complaints:**

5. **Past Medical History:**

< General Health Status

< Childhood Illnesses

< Adult Illnesses

< Psychiatric Illnesses

< Accidents/Injuries

< Surgery

< Hospitalizations

6. Current health status and life-style:

< Allergies

< Immunizations

< Screening Tests incl. xrays

< Environmental Hazards (Home, School, Work)

< Exercise and Leisure

< Sleep Patterns

< Diet

< Current Medication
Analgesics/week:

< Tobacco

< Alcohol

< Social Drugs

7. Immediate Family Medical History:

< Age

< Health

< Cause of Death

< DM

< Heart Disease

< TB

< Stroke

< Kidney Disease

< CA

< Arthritis

< Anaemia

< Headaches

< Thyroid Disease

< Epilepsy

< Mental Illness

< Alcoholism

< Drug Addiction

< Other

8. Psychosocial history:

< Home Situation and daily life

- Important experiences
- Religious Beliefs

9. Review of Systems:

< General

< Skin

< Head

< Eyes

< Ears

< Nose/Sinuses

< Mouth/Throat

< Neck

< Breasts

< Respiratory

< Cardiac

< Gastro-intestinal

< Urinary

< Genital

< Vascular

< Musculoskeletal

< Neurologic

< Haematologic

< Endocrine

< Psychiatric

APPENDIX D

Durban Institute of Technology

PHYSICAL EXAMINATION: SENIOR

Patient Name : _____ **File no :** **Date :** _____

Student : **Signature :**

VITALS:

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

GENERAL EXAMINATION:

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

SYSTEM SPECIFIC EXAMINATION:

CARDIOVASCULAR EXAMINATION

RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION

NEUROLOGICAL EXAMINATION

COMMENTS

Clinician: **Signature :**

APPENDIX E

DURBAN INSTITUTE OF TECHNOLOGY

REGIONAL EXAMINATION - CERVICAL SPINE

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

Date: ..... Student: .....

Clinician: ..... Sign: .....

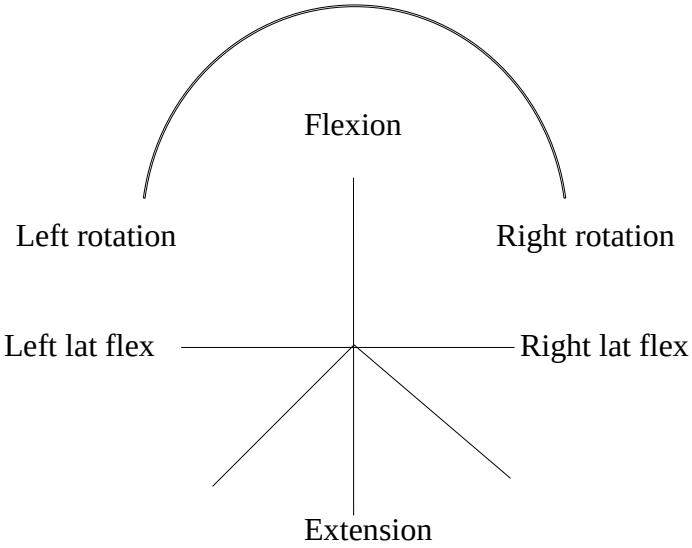
OBSERVATION:

Posture
Swellings
Scars, discolouration
Hair line
Body and soft tissue contours

Shoulder position
Left :
Right :
Shoulder dominance (hand):
Facial expression:

RANGE OF MOTION:

Extension (70º):
L/R Rotation (70º):
L/R Lat flex (45º):
Flexion (45º):



PALPATION:

Lymph nodes
Thyroid Gland
Trachea

ORTHOPAEDIC EXAMINATION:

Tenderness		Right	Left
Trigger Points:	SCM		
	Scalenii		
	Post Cervicals		
	Trapezius		
	Lev scapular		

	Right	Left		Right	Left
Doorbell sign			Cervical compression		
Kemp's test			Lateral compression		
Cervical distraction			Adson's test		
Halstead's test			Costoclavicular test		
Hyper-abduction test			Eden's test		
Shoulder abduction test			Shoulder compression test		
Dizziness rotation test			Lhermitte's sign		

Brachial plexus test					

NEUROLOGICAL EXAMINATION:

Dermatones	**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					
Cerebellar tests:		Left		Right				
Disdiadochokinesis								

VASCULAR:	**Left**	**Right**		**Left**	**Right**
Blood pressure			Subclavian arts.		
Carotid arts.			Wallenberg's test		

MOTION PALPATION & JOINT PLAY:

Left: Motion Palpation:
Joint Play:
Right: Motion Palpation:
Joint Play:

Upper Thoracics:
Motion Palpation:
Joint Play:

BASIC EXAM: SHOULDER:
Case History:

BASIC EXAM: THORACIC SPINE:
Case History:

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

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

APPENDIX F
DURBAN INSTITUTE OF TECHNOLOGY

Patient Name: ***File #:*** ***Page:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature:***

S: *Numerical Pain Rating Scale (Patient)* *Intern Rating* ***A:***
Least ***0 1 2 3 4 5 6 7 8 9 10*** *Worst*

0: ***P:***

E:

Special attention to: ***Next appointment:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature:***

S: *Numerical Pain Rating Scale (Patient)* *Intern Rating* ***A:***
Least ***0 1 2 3 4 5 6 7 8 9 10*** *Worst*

O: ***P:***

E:

Special attention to: ***Next appointment:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature***

S: *Numerical Pain Rating Scale (Patient)* *Intern Rating* ***A:***
Least ***0 1 2 3 4 5 6 7 8 9 10*** *Worst*

O: ***P:***

E:

Special attention to: ***Next appointment:***

Patient Name: ***File #:*** ***Page:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature:***

S: ***Numerical Pain Rating Scale (Patient)*** ***Intern Rating*** ***A:***
Least 0 1 2 3 4 5 6 7 8 9 10 Worst

0: ***P:***

E:

Special attention to: ***Next appointment:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature:***

S: ***Numerical Pain Rating Scale (Patient)*** ***Intern Rating*** ***A:***
Least 0 1 2 3 4 5 6 7 8 9 10 Worst

O: ***P:***

E:

Special attention to: ***Next appointment:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature***

S: ***Numerical Pain Rating Scale (Patient)*** ***Intern Rating*** ***A:***

Least ***0 1 2 3 4 5 6 7 8 9 10*** ***Worst***

O: ***P:***

E:

Special attention to: ***Next appointment:***

APPENDIX G
CMCC NECK DISABILITY INDEX

Patient Name:_____File no.:_____Date:_____

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

Section 1 - Pain Intensity

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

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

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

Section 3 - Lifting

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

Section 4 - Reading

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

Section 5 - Headaches

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

Section 6 - Concentration

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

Section 7 - Work

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

Section 8 - Driving

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

Section 9 - Sleeping

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

Section 10 - Recreation

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

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

APPENDIX H

Numerical Rating Scale - 101 Questionnaire

Date:_____ File no:_____ Visit no:_____

Patient name: _____

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its worst**. A zero (0) would mean "no pain at all", and one hundred (100) would mean "pain as bad as it could be".

Please write only **one** number.

0 _____ 100

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its least**. A zero (0) would mean "no pain at all" and one hundred (100) would mean "pain as bad as it could be".

Please write only **one** number.

0 _____ 100

APPENDIX I

Are you between the ages

25-50

And work between 3-8 hours at a desk per day and suffer from

NECK PAIN?

RESEARCH IS CURRENTLY BEEN CONDUCTED AT

DURBAN INSTITUTE OF TECHNOLOGY CHIROPRACTIC DAY CLINIC

Treatment is **FREE** for those who qualify for the study

For more information

CONTACT

ROMONA

ON

0826633225

OR

2042205

APPENDIX J

Patient Name: _____

File Number: _____

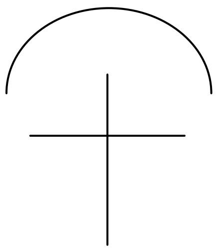
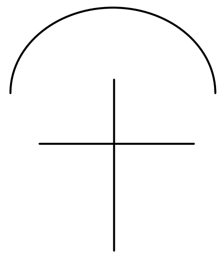
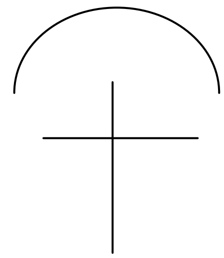
CROM GONIOMETER			
Date			
Treatment	1	2	Follow-up
	Baseline	Before	Before
Flexion			
Extension			
Right Rotation			
Left Rotation			
R. Lateral Flexion			
L. Lateral Flexion			

Algometer		
Treatment	**Date**	**Before**
1		
2		
Follow-up		

APPENDIX K

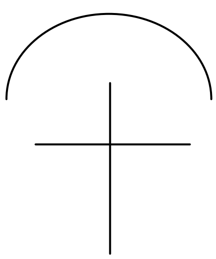
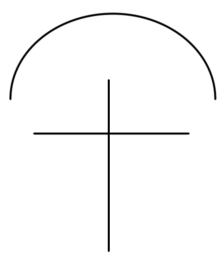
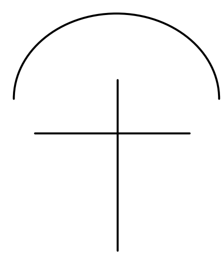
CROM	ALGO	NRS	CMCC

PATIENT									
INITIAL									
TREATMENT 2									
1 WEEK FOLLOW-UP									

CROM	ALGO	NRS	CMCC

PATIENT									
INITIAL									
TREATMENT 2									
1 WEEK FOLLOW-UP									

CROM	ALGO	NRS	CMCC

PATIENT									
INITIAL									
TREATMENT 2									
1 WEEK FOLLOW-UP