THE SHORT TO MEDIUM TERM EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION STRETCHING AS AN ADJUNCT TREATMENT TO CERVICAL MANIPULATION IN THE TREATMENT OF MECHANICAL NECK PAIN.

By

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A dissertation presented to the Faculty of Health at Durban Institute of Technology in partial compliance with the requirements for the Master's Degree in Technology in the department of Chiropractic.

I, Laura Maie Wilson, do declare that this dissertation is representative of my own work.

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Approved for final examination

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Dr. T. MacDougall, M.Tech.Chiro (S.A.) Date

DEDICATION

This dissertation is dedicated to my family. To my mother and father, Sandra and Michael Wilson for all your love, understanding and encouragement. To my sister, Michele Wilson for being my best friend.

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ABSTRACT

The purpose of this study was to determine the short to medium term effectiveness of Proprioceptive Neuromuscular Facilitaion (P.N.F.) stretching [using the Contract-Relax-Antagonist-Contract (C.R.A.C.) technique] as an adjunct treatment to cervical manipulation in the treatment of Mechanical Neck Pain.

This clinical randomized trial was conducted on a sample population of sixty patients diagnosed with chronic mechanical neck pain. They were randomly assigned to one of two groups (n = 30). Both groups received chiropractic cervical manipulation of the cervical spine, with group B also receiving the C.R.A.C. technique of P.N.F. stretching to the Posterior Cervical muscles. The patients were each treated four times in two weeks with a fifth consultation for data collection.

Both groups were evaluated in terms of subjective and objective clinical findings. The subjective assessment consisted of three questionnaires (CMCC Neck Disability Index, Numerical Pain Rating Scale – 101 and the McGill Short Form Pain Questionnaire). The objective assessment was made by using the Digital Algometer and CROM Goniometer. To determine the medium-term effectiveness of the treatment the subjective and objective measurements were taken prior to the first treatment and at the fifth consultation and to determine short-term objective effect of the treatment the objective measurements were taken again before and after the first treatment.

Statistical analysis of the data revealed that both groups responded equally well to their respective treatments (p = 0.05). Intra-group analysis revealed that group B

(chiropractic manipulation and P.N.F. stretching) showed a statistically greater effect on increasing pain threshold levels and resulted in a clinically greater improvement in active cervical range of motion than group A (chiropractic manipulation alone), although this was not statistically significant.

The results of this study suggest that the C.RA.C. technique of P.N.F. stretching for the Posterior Cervical muscles when combined with cervical manipulation in the treatment of mechanical neck pain, appears to contribute to treatment efficacy by increasing patient pain threshold levels and contributing to increased cervical range of motion, but when compared to cervical manipulation alone there was no statistically significant difference.

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1. INTRODUCTION

"The cervical spine has sacrificed stability for mobility, allowing it to become the most mobile segment of the spine, thereby making itself vulnerable to injury" (Magee 1997:2)

Neck pain affects 40-50% of the general population (Kelsey 1982:146) with an annual prevalence of 34,4% (Bovin et al. 1994). According to Talkala et al. (1982) in a middle aged population the prevalence of neck pain is 18% among females and 16% among males.

According to Gatterman (1990:205) zygapophyseal joints strain leads to joint locking and muscle strain which he cites as the most common neck injury resulting in mechanical neck pain. Cassidy, Lopes and Yong-Hing (1992a) agree that neck pain is common and state that most cases are attributed to mechanical dysfunction.

The Chiropractor offers spinal manipulation as a treatment for mechanical neck pain, which involves delivering a high velocity, low amplitude thrust to a fixated segment to restore normal articular motions and decrease pain (Gatterman 1990:49).

In a blinded clinical trail of 256 patients diagnosed with chronic non-specific back and neck complaints, Koes et al. (1992) found that spinal manipulation showed a greater and faster improvement in physical functioning (the ability to perform lumbar, thoracic and cervical movements) than treatment by placebo, general practitioner (non-steroidal anti-inflamatory's or analgesics) and physiotherapy (massage, exercise and modalities). Similar findings were found by Cassidy et al.(1992) who showed that cervical manipulation increases cervical range of motion and decreases pain.

Kendall et al. (1993:341) found a correlation between posterior cervical muscle dysfunction, anterior head carriage and round upper back postures. He believes these postures may result in compressive forces on the articulating facets and posterior vertebral bodies, which may lead to zygapophyseal joint dysfunction.

In Liebenson's (1996:271) opinion, when a joint or muscle is impaired it will cause compensatory changes in its functional partner. Few investigations have focused on the muscles of the cervical spine (Porterfield 1995:47), yet they play a vital role in counterbalancing the forces of gravity and minimizing abnormal stresses that are applied to the connective tissue of the spine (Porterfield 1995:12).

Proprioceptive neuromuscular facilitation (P.N.F.) was developed to incorporate normal patterns of movement through the entire range of motion of a joint to improve treatment efficacy and increase strength, coordination and flexibility (McAtee 1993:13).

In a literature review done by McAtee (1993) eight out of fourteen (57%) studies found P.N.F. to be significantly more effective in increasing the range of motion and flexibility than static, ballistic or passive stretching. In a randomized controlled study of 30 male subjects, Tanigawa (1972) compared the effect of P.N.F. and passive muscle mobilization on hamstring muscle tightness. He found that P.N.F. increased muscle range of motion to a greater degree and at a faster rate than passive mobilization, therefore indicating P.N.F. as a more effective technique for increasing muscle length.

The literature shows that neck pain is a common problem, therefore it is important to have an effective treatment protocol. Chiropractic cervical manipulation has been shown to be effective in the treatment of mechanical neck pain. The posterior cervical muscles are intimately associated with the joints in the cervical spine, and P.N.F. is indicated as the most effective stretching technique. Yet to date, no research has involved P.N.F. stretching of the posterior cervical muscles in conjunction with cervical manipulation in the treatment of mechanical neck pain.

2. REVIEW OF THE RELATED LITERATURE

2.1. INTRODUCTION

This chapter gives an overview of the literature related to mechanical neck pain. Cervical manipulation and Proprioceptive neuromuscular facilitation are also discussed as they are the interventions used in this study.

2.2. INCIDENCE AND PREVALANCE

Neck pain affects 40-50% of the general population (Kelsey 1982:146) with as many as 35% of people recalling an episode of neck pain at some point in their lives (Bland 1994:4).

In a Norwegian based randomized cross-sectional questionnaire study of 9918 Norwegian adults (18-67 years), Bovin et al.(1994) found the annual prevalence of neck pain to be 34,4%, with the frequency of complaints lasting longer than one month to be higher in women than men, and 13,8% reporting pain lasting longer than 6 months. Similar findings were found in a questionnaire study of 8000 Finnish adults (Makela et al.1991).

Grieve (1988:190) reports that there was an 18% incidence of neck pain among 2500 randomly selected men and women, with a sex difference of 20% in women and 16% in men.

According to Bland (1994:6) working individuals between the age of 25 and 29 years of age have a 25% to 30% incidence of one or more attacks of stiff neck. For those over 45 years of age, this figure rises to 50%. It is suggested that this is due to cervical spondylosis being almost universal at 50 years of age.

Drew (1995) conducted an epidemiological study at the Technikon Natal Chiropractic Clinic comparing the types of conditions seen at the teaching clinic with those seen in private chiropractic clinics in South Africa. It was found that 54,4% of the patients presenting to the teaching clinic and 57,4% of the patients presenting to private clinics complained of neck pain. The teaching clinic patients making up the 54,4% of neck pain were further divided into 16,7% presenting with neck pain only, 21,6% with neck pain and headaches and 16,1% with neck and arm pain. In a comparative study of 6 Chiropractic College teaching clinics, neck pain accounted for 19 – 27% of the patients complaints (Nyiedo et al. 1989:83).

Mennel (1990) found that in 100 consecutive patients complaining of neck pain, 93% had inter-laminar joint dysfunction with symptoms ranging from one day to 41 years. Of these patients 17% percent had suffered for less than six months and 68% were women, which shows that the majority of the neck pain patients have chronic symptoms and that it occurs more commonly in females than males.

Cote et al. (2000) conducted a questionnaire study on 1131 Saskatchewan adults (ages 20 to 69 years) and found that 66% of adults had experienced neck pain in their lifetime with 54% experiencing neck pain over the previous 6 months, of which 5% were significantly disabled by their neck.

The literature indicates that neck pain is a common musculoskeletal complaint, which appears to have a higher incidence in females than males and tends to increase with increasing age.

2.3 ANATOMY

2.3.1 THE CERVICAL SPINE

The cervical spine consists of seven vertebrae (C1-C7) which form two functionally distinct but interacting components: the upper (occiput, atlas and axis) and the lower (C3-C7) cervical spine (Haldeman 1992:137).

The cervical vertebrae are distinctive for their oval transverse foramen through which the vertebral arteries pass. In the C7 vertebrae they are small and transmit only small accessory vertebral veins (Moore 1992:331). The cervical apophyseal joints of the mid to lower cervical spine incline medially in a coronal plane and obliquely in the sagital plane so the they are approximately at a 45 degree angle to the vertical (Shafer and Faye 1990:80). The cervical joint capsules are richly innervated by the recurrent meningeal or sinuvertebral nerve, and nociceptive fibers are also particularly prevalent (Haldeman 1992:138). This means that injury to the joint capsule would result in pain.

The intervertebral discs (IVD) make up one fourth of the length of the cervical spine. They are stellar in shape and thicker anteriorly than posteriorly, thereby contributing to the cervical lordosis (Moore 1992:331).

The intervertebral foramen (IVF) are approximately one centimeter in length and increase in size caudally. There is no true IVF between the atlas and the axis. The spinal nerve root and its sheath occupy one third to a half of the IVF, the rest is filled with fat, connective tissue and vessels. There are eight cervical nerve roots. The C1 nerve root exits between the occiput and C1, therefore in the cervical spine each nerve root is named after the vertebrae below (Moore 1992:331).

The cervical vertebrae have another distinguishing feature – the uncovertebral joints (joints of Lushka). These joints are present from C3-C7 and give a saddle shape to the upper aspect of the cervical vertebrae which is more pronounced posterolaterally. They have articular cartilage, a synovial membrane, a joint space, a capsule and subchondral bone. They form a barrier to posterolateral disc protrusions thereby protecting the spinal cord. Their hypertrophy adds to encroachment of the IVF which could lead to nerve root entrapment (Porterfield and De Rosa 1995:86).

2.3.2. THE POSTERIOR CERVICAL MUSCLES

The posterior cervical muscles consist of 3 muscles:

1) Semispinalis capitis
2) Semispinalis cervicis
3) Longissimus capitis

2.3.2.1. Anatomy

1) Semispinalis capitis and cervicis (Travell and Simons 1983:305)

Semispinalis capitis overlies semispinalis cervicis. They both attach to the transverse processes of T1-6 and sometimes T7, semispinalis capitis also attaches to the transverse processes of C3-6.

Semispinalis capitis inserts into the occiput between the inferior and superior nuchal lines and semispinalis cervicis inserts into the spinous processes of C2-5 (these muscles expand 4-5 vertebrae).

These muscles are innervated by the dorsal rami of the cervical nerves.

Bilaterally these muscles extend the head, cervical and thoracic spine, unilaterally they cause rotation to the opposite side.

These muscles make up the largest muscle mass in the neck (Moore 1992:355).

2) Longissimus capitis and cervicus (Moore 1992:353)

Both attach to the superior part of the thoracic transverse processes with Longissimus capitis also attaching to the cervical transverse processes. Longissimus capitis insert into the mastoid process of the temporal bone and Longissimus cervicus inserts into the cervical transverse processes.

2.4. MECHANICAL NECK PAIN

2.4.1. AETIOLOGY

Mennell (1990) is of the opinion that mechanical joint pain arises from the synovial joints of the spine, which become hypomobile due to trauma, immobilization and as a symptom of a previous pathological condition. This prevents normal movement from taking place and therefore results in pain.

According to Bergmann et al. (1993:55) any condition or event (e.g. incorrect posture, acute injury, aging, congenital or developmental defects) leading to altered joint or muscle structure and function, can result in mechanical neck pain.

Haldeman (1981) feels that spinal pain is multifactorial and that most theories implicate the intervertebral disc (IVD) as the site of pain. However, most structures in the spine have a sensory innervation and can therefore be implicated as a source of spinal pain. Examples are the annulus fibrosis, major ligaments, facet joints and capsules, vertebral body, posterior osseous structures and paraspinal muscles, skin and subcutaneous tissue, duramata and walls of the epidural sheath and arteries.

Schafer and Faye (1990) and Gillet and Lickens (1969) hypothesis that mechanical joint dysfunction follows three phases of development: muscular, ligamentous and the articular phase. This means that segmental muscle spasm and contraction results in muscular fixations which with time causes the ligaments to adapt to a limited range of motion resulting in contracture formation, shortening of the joint capsule and surrounding ligament fixations. Fibrous adhesions develop between the joint surfaces and the intra-articular soft tissue starts to degenerate resulting in articular fixations with the end result being bony ankylosis and irreversible fixations.

Gainsbury (1985) postulates that there are three major causes of mechanical spinal dysfunction:

1. Extra-segmental – fibrous adhesions in muscle and fascia and the shortening of ligaments
2. Non-apophyseal intra-segmental – discs, muscle spasm, congenital and acquired anomalies
3. Apophyseal – synovitis, degeneration, capsule fibrosis, adhesions and acute joint locking

Trauma through either direct (blows or falls) or indirect (micro-trauma) contact is sited by Gillet and Liekens (1969) to be the cause of joint fixations. Halderman (1992) theorized that pain may be produced by the synovial folds being pinched within the joint cavity. This can occur through two mechanisms, firstly by pulling on pain sensitive synovial tissue and capsule due to entrapment. Secondly by synovitis caused by the trauma of being entrapped with associated tissue damage and cell rupture, which results in the release of histamine, bradykinin, substance P and potassium ions. These substances all cause nociceptive nerve impulses and ischaemia, which the patient perceives as pain.

Grieve (1988:177) comments that in the absence of major injury, the greatest incidence of neck pain is due to degeneration and poor posture, which causes muscle imbalances and asymmetrical soft tissue contractures which results in joint fixations.

Porterfield and DeRosa (1995:4) deduce that it is unreasonable to assume that one isolated tissue is responsible as the mechanism of injury and the process of degeneration affects multiple tissues rather than one structure or tissue in isolation. They site most common causes of neck pain to be from locking or spasmodic torticollis, muscle or connective tissue strain, from postural overload or repetitive motion and injury from uncontrolled acceleration of the head and neck and cervical spondylosis (Porterfield and DeRosa, 1995:14).

2.4.2. DIAGNOSIS

According to Grieve (1988:378) chronic mechanical neck pain presents as follows:

1. Local chronic cervical pain with/without arm pain
2. Juxtaposition of hypermobile and hypomobile segments of the cervical spine due to spondylitic changes
3. Asymmetrical neck pain that worsens as the day progresses and is aggravated by driving, reading etc.
4. Unilateral occipital pain and neck pain
5. Restricted and painful cervical rotation and lateral flexion to the painful side
6. Prominent upper and middle trapezius and levator scapulae muscles.

Cassidy et al. (1992a) conducted a randomized controlled trial of 100 consecutive patients with mechanical neck pain. All the patients had unilateral neck pain (radiating into the trapezius muscle) aggravated by movement and associated with local paraspinal tenderness, decreased range of motion according to goniometer readings and local paraspinal tenderness.

Schafer and Faye (1990:349) described the signs and symptoms of cervical motion unit dysfunction as articular grating, stiffness, tenderness, hypertonic or flaccid muscles, occipital headache, trigger point development, pain especially on movement, visual postural imbalances and functional motion segment alterations.

Haldeman (1992:459) describes motion-unit dysfunction by the following criteria:

1) vertebral mal-position
2) abnormal vertebral motion
3) abnormal end-feel or joint play
4) soft tissue abnormalities
5) muscle contraction or imbalances

Bergmann has modified the acronym, PARTS from Bourdillon and Day (1992:63) to describe joint dysfunction:

P – pain and tenderness, produced by palpation of bony and soft tissue structures

A – localized or multiple levels, seen through observation, static palpation of roentographs

R– range of motion, active, passive and accessory felt through motion palpation or roentographs

T– tone, texture and temperature abnormalities, changes to soft tissue either observed palpated or through instrumentation

S – special tests, e.g. Leg length

Edwards et al. (1995:871) found that mechanical neck pain frequently refers pain to the occiput, shoulders or nuchal muscles and is associated with restricted neck movements and a history of awkward posture or trauma. They also noted that pathology at the atlas, axis and C3 often refers pain to the occipital, retro-orbital and temporal areas while the lower cervical spine tends to refer pain to the interscapular and anterior chest wall area.

2.4.3. DIFFERENTIAL DIAGNOSIS

Gattermann (1990:232) summaries the differential diagnosis to include the following:

1. muscle syndromes – fibromyalgia
2. biomechanical disorders – joint fixation and facet joint sprain, cervical disc herniation, degenerative disc disease, cervical spondylosis, thoracic outlet obstruction and fractures.
3. inflammatory disease – infection, ankylosing spondylitis, rheumatoid arthritis and spondyloarthropathies
4. congenital abnormalities – cervical rib and congenital stenosis
5. systemic disease – anemia, leukemia, paget's disease and osteoporosis
6. tumours – primary and secondary

Edwards et al. (1995:871) also consider referred pain from other structures such as angina pectoris, aortic aneurysm, pancoast tumor, diaphragm, pharynx, cervical lymph nodes, teeth and the shoulder and acromio-clavicular joint.

However, inflammatory, neoplastic and metabolic diseases according to Edwards et al. (1995:871) are more insidious in onset and have a prolonged duration and are usually not so obviously influenced by posture and movement.

2.4.4. PROGNOSIS

The Mercy Guidelines (Haldeman et al. 1993) suggest a treatment period of approximately 6 weeks of chiropractic care, for uncomplicated cases of chronic mechanical neck pain. They suggest a high treatment frequency in the first 1-2 weeks, with 3-5 treatments per week. If the patient is responding, the treatment frequency is decrease for the next 3-6 weeks. If the patient is not responding at this point, one should change the treatment. If still unsuccessful special studies should be carried out, such as radiographic examination or referral (Haldemann et al. 1993).

Gore et al. (1987) conducted a long-term follow up assessment of 205 patients complaining of neck pain, to try and establish significant factors in the prognosis of neck pain. None of the participants had a history of neck surgery, malignancy, rheumatoid artheritis or objective neurological deficits. Each patient had been seen at least 10 years previously for neck pain, where they were evaluated clinically and a lateral x-ray was taken. At the follow-up consultation another lateral x-ray was taken and the participant filled out a questionnaire. The results showed that 79% had decreased pain, 43% were pain free and 32% had moderate to residual pain. The only clinical feature found to be predictive of long-term neck pain was a history of trauma and initially a severe pain rating.

Other treatments to include are simple analgesics, soft collar, reassurance, bed rest and traction, postural advice, muscle strengthening exercises and stretching. Surgery is only required in those patients with neurological signs and symptoms of radiculopathy or progressive cervical myelopathy (Edwards et al. 1995:871).

2.5. CHIROPRACTIC MANIPULATION

2.5.1. INTRODUCTION

Chiropractors subscribe to a holistic heath care model, where health is viewed as a complex process whereby the different parts of the body adapt and change to the internal and external environments (Bergmann, 1993:3).
The chiropractic profession has been around for a century but there are records of manipulation been used as far as 4000 years ago. From there writings Hippocrates, Galen, Celsius, Orbasius all noted the use of manual procedures (Bergmann, 1993:1).

2.5.2. DEFINING MANIPULATION

According to Haldeman (1992:624), " spinal manipulative therapy broadly defined includes all procedures where the hands are used to mobilize, adjust, manipulate, apply traction, massage, stimulate, or otherwise influence the spine and paraspinal tissues with the aim of influencing the patients health".

In this study the spinal manipulative technique used is the adjustment that is defined by Haldeman (1992:621) as: " a specific form of articular manipulation using either long or short leverage techniques with specific contacts and is characterized by a dynamic thrust of controlled velocity, amplitude, and direction."

Sandoz (1969) describes an adjustment as a passive, carefully regulated thrust or force delivered to a joint with controlled speed, depth and magnitude at or near the end of the physiologic range of motion for that joint, but not exceeding the anatomical limit.

It is often accompanied by a joint “cracking” sound, know as the vacuum phenomenon and the resultant physiological response.

The characteristics of adjustive techniques is described by Haldeman (1992:448) as:

1) a controlled force delivered with high velocity
2) specific direction or line of drive
3) Regulated depth and magnitude that is delivered through a specific contact using muscle power body weight or mechanical apparatus.

2.5.3 EFFECTS OF MANIPULATION

Curl (1994:297) explains the therapeutic effects of manipulation through two mechanisms. Firstly, mechanical, which includes mechanoreceptor stimulation, muscle spindle stretching and breaking down of articular adhesions resulting in an increase in active and passive joint motion. Secondly, manipulation results in reflex inhibition of pain and muscle spasm and stimulation of the autonomic nervous system.

Manipulation is said to restore flexibility of the joint capsule and surrounding ligaments and muscles by preventing contracture formation and may result in the rupturing of cross-links between healing tissue (Basmajian, 1985:37). Basmajian (1985) hypothesizes that the interest and concern as well as the “hands on” approach of a qualified person assessing the condition may ease some of the stress-related aspects for the patient.

Bergman (1993:139) describes several hypotheses to explain the effectiveness of chiropractic manipulation:

1) Mechanical

The “cavitation” is the rapid separation of two joint surfaces and results in stretching of the periarticular tissues (releasing intra-articular and extra-articular adhesions) and stimulates joint nociceptors and mechanoreceptors (which stimulate the goldi tendon organs or results in somatic afferent receptor activity). This results in a break down of the pain cycle, leading to a decrease in pain, muscle spasm, joint hypomobility and soft tissue in-flexibility and muscle fatigue.

Manipulation stimulates the repair of the articular soft tissue and cartilage and prevents excessive fibrosis formation, atrophy and degeneration, thereby maintaining tissue extensibility.

2) Analgesic

Both superficial and deep somatic mechanoreceptos, proprioceptors and nociceptors are stimulated by manipulation, which sends strong afferent segmental impulses to the spinal cord resulting in central pain transmission inhibition.

It has been theorized that manipulation can cause the release of enkephalins and endorphins (endogenous opioids) which decreased pain sensation, and the placebo effect of having a consultation with a concerned and skilled practitioner is said to add to the analgesic effect.

3) Neurobiologic

By restoring normal joint mechanics and altering neurological reflexes associated with joint dysfunction, local and distant somatic tissues are restored to normal functioning.

4) Circulatory

The flow of blood and lymphatic fluid is aided by the musculoskeletal system. Therefore any disruption of normal musculoskeletal functioning will decrease the efficacy of the circulatory system.

It is hypothesised that the subluxation complex can alter segmental sympathetic tone. This could result in vasoconstriction to the tissues at that segment. Manipulation would then remove the sympathetic irritation and improve circulation (Bergman 1993:156)

In a pilot study conducted by Vernon et al. (1990) five patients received manipulation and 4 received oscillatory mobilization of the cervical spine for chronic neck pain. The manipulated group showed a mean increase in pressure pain thresholds ranging from 40-56% (average 45%) while the other group showed no change. They relate the results to afferent bombardment from the articular and myofascial receptors that produce pre-synaptic inhibition of the segmental pathways and possibly activate the endogenous opiate system.

Cassidy et al. (1992b) showed that cervical manipulation resulted in an immediate increase in range of motion in all directions and decreased pain, in a pilot study they conducted with 50 patients suffering from unilateral neck pain with no neurological deficit.

2.5.4. EFFICACEY OF MANIPULATION

Giles and Muller (1999) conducted a prospective, independently assessed pre-intervention and post-intervention pilot study of the treatment of chronic spinal pain syndromes. Seventy-seven patients, aged 25-75 years, were randomly assigned to one of 3 groups [spinal manipulation (36), needle acupuncture (20) and a non-steroid anti-inflammatory (21)]. After a treatment period of 4 weeks the group receiving spinal manipulation was the only group that showed a statistically significant improvement ($p = < 0.001$). No numerical distribution of patients receiving neck or lower back treatment was given but the results showed that those receiving neck manipulations had a 25 % improvement on the neck disability index and those receiving lower back manipulations showed a 30,7% decrease on the Oswestry scale. Pain reduction according to the visual analogue scale was 33% for the neck, 46% for the mid-back and 50% for the lower back. The other interventions showed no significant improvement on any of the outcome measurements.

Similar findings were found by Koes et al. (1992) who conducted a blinded clinical trial of 256 patients (mean age 43) with non-specific back and neck pain. The patients were randomly assigned to one of four groups [placebo, spinal manipulation, general practitioner (non-steroidal anti-inflamatory's or analgesics) or physiotherapy (massage, exercise and modalities)]. The manipulated group was the only group that showed a statistical significant improvement at 3 weeks, at 6 weeks it was the only superior to the treatment by a general practitioner and placebo and at 12 weeks there appeared to be no statistical difference between the 3 groups. The authors therefore concluded that spinal manipulation showed a faster and larger improvement in physical functioning.

Sloop et al. (1982) conducted a study on 39 patients with cervical spondylosis or non-specific neck pain, with at least one month of symptoms. The 39 patients were divided into 2 groups, 21 patients received diazepam (NSAIDs) and one cervical rotational manipulation (group A) and the other group of 18 patients received diazepam

(NSAIDs) only (group B). After 3 weeks 57% of group A and 28% of group B felt the treatment was working and at 12 weeks 78% of group A and 33% of group B felt the treatment was working. Although no statistical difference was noted between the 2 groups, those receiving the manipulation showed a greater percentage of patients being satisfied with the treatment.

In a randomized controlled trial of 100 patients with unilateral neck pain referring into the trapezius muscle, Cassidy et al. (1992a) divided the patients into two treatment categories. Group one received one rotational manipulation to the cervical spine and group two received one session of cervical spine mobilization. Immediately after the treatment, group one showed an 80% improvement and group two a 69% improvement. Both groups showed a decreased in pain intensity, group one by 17,3 and group two by 10,5 points. Range of motion increased in group one but not by a statistical difference. The authors conclude that a single manipulation is more effective than cervical spine mobilization in decreasing pain in patients suffering from mechanical neck pain.

2.5.5. COMPLICATIONS AND CONTRA – INDICATIONS OF MANIPULATION

The Swiss Medical Society for manual medicine conducted a retrospective survey to determine the rate of morbidity and mortality of manipulation. The study involved 203 physicians who used manipulation as a treatment. A total of 2 268 000 manipulations were performed, with 1408 complications arising, 1255 were from cervical spine manipulation and 153 from lumbar spine manipulation (Haldeman, 1992:552).

Complications included:

1) Cervical spine

- 1218 patients experienced vertigo/ asystematic dizziness
- 10 patients had diminished consciousness
- 12 patients experienced a loss of consciousness lasting several seconds to five minutes
- 4 patients developed additional neurological symptoms after a brief loss of consciousness
- 11 patients had neurological disturbances resembling radicular syndromes (parasthesia and reflex changes)

2) Lumbar spine

– 140 patients experienced increased pain
– 9 patients demonstrated radicular deficits (absent reflexes and sensory changes)
– 3 patients underwent surgery due to acute radicular symptoms
– 1 patient developed a cauda equina syndrome and underwent surgery

From this study the minimum rate of complications due to cervical manipulation was determined to be 1 per 41500 manipulations. Neurological complications with radicular deficit occurred in 1 per 174 000, with severe neurological complications arising in 1 per 41 500 manipulations administered (Haldeman, 1992:552).

Gatterman (1990:67) lists the following as contra-indications to manipulation:

1) vascular
    - vertebral-basilar insufficiency
    - artherosclerosis
    - aneurysm

2) tumour
    - lung, thyroid, prostate and breast known to metastasis to the spine
    - bone primary
3) trauma
    - fracture
    - joint instability or hypomobility
    - severe sprains
    - unstable spondylolisthesis
4) arthritis
    - rheumatoid arthritis (transverse ligament rupture and increased inflammation)
    - ankylosing spondylitis (increased inflammation)
    - psoratic arthritis (transverse ligament rupture)
    - severe osteoarthritis (increased instability and neurological compromise)
    - uncoarthrosis (vertebral artery compromise)
5) psychological
    - malingering
    - hysteria
    - hypochondriasis
    - pain tolerance
6) metabolic
    - clotting disorders (spinal heamatoma)
    - osteopenia (osteoporosis or osteomalacia)

7) Neurological

- disc lesions
- space occuping lesions

In a literature review of the appropriateness of manipulation and mobilization of the cervical spine, Coulter et al. (1996) estimates the risk of complications to be 1 in 40 000 for mild complications (dizziness, vertigo etc.) and 1 in 400 000 for serious complications (vertebrobasilar accident, spinal cord compression etc.).They concluded the rate of complications due to cervical spine manipulation to be 1 in a million manipulations.

2.6. PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION

2.6.1. INTRODUCTION

Proprioceptive neuromuscular facilitation (P.N.F.) was developed in the late 1940's by a neurophysiologist named Dr. Herman Kabat, MD, PhD and his two assistants namely Margret Knott and Dorothy Voss. They realized that movement occurs in spiral-diagonal patterns (not isolated movements but a combination e.g. combing ones hair involves abduction, external rotation and extension of the shoulder joint), and used these patterns to stimulate the nervous system more normally than by isolating each muscle (McAtee, 1993:2).

2.6.2 DEFINITION OF P.N.F

P.N.F. is a technique that develops or re-establishes proper functioning of joints and related structures (Surburg, 1981) by using neurolgical reflexes to assist the stretching technique (Redwood, 1997:271).

Accorging to Tanigawa (1972) P.N.F. is defined as "a method of promoting the response of the neuromuscular mechanism through stimulation of the proprioceptors".

2.6.3. EFFECTIVENESS OF P.N.F.

According to Arnheim and Prentice (1993:360) there are four major neurophysiological principles to explain P.N.F. effectiveness:

1) muscle and joint activity – through muscle spindle and goldi tendon activity
2) Irradiation – occurs when a maximal contraction of a muscle is achieved by
3) applying resistance, resulting in excitation of the primary muscle which then overflows to its synergistic muscles which become involved to overcome the resistance.
4) Sherrington's law of successive induction – flexion enhances extension and extension enhances flexion
5) Sherrington's law of reciprocal inhibition – reflex or voluntary contraction of a muscle with simultaneous relaxation in its antagonist muscle.

Basmajian and Wolf (1990:305) explain the effectiveness of P.N.F. by the use of facilitatory stimuli, which decrease the motor neuron threshold or enhance the recruitment of additional motor neurons. When a isometric contraction is followed by active relaxation of that muscle, it results in inhibition of the alpha motor neuron supplying that muscle, resulting in further elongation and relaxation.

2.6.4. EFFICACY OF P.N.F.

In a literature review done by McAtee (1993:11) eight out of fourteen studies (57%) found P.N.F. to be significantly more effective for increasing range of motion and flexibility than static, ballistic or passive stretching.

Etnyre and Abraham (1986) conducted a study to see the effect of three different stretching techniques on ankle dorsiflexion. Twelve subjects were selected and performed 3 different methods of stretching on different days. The stretching technique used were, static stretching and two P.N.F. techniques, contract-relax (C.R) and contract-relax-antagonist-contract (C.R.A.C.). The results revealed a significant difference between all three methods. The C.R.A.C. technique was superior to the C.R. technique, and the C.R. technique was superior to the static stretch. The pre- and post –treatment results revealed gains in range of motion for C.R. and the C.R.A.C. technique. Similar findings were found by Moore and Hutton (1980), in a study on 21 female gymnasts. They compared 3 methods of stretching the hamstring [static(s), contract-relax(C.R.) and contract-relax-agonist-contract(C.R.A.C.)]. Twelve subjects (57%) showed significantly greater EMG activity with the C.R.A.C. technique than with the other techniques. They also found that the C.R.A.C. technique resulted in the largest gains of hip flexion.

Sady et al. (1982) randomly assigned 44 college men to 1 of 4 stretching groups [control (10), ballistic (11), static (10) and P.N.F. (12)] to compare the flexibility of the shoulder, trunk and hamstring muscles. Baseline measurements were obtained on 2 separate days prior to and following a 3 day per week hamstring flexibility program for 6 weeks. Only those receiving P.N.F stretching showed increased flexibility when compared to the control group.

McCarthy et al. (1997) conducted a single blinded study to determine the effect of performing the C.R.A.C. technique of P.N.F. stretching on cervical range of motion. Forty asymptomatic males joined the study and were divided into two groups with 19 in the control group and 21 in the experimental group. The C.R.A.C. technique was applied to the cervical spine in lateral flexion with contralateral rotation and in flexion. The exercises were done twice daily for seven days. The authors conclude that the exercise group had significantly increased active cervical range of motion when compared to the control group. This study promotes the use of P.N.F. stretching in the spine.

The literature therefore indicates P.N.F. stretching (especially the C.R.A.C. technique) to be the most effective stretching technique to increase flexibility and range of motion.

2.6.5. INDICATIONS FOR P.N.F.

According to Liebenson (1996:255) the main effect of P.N.F. is to treat the muscles, primarily to relax overactive muscles or stretch shortened muscle and fascia. Following chiropractic adjustments P.N.F. can be used to reinforce neuromusclar re-education.

Thomson et al. (1991:441) used P.N.F. to initiate muscle contraction, to strengthen muscles, increase range of motion and improve co-ordination.

According to Hammer (1991:279) P.N.F. is used to:

1) restore a functional range of motion and to initiate movement into and through a range of motion – mobility
2) to develop the ability to improve and maintain posture against gravity – stability
3) to develop and improve unilateral weight-bearing – balance and co-ordination
4) to develop the ability to manipulate the environment – skill

2.6.6. CONTRA - INDICATIONS OF P.N.F.

According to Voss et al. (1985:23) the contra-indications to P.N.F. stretching are:

1) trauma
2) infection
3) vascular compromise
4) anti-coagulant therapy
5) severe diabetes mellitis
6) sensory deficit

Moerau and Nook (1992) indicate that P.N.F. should not be performed if there is a lack of stability in any of the articulations involved in the stretch or if there is any evidence of acute soft tissue or muscle injury near the area being treated.

2.7. CONCLUSION

Manipulation has been proven to be effective for the treatment of mechanical neck pain by various authors (Cassidy et al. 1992; Sloop et al. 1982 and Brunarski 1984).

Osternig et al. (1987) states that Proprioceptive Neuromuscular Facilitation (P.N.F.) stretching has been shown to be effective in inducing muscle relaxation and increasing joint range of motion. Various authors (Sady 1982 and Tanigawa 1972) indicate that P.N.F. is significantly more effective than static stretching and McCarthy et al. (1997) have shown that P.N.F. of the cervical spine increases cervical range of motion.

In Porterfield's (1995) opinion most studies address the joint and not the muscle component of conditions affecting the spine. Liebenson (1996:271) is of the opinion that shortened posterior cervical muscles contribute to cervical headaches (due to the presence of trigger points in the shortened muscle) and cervical zygopophyseal joint dysfunction (due to the decrease in cervical range of motion). Travell and Simons (1983) suggest that trigger points in the posterior cervical muscles are often a cause of pain and tenderness over the back of the head and neck and indicate spray and stretch as a treatment. McCarthy et al. (1997) suggest that stretching exercises may be useful to maintain the effects of manipulation and massage in maintaining mobility.

To date there has been no research that incorporates chiropractic manipulation and P.N.F. stretching of the posterior cervical muscles into the treatment protocol for chronic mechanical neck pain.

Therefore, the aim of the study is to further the knowledge and insight into the treatment protocol for chronic mechanical neck pain, by incorporating a P.N.F. stretching technique to the posterior cervical muscles to improve treatment efficacy.

3. MATERIALS AND METHODS

3.1. INTRODUCTION

This chapter describes the design of the study, from how the data was collected, to what measurements were used and to how the data was statistically analysed.

3.2. THE DATA

The data consists of primary and secondary data.

3.2.1. PRIMARY DATA

On the initial examination a case history (Appendix C), relevant physical examination (Appendix D) and cervical regional examination (Appendix E) were completed by the researcher, followed by the subjective and objective data.

The subjective data included:

- The patient's perception of their disability, this is obtained from the CMCC Neck Disability Index (Appendix G).
- The patient's perception of the intensity of the pain, obtained from the Numerical Rating Scale-101 (Appendix H).
- The patient's perception of the quality of the pain, recorded by the McGill Short Form Pain Questionnaire (Appendix I).

The objective measurements included:

- The patient's pressure threshold in terms of pain (Digital algometer) (Appendix F).
- Assessing changes in the patient's active cervical range of motion (CROM goniometer) (Appendix F).

3.2.2. SECONDARY DATA

This consists of a review of the literature related to mechanical neck pain and the interventions used in this study (Chiropractic cervical manipulation and P.N.F. stretching) to demonstrate a lack of information, thereby giving support to the study. It also involves assessing the reliability and validity of the objective and subjective measurements used in the study.

3.3. THE SUBJECTS

The study attracted patients from the greater Durban area by placing advertisements on notice boards at the Technikon Natal Campus and Chiropractic clinic, at shopping centers and in local newspapers. Pamphlets were also distributed to local areas. The study was limited to those patients diagnosed with chronic mechanical neck pain, for the purpose of this study chronic was defined as a period of six weeks or more. On replying to the advertisements the prospective patients, were telephonically interviewed to see if they were eligible for the study. The interview consisted of several questions:

1) How old are you?
2) How long have you had this condition (acute/chronic)?
3) Questions to see if any of the contra-indications were present.

Patients were accepted into the study irrespective of race or gender, but had to be between the ages of 25 and 55 years of age. If the patient was currently taking any medication (e.g. anti-inflammatory) or receiving any treatment that would interfere with the results of the study they were asked to discontinue the treatment 24 hours prior to starting the research programme.

3.4. THE METHOD

On the initial consultation each patient underwent a full case history (Appendix C), relevant physical (Appendix D) and full cervical regional examination (Appendix E). The diagnosis of chronic mechanical neck pain was made according to the following criteria:

1. Local chronic cervical pain with or without arm pain.
2. Hypermobility and hypomobility of the cervical spine as a result of spondylitic changes.
3. Asymmetrical neck pain that worsens during the day and is aggravated by driving, reading etc.
4. Unilateral occipital pain and neck pain.
5. Painful and restricted cervical rotation and lateral flexion to the painful side.
6. Prominent upper and middle trapezius and levator scapulae muscles. For the purpose of this study "prominent" meant spasmodic.

The patient had to have three of the above six criteria to qualify for this study (Grieve 1988:378).

Each patient received a patient information sheet (Appendix B) on the initial consultation describing the nature and purpose of the clinical trial in layman's terms. The patient was asked to complete a informed consent form (Appendix A) prior to the start of treatment to ensure the patient understood his/her involvement in the study.

Both groups received 4 treatments within 2 weeks with a fifth consultation for data collection (Haldeman et al. 1993). It was stated that if the patient should become pain-free before the end of the treatment period he/she would continue with the following visits until the end of the treatment period, but no treatment would be administered, allowing for further evaluation. If the patient wished to leave the study at any time they were free to do so.

The subjective measurements (CMCC Neck Disability Index, NRS-1O1 and McGill Short Form Questionnaire) were completed prior to the first treatment and at the fifth consultation to assess for subjective treatment efficacy.

The objective measurements (Digital Algometer and CROM Goniometer) were taken on the initial consultation prior to and after the first treatment to assess for objective short term effects of the two treatment protocols and again prior to the second treatment and on the fifth consultation to assess for medium term effectiveness of the two treatment protocols.

Both groups received an established form of treatment in the terms of chiropractic manipulation, were the joint to be manipulated was determined by motion palpation, which was performed according to the technique described in Faye and Wiles (1992: 314-318). Group 2 also received the Contract- Relax-Antagonist-Contract stretching technique of Proprioceptive Neuromuscular Facilitation of the posterior cervical muscles.

All patient information was confidential and no patient was coerced into participating in the study.

3.5. INCLUSION AND EXCLUSION CRITERIA

3.5.1. Inclusion criteria:

1) Only patients between the ages of 25 and 55 years of age were accepted. This age group was selected to exclude those patients with significant degenerative changes, which occur mostly after the age of 60 (Edwards, 1995) and included those patients who are in the dysfunctional phase of degeneration (Kirkaldy-Willis 1992:105).
2) Only patients diagnosed with chronic mechanical neck pain (six weeks or longer) were accepted (Grieve 1988:378).
3) Any condition associated with the mechanical neck pain (eg. Myofasciitis) was assessed and noted in the cervical spine regional examination but no treatment was administered for these conditions.

3.5.2. Exclusion criteria:

1) Patients younger than 25 or older than 55 years of age.
3) Contra -indications to manipulation (Gatterman 1990: 67)
   - Vertebral malignancy
   - Vertebral-basilar insufficiency(positive Wallenberg test)
   - Bone infections
   - Fractures
   - Joint hypermobility
   - Clotting disorders
   - Osteopenia
   - Spondyloarthropathies

2) Contra-indications to P.N.F. stretching (Voss et al. 1985:23)

- Trauma – to avoid further damage to the tissues
- Infection – to prevent spread of the infection
- Vascular compromise – to avoid further damage to the blood supply or aggravate ischaemia
- Anticoagulant therapy – to prevent haemorrhage
- Sensory deficit – to prevent damage to tissues that have no pain or proprioception

4) Hard neurological signs

5) Patients requiring radiographic evaluation were excluded

6) If the patient was currently taking any medication (eg. Anti-inflammatroy) or receiving any treatment (e.g. Physiotherapy) that would interfere with the results of the study they were asked to discontinue the treatment prior to starting the research programme, if they could or would not then they were excluded from the study.

3.6. THE SAMPLE GROUP

The study sample size was limited to 60 patients, who were selected according to the above criteria. The participants were randomly assigned into one of two groups. This involved 60 pieces of paper, 30 with group A (cervical manipulation) written on it and 30 with group B (cervical manipulation and P.N.F. of the posterior cervical muscles) written on it. Each new patient randomly selected one piece of paper on the initial consultation to determine which of the two groups they would fall into.

3.7. MEASUREMENTS

3.7.1. SUBJECTIVE MEASUREMENTS

3.7.1.1.CCMC NECK DISABILITY INDEX (APPENDIX G)

The CMCC neck disability index (CMCC) was used to assess for disability in terms of daily living, resulting from the neck pain. It has been shown to have a high degree of validity and internal consistency (Vernon and Moir, 1991). It consists of 10 sections each consisting of 6 options. The first option receives a zero score and the sixth option receives a score of five. Once completed, the scores for each section were added together and multiplied by two to attain a percentage. This percentage represents the disability the patient experienced at the different measuring times (treatment one and five). These values were then recorded onto spreadsheets.

3.7.1.2. NUMERICAL RATING SCALE (NRS-101) (APPENDIX H)

The NRS-101 was used to gauge the patient's perception of pain intensity when it is at its worst and when it is at its least. Jensen et al. (1986) demonstrated the validity and practicality of the NRS-101. There are two sections, in both the patient rates his/her pain on a scale of zero (no pain) to 100 (worst pain). In the first section he/she chooses a number when the pain is at its worse and in the second when the pain is at its least.

The two answers are then added together and divided by two to get a percentage. The results were then recorded onto spreadsheets.

3.7.1.3. McGILL SHORT FORM PAIN QUESTIONNAIRE (APPENDIX I)

The McGill Short Form Questionnaire was used to assess the quality of pain experienced by the patient. Melzack and Katz (1992) demonstrated the validity and practicality of this questionnaire. The quality of pain is graded: zero for no pain, one for mild pain, two for moderate pain and three for severe pain. There are fifteen different descriptions for pain which are graded by the patient. The final results are tallied to get a figure out of 45, which is then converted to a percentage. The results were then recorded onto spreadsheets.

3.7.2. OBJECTIVE MEASUREMENTS

3.7.2.1. CROM GONIOMETER (APPENDIX F)

The CROM goniometer was used to assess for changes in active cervical range of motion. The cervical range of motion (CROM) instrument used in this study was the Performance Attained Associates Mode (3600 Labore Rd, Suite 6, St Paul, MN 55110-4144). This device has been shown to produce good intra and inter tester reliability in measuring cervical spine range of motion (Youdas et al., 1991).

To measure cervical spine range of motion the patient was made to sit in a straight back chair with their lower back pressed against the back of the chair. The chair was placed so that the magnatic yolk faced North. The CROM was then fastened in position. Measurements in degrees were then taken for each range of motion. Care was taken to ensure that the patient’s shoulders and body remained still during the procedure to ensure that each motion was purely in the direction being measured. The results of each of the six ranges of motion were recorded onto appendix J and then transferred to spreadsheets for analysis.

3.7.2.2. DIGITAL ALGOMETER (APPENDIX F)

The Digital algometer (Livingston et al. 1998) was used to assess for changes in point tenderness over the effected cervical facet joint (Fischer 1986). The algometer used in this trial was the Algometer commander and Digitrack commander (Jtech Medical Industries, 4314 ZEVEX Park Lane, Salt Lake City, UT 84123, USA). The algometer is a sensitive force gauge designed to measure forces applied to specific locations (Livingston et al. 1998). It measures pressure thresholds, which Fischer (1986) described as the minimum pressure or force that induces pain or discomfort. The force readings were measured in newtons per centimeter squared. An average of three readings were taken.

Fisher (1986) confirmed the validity of the algometer as a means to measure manipulation as an intervention, stating that the algometer can be used to quantify the patient's response to manipulation. He concludes that the reproducibility of pressure threshold measurements indicates that the records of pain intensity are reliable.

The readings were taken as follows:

1) The procedure was explained to the patient and they were instructed to verbally indicate to the examiner the onset of pain.
2) The screen was cleared to indicate a zero reading
3) The examiner located the affected cervical facet joint, by motion palpation, and placed the algometer head perpendicular to the skin.
4) The examiner slowly increased the pressure at a rate of 2 newtons per second.
5) The examiner removed the algometer on the command of the patient and the algometer automatically took a reading.

6) The process was repeated 3 times so that an average reading was obtained at the end in newtons.

3.8. INTERVENTIONS

Upon completion of the initial examination, provided the inclusion and exclusion criteria had been met the various treatments were administered by the researcher.

3.8.1. CHIROPRACTIC MANIPULATION

Both group one and two received Chiropractic cervical manipulation that was performed according to the diversified technique (Shafer and Faye 1990:127-138 and Bergman 1993:234-293), with standard cervical manipulative techniques being performed in the direction of the cervical fixations (Bergman 1993: 253-293). The manipulations were performed with the patient either seated or supine.

3.8.2. C.R.A.C. TECHIQUE OF P.N.F. STRETCHING

The C.R.A.C. technique of P.N.F. stretching for the Posterior Cervical muscles was performed according to the guidelines set out by Moreau and Nook (1995) and Szaraz (1990). The stretching was done after the cervical manipulations were completed.
The C.R.A.C. technique of P.N.F. stretching of the Posterior Cervical muscles was performed as follows:

<u>STRETCH POSITION</u>

The patient lie’s supine with the researcher’s hands on his/her shoulders so that the researcher’s forearms are crossed, the patients head then rests on the researchers crossed forearms.

CONTRACTION PHASE

The patient then pushes his/her head back against the researcher's forearms. The contraction is held for 8 seconds.

RELAXATION PHASE

The patient then relaxes the neck and lowers his/her head to the bed.

ANTAGONIST CONTRACTION PHASE

The patient then lifts his/her head off the bed (into flexion) until a stretch is felt at the back of the neck.

STRETCH PHASE

The researcher then lifts the patient's head further into flexion until the stretch is felt over the posterior cervical muscles. The patient is then asked to push back against the researcher's forearms, this starts the next set of P.N.F. stretches.

This was repeated for a total of three sets.

3.9. TREATMENT OF THE SUBPROBLEMS:

The purpose of this study was to investigate the short to medium term effectiveness of Proprioceptive Neuromuscular Facilitation stretching (using the C.R.A.C. technique) as an adjunct treatment to cervical manipulation in the treatment of chronic mechanical neck pain.

3.9.1. THE FIRST SUB PROBLEM

To determine the effectiveness of cervical manipulation versus cervical manipulation and P.N.F. stretching of the Posterior Cervical muscles in the treatment of mechanical neck pain in terms of subjective clinical findings.

3.9.2. THE SECOND SUBPROBLEM

To determine the effectiveness of cervical manipulation versus cervical manipulation and P.N.F. stretching of the Posterior Cervical muscles in the treatment of mechanical neck pain in terms of objective clinical findings.

3.10. STATISTICAL ANALYSIS

3.10.1. TREATMENT OF THE DATA

3.10.1.1. Subjective data

The subjective data was treated as follows:

- The three questionnaires that were completed by the patient were screened to ensure that they had been correctly completed.
- Raw data from the three questionnaires were converted to percentages and recorded separately for each group.
- The data was analysed using a 5% level of significance.

3.10.1.2. Objective data

The objective data was treated as follows:

- The digital algometer readings were recorded separately for each consultation and each group.

- The C.R.O.M. goniometer readings were recorded separately for each range of motion and each group.
- The data was analysed using a 5 % level of significance.

3.10.2. STATISTICAL ANALYSIS OF THE DATA

The Technikon Natal statistician was consulted as to how the study should be analysed. The research data was transferred onto a spreadsheet in the SPSS software package for statistical analysis. The p-value was set at the significance level of 5%.

For intra-group analysis the parametric paired T-test was used to analyse the results from the objective data obtained before and after the first consultation and Friedman's T-test was used to analyse the objective data obtained on the first, second and fifth consultations. If the results from the Friedman's test were significant Dunn's procedure was then carried out. To analyse the subjective data obtained at treatment one and five the Wicoxen-signed rank test was used.

For inter-group analysis the parametric un-paired T-test was used to analyse the objective data that was obtained prior to the first and at the fifth consultation, the non-parametric Mann-Whitney U-test was used to analyse the subjective data obtained at treatments one and five.

3.10.2.1. Paired T-test for the objective data

The paired T- test is a parametric test that was used to determine if there was any difference within each group from before the first treatment to after the first treatment according to the data obtained from the Digital algometer and C.R.O.M. goniometer.

Hypothesis testing:

The null hypothesis Ho states that there was no difference between the readings taken before and after the treatments with regards to the variable of interest.

The alternative hypothesis H_1 states that there was a difference between the readings taken before and after the treatment with regards to the variable of interest.

Ho : Reading Before treatment 1 = Reading After treatment 1

(There was no difference between the two treatments)

H_1 : There was a difference between the readings taken before and after treatment 1.

$\propto = 0.05$ level of significance

Decision rule:

For a two-tailed test:

- Reject Ho at α level of significance if $p < \alpha$.
- Accept Ho at α level of significance if $p \leq \alpha$.

3.10.2.2. Friedman's T test for K-related samples analysing objective data

The Friedman's test is a non-parametric test that compares three or more related samples (Daniel 1978:231). If there is a small p-value (e.g. p = 0.05) one can conclude that at least one of the treatments differs from the others (Daniel 1978:231). Therefore it is necessary to conduct a post-test comparison procedure called Dunn's test to see which one of the treatments differed. The Friedman's T-test was used to determine if any difference occurred within each group prior to the first, second and fifth treatments according to the data obtained from the Digital algometer and the C.R.O.M. goniometer.

Hypothesis testing:

The null hypothesis Ho states that there was no difference between treatments with regard to the variable of interest.

The alternative hypothesis H_1 states that there was a difference between the treatments with regards to the variable of interest.

Ho : The three tests yield identical results.

H_1 : At least one treatment tends to yield larger values than at least one other method.

$\propto = 0.005$ level of significance

Decision rule:

For a one-tailed test:

- Reject Ho at $\propto$ level of significance of $p/2 < \propto$
- Accept Ho at $\propto$ level of significance if $p/2 \geq \propto$

<u>Dunn's Procedure for Friedman's T test:</u>

If the null hypothesis was rejected for the Friedman's T test, then this multiple comparison procedure will be applied to determine which of the treatments was significantly different (Daniel 1978:231).

3.10.2.3. Wilcoxen Signed Rank test for the subjective data

The Wilcoxen Signed Rank test was the non-parametric test used to compare related samples. It was used to determine if there was any difference within each group from treatment one to five, according to the data collected from the CMCC Neck Disabiliy Index, the NRS – 101 and the McGill short form.

Hypothesis testing:

The null hypothesis Ho states that there was no difference within the groups with regards to the variable of interest. The alternative hypothesis H1 states that there was a difference within the groups with regards to the variable of interest.

Ho : Treatment 1 = Treatment 5

(There was no difference between the two treatments)

H_1 : There was a difference between the readings taken at treatment 1 and 5.

$\propto = 0.05$ level of significance

Decision rule:

For a two-tailed test:

- Reject Ho at α level of significance if $p < \alpha$.
- Accept Ho at α level of significance if $p \geq \alpha$.

3.10.2.3. Mann-Whitney Test for the subjective data

The Mann-Whitney test was the non-parametric test used to determine if there was a difference between the two groups at treatment one and five according to the readings taken with the CMCC Neck Disabiliy Index, the NRS – 101 and the McGill short form.

Hypothesis testing:

The null hypothesis Ho states that there was no difference between the groups with regards to the variable of interest. The alternative hypothesis H1 states that there was a difference between the groups with regards to the variable of interest.

Ho : Group 1 = Group 2 (There was no difference between the two treatments).

H_1 : There was a difference between the groups (There was a difference between the two treatments).

$\propto$ = 0.005 level of significance

Decision rule:

For a two-tailed test:

- Reject Ho at $\propto$ level of significance if $p < \propto$
- Accept Ho at $\propto$ level of significance if $p \geq \propto$

3.10.2.3. Un-paired T-test for the objective data

The un-paired T-test was the parametric test used to determine if there was a difference between the groups prior to treatment one and five according to the readings taken on the Digital algometer and CROM goniometer.

Hypothesis testing:

The null hypothesis Ho states that there was no difference between the groups with regards to the variable of interest. The alternative hypothesis H1 states that there was a difference between the groups with regards to the variable of interest.

Ho : Group 1 = Group 2 (There was no difference between the two treatments).

H_1 : There was a difference between the two groups (There was a difference between the two treatments).

$\propto$ = 0.005 level of significance

Decision rule:

For a two-tailed test:

- Reject Ho at $\propto$ level of significance if $p < \propto$
- Accept Ho at $\propto$ level of significance if $p \geq \propto$

3.11. MEANS OF DATA COLLECTION

All the data that was required was collected from the patients who participated in the study at the Technikon Natal Chiropractic Clinic. The researcher carried out the data collection. The subjective information was collected prior to the first and on the fifth consultation and the objective measurements were taken prior to and after the first treatment and prior to the second and fifth treatments. This information was stored in each patient's file.

3.12. SUMMARY

Sixty patients complaining of mechanical neck pain were selected into the study. They were then randomly allocated to one of two groups. Those in group A received cervical manipulation only and those in group B, received chiropractic manipulation and P.N.F. stretching of the Posterior Cervical muscles. Each patient was assessed in terms of subjective and objective clinical findings and all the necessary data was recorded for statistical analysis.

4. <u>RESULTS</u>

4.1. INRODUCTION

The first part of this chapter contains the demographic data obtained from the sixty patients included in the study, which were divided into two equal groups of thirty. The second part of the chapter contains the statistical analysis of the subjective and objective data obtained from the patients over the treatment period.

4.2. CRITERIA GOVERNING THE ADMISSIBILITY OF THE DATA

Only information that was obtained from the case history, cervical regional examination, Digital Algometer, CROM Goniometer, CMCC Neck Disability Index, NRS-101 and McGill Short Form Pain Questionnaire were used as data in this study. The pain questionnaires were explained to the patient prior to them being filling out by the patient. The readings from the Digital Algometer and CROM Goniometer were taken by the researcher.

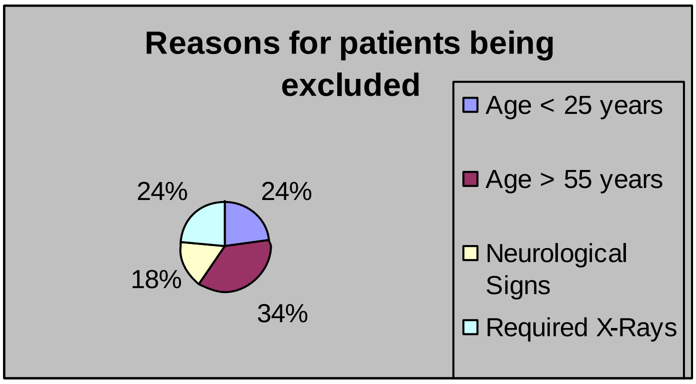
The null hypothesis Ho states that there was no difference between consultations with regards to the variable of interest. The alternative hypothesis H_1 states that there was a difference between consultations with regards to the variable of interest. The level of significance ($\propto$) was set at 0.05.

4.3. SAMPLE SIZE

The sample size of the study was limited to sixty patients, with thirty in each group. There were 83 respondents to the advertisements offering treatment for mechanical neck pain. The patients were screened telephonically according to the research criteria. This resulted in 7 people being excluded. The remaining 66 patients came to the Technikon Natal Chiropractic Clinic for further assessment. On the initial assessment 3 patients were excluded from the study. This resulted in the remaining 63 patients been included into the study, where 3 were excluded during the study for non-compliance.

4.3.1. Reasons for patients being excluded during the telephonic interview (Table 4.1.):

Exclusion criteria	No. of patients	Percentage %
Age < 25 years	4	24%
Age > 55 years	6	34%
Neurological Signs	3	18%
Required X-Rays	4	24%



4.3.2. Reason for patients being excluded on initial consultation (Table 4.2.):

Exclusion criteria	No. of patients	Percentage %
Myofasciitis	1	33,33%
High Blood Pressure	2	66,67%

4.3.3. Reason for patients not completing the research program (Table 4.3.):

Exclusion Criteria	No. of patients	Percentage %
Non-compliance	1	33.33%
Lack of Transport	1	33.33%
Technikon Holidays	1	33.33%

4.4. DEMOGRAPHIC DATA

The demographic data includes age, gender, racial distribution and occupational information.

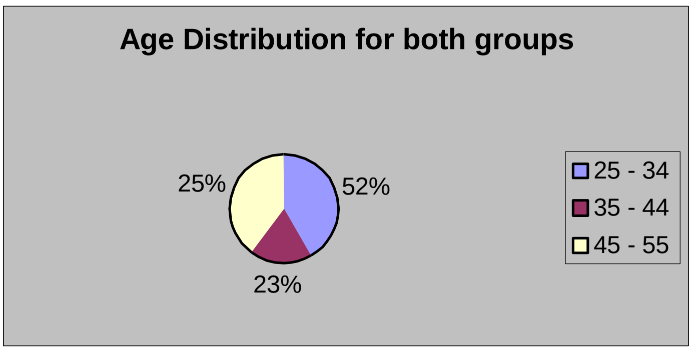
4.4.1. Age distribution (Table 4.4.):

Age Group	Group A	Group B	Percentage %
25 – 34 years	13	18	52%
35 – 44 years	7	7	23%
45 – 55 years	10	5	25%

The mean age of group A = 38 years

The mean age of group B = 35 years

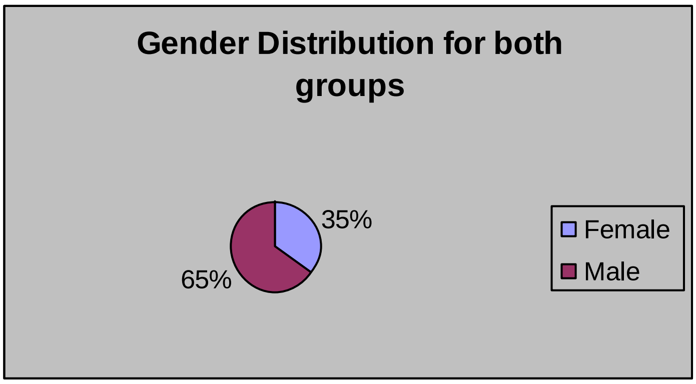
The mean age of both groups = 36.5 years



4.4.2. Gender Distribution (Table 4.5.):

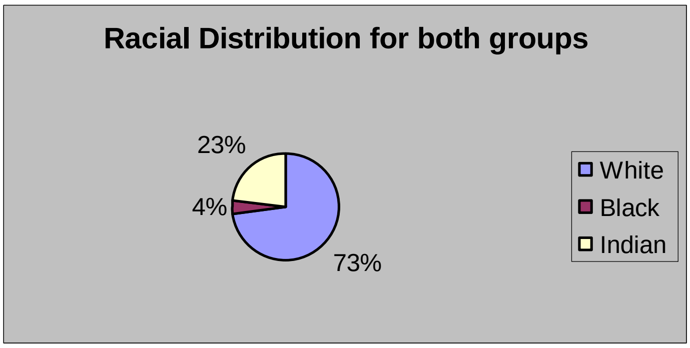
Gender	Group A	Group B	Percentage %
Female	10	11	35%
Male	20	19	65%

The female to male ratio is 1: 2



4.4.3. Racial Distribution (Table 4.6.):

Race	Group A	Group B	Percentage %
White	24	20	73%
Black	1	1	4%
Indian	5	9	23%



4.4.4. Occupations of the patients (Table 4.7.)

Group A	No	%	Group B	No	%
Student	2	7	Student	6	20
Self Employed	5	25	Self Employed	4	13
Personal Assistant	1	3	Personal Assistant	1	3
Manager	5	17	Manager	2	7
Lecture	2	7	Lecture	1	3
Unemployed	1	3	Unemployed	3	10
Violinist	1	3	Beauty Therapist	1	3
Clothing Designer	1	3	Paramedic	1	3
Sales Consultant	1	3	Chiropractor	2	7
Logistics controller	1	3	MTN Technician	1	3
Inspector	1	3	Photographer	1	3
Field marketer	1	3	Defence Force	1	3
Real Estate Agent	1	3	Architectural Technician	1	3
Insurance	1	3	Minister	1	3
I.T.	2	7	Secretary	1	3
Teacher	1	3	Air-conditioning	1	3
Autoelectrician	1	3	Bank clerk	1	3
Retired	2	7	Fire technician	1	3

4.5. ANALYSIS OF THE DATA

In order to analyse the data both parametric and non-parametric tests were used.

For inter-group analysis the parametric un-paired T-test was used for the objective data obtained prior to the first treatment and on the fifth treatment, and the non-parametric Mann-Whitney U-test was used for the subjective data obtained on the first and fifth treatments.

For intra-group analysis the parametric paired T-test was used for the objective data obtained prior to and after treatment one, and the non-parametric Friedman's T-test was used for the objective data obtained prior to treatment one, two and five. The non-parametric Wilcoxen signed rank test was used for intra-group analysis of the subjective data obtained at treatment one and five.

4.5.1. INTER – GROUP ANALYSIS

4.5.1.1. Parametric Un-paired T-test for objective data

4.5.1.1.1. Digital Algometer

Table 4.8. – Inter-group analysis of the Digital Algometer results obtained prior to treatments one and five.

Digital Algometer:					
	Group A		**Group B**		
Treatment No.	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**P - value**
1	32.1	10.93	27.43	10.7	0.100
5	33.53	10.97	33.8	13.72	0.934

The null hypothesis Ho was accepted for the Digital Algometer, indicating that at the $\propto$ = 0,05 level of significance there was no significant difference between the two groups at treatment one and five. This indicates that both treatments were equally effective.

4.5.1.1.2 CROM Goniometer

Table 4.9. – Inter-group analysis of the CROM Goniometer results obtained prior to treatments one and five.

CROM Goniometer:						
		Group A		Group B		
Range of motion	**Treatment**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**P - value**
Flexion	**1**	49.17	11.8	49.2	10.14	0.99
	5	54.67	11.13	53.17	9.12	0.57
Extension	**1**	61.77	9.75	58.7	9.26	0.22
	5	66.43	9.13	64.2	8.1	0.32
Right Rotation	**1**	63.67	10.07	62.57	8.93	0.66
	5	67.77	8.15	67.97	8.04	0.92
Left Rotation	**1**	66.27	8.53	65.07	8.21	0.58
	5	69.73	6.25	71.53	5.7	0.25
R. Lateral Flexion	**1**	42	8.9	41.57	7.21	0.84
	5	45.23	7.36	45.47	6.29	0.9
L. Lateral Flexion	**1**	42.83	8.15	39.83	7.77	0.15
	5	45.63	8.34	44.57	6.27	0.58

The null hypothesis Ho was accepted for the CROM Goniometer, indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at treatment one and treatment five. This indicates that both treatments were equally effective.

4.5.1.2. Non-parametric Mann-Whitney U-test for the subjective data.

4.5.1.2.1. CMCC Neck Disability Index

Table 4.10. – Inter-group analysis of the CMCC Neck Disability Index results at treatments one and five.

CMCC Neck Disability Index:					
	Group A		Group B		
Treatment	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**P - value**
1	22.93	9.55	23.87	14.86	0.63
5	8.13	9.22	9.27	14.24	0.84

The null hypothesis Ho was accepted for the CMCC Neck Disability Index, indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at treatment one and treatment five. This indicates that both treatments were equally effective.

4.5.1.2.2. Numerical Pain Rating Scale – 101

Table 4.11. – Inter-group analysis of the Numerical Pain Rating Scale – 101 results at treatments one and five.

Numerical Pain Rating Scale – 101:					
	Group A		**Group B**		
Treatment	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**P – value**
1	38.8	15.13	41.17	13.6	0.824
5	20.12	16.56	18.75	21.33	0.894

The null hypothesis Ho was accepted for the Numerical Pain Rating Scale – 101, indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at treatment one and treatment five. This indicates that both treatments were equally effective.

4.5.1.2.3. McGill Short Form Pain Questionnaire

Table 4.12. – Inter-group analysis of the McGill Short Form Pain Questionnaire results at treatment one and five.

McGill Short-Form Pain Questionnaire:					
	Group A		**Group B**		
Treatment	**Mean**	**Std.**	**Mean**	**Std.**	**P - value**

		Deviation		**Deviation**	
1	23.67	16.74	27.93	11.82	0.06
5	8.57	11.65	10.33	12.59	0.62

The null hypothesis Ho was accepted for the McGill Short Form Pain Questionnaire, indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at treatment one and treatment five. This indicates that both treatments were equally effective.

4.5.2. INTRA – GROUP ANALYSIS

4.5.2.1. Parametric paired T-test for the objective data.

4.5.2.1.1. Digital Algometer

Table 4.13. – Intra-group analysis of the results obtained from the Digital Algometer before and after treatment one.

Digital algometer			
	Mean	**Std. Deviation**	**P - value**
Group A	1.43	4.86	0.117
Group B	1.4	5.68	0.187

The null hypothesis Ho was accepted for the Digital Algometer, indicating that at the $\propto = 0.05$ level of significance there was no difference between the before and after measurements taken at treatment one for group A and B. This indicates neither treatment resulted in an increased pain threshold after one treatment.

4.5.2.1.2. CROM Goniometer

Table 4.14. – Intra-group analysis of the results obtained from the CROM Goniometer before and after treatment one.

CROM Goniometer						
	Group A			**Group B**		
Range of motion	**Mean**	**Std. Deviation**	**P - value**	**Mean**	**Std. Deviation**	**P - value**
Flexion	3.57	6.07	0.003	2.73	3.9	0.001
Extension	3.03	4.06	0	4.9	4.89	0
Right Rotation	2.87	4.03	0.001	3.87	5.02	0
Left Rotation	3.4	5.08	0.001	3.7	5.59	0.001
R. Lateral Flexion	1.97	3.03	0.001	2.7	4.24	0.002
L. Lateral Flexion	2.97	4.23	0.001	2.07	3.07	0.001

R. = right
L. = left

The Null hypothesis Ho was rejected for the CROM Goniometer, indicating that at the $\propto = 0,05$ level of significance there was a difference between the before and after measurements at treatment one within each group. This indicates that both treatments were effective in increasing the active cervical range of motion after one treatment.

4.5.2.2. Non-parametric Friedman's T-test for the objective data

Friedman's T-test was used for three or more related samples, if the null hypothesis was rejected for Friedman's T-test a post-test procedure called Dunn's procedure was performed to see which one of the treatments differs.

4.5.2.2.1. Dunn's Procedure for use with the Friedman's T test:

Let Rj and Rĵ be the jth and ĵth treatment rank totals.

Let $\propto$ be the experiment-wise error rate. Usually at $\propto = 0.10$.

Decision Rule:

$$| R_j - R_{\hat{j}}| \geq z \sqrt{\frac{bk(k+1)}{6}}$$

In the above formula:

b = the number of blocks
k = the number of treatments
z = the inverse normal distribution corresponding to (1- [$\propto$/ k(k/-1)])

In order to complete the treatment rank totals, the values in each block were ranked from highest to lowest and the sum of the ranks for each treatment was computed.

In this case $k = 3$, $\propto = 0.10$, $z = 2.12$

Therefore according to the equation,

$$| R_j - R_{\hat{j}}| \geq z \sqrt{\frac{bk(k+1)}{6}}$$

$$| R_j - R_{\hat{j}}| \geq 2.12 \sqrt{\frac{30(3)(3+1)}{6}}$$

$$| R_j - R_{\hat{j}}| \geq 16.42$$

4.5.2.2.2. Digital Algometer

Table 4.15. – Intra-group analysis of the results obtained from the Digital Algometer at treatments one, two and five.

Digital Algometer						
	Group A			**Group B**		
Treatment	**Mean**	**Std. Deviation**	**P - value**	**Mean**	**Std. Deviation**	**P - value**
1	32.10	10.93	0.598	27.43	10.7	0.031
2	32.83	9.46.		30.3	12.02	
5	33.53	10.97		33.8	13.73	

For Group A, the null hypothesis Ho was accepted for Digital Algometer readings, indicating that at the $\propto = 0,05$ level of significance there was no difference between the three consultations. This indicates that group A showed no improvement in pain threshold.

For Group B the Null hypothesis Ho was rejected for the Digital Algometer, indicating that at the $\propto = 0.05$ level of significance there was a difference between the consultations.

Therefore Dunn's Procedure was performed:

Rank Totals are:
Rank 1 (R1) = 49.5
Rank 2 (R2) = 60.9
Rank 5 (R5) = 69.6

R1 -R2	49.5 - 60.9 =	11.4
R2 -R5	60.9 – 69.6 =	8.7
R1 -R5	49.5 – 69.6 =	20.1

Between treatments one and two: 11.4 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 8.7 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 20.1 ≥ 16.42. The result was declared significant. Therefore there was a difference between treatments one and five.

This indicates that the treatment used in group B resulted in a increased pain threshold from treatment one to five.

4.5.2.2.2. CROM Goniometer

Table 4.16. – Intra-group analysis of the results obtained from the CROM Goniometer at treatments one, two and five.

CROM Goniometer								
		Group A			Group B			
ROM	**Tx**	**Mean**	**S.D.**	**P - value**	**Mean**	**S.D.**	**P - value**
Flexion	**1**	49.17	11.8	.004	49.2	10.14	.010
	2	53.23	10.92		50.43	12.03	
	5	54.66	11.13		53.17	9.12	
Extension	**1**	61.77	9.75	.003	58.7	9.26	.004
	2	63.93	8.43		62.76	9.16	
	5	66.43	9.13		64.2	8.11	
R. Rot	**1**	63.67	10.07	.005	62.57	8.93	.002
	2	64.6	9.23		66.23	8.66	
	5	67.77	8.15		67.97	8.04	
L. Rot	**1**	66.27	8.53	.008	65.07	8.21	.000 (< 0.001)
	2	68.77	6.01		69.13	5.34	
	5	69.73	6.25		71.53	5.7	
R.L.F.	**1**	42	8.91	.031	41.57	7.21	.000 (< 0.001)
	2	44.03	6.44		43.57	7.5	
	5	45.23	7.36		45.47	6.29	
L.L.F	**1**	42.83	8.15	.025	39.83	7.77	.000 (< 0.001)
	2	44.86	6.77		42.4	8.14	
	5	45.63	8.34		44.57	6.27	

ROM = Range of motion
Tx = Treatment
S.D. = Standard deviation
R. = Right
L. = Left
R.L.F. = Right lateral flexion
L.L.F. = Left lateral flexion

The Null hypothesis Ho was rejected for the CROM Goniometer for both groups, indicating that at the $\propto = 0.05$ level of significance, there was a significant difference for each range of motion between the consultations. Therefore Dunn's Procedure was performed for each group:

<u>GROUP A:</u>

1) <u>Flexion:</u>

Rank Totals are:
Rank 1 (R1) = 47.1
Rank 2 (R2) = 62.4

Rank 5 (R5) = 70.5

R1 -R2	47.1 – 62.4 =	15.3
R2 -R5	62.4 – 70.5 =	8.1
R1 -R5	47.1 – 70.5 =	23.4

Between treatments one and two: 15.3 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 8.1 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 23.4 ≥ 16.42. The result was declared significant. Therefore for group A flexion improved by treatment five.

2) Extension:

Rank Totals are:
Rank 1 (R1) = 46.5
Rank 2 (R2) = 63
Rank 5 (R5) = 70.5

R1 -R2	46.5 – 63 =	16.5
R2 -R5	63 – 70.5 =	7.5
R1 -R5	46.5 – 70.5 =	24

Between treatments one and two: 16.5 ≥ 16.42. The result was then declared significant. Therefore there is a difference between treatment one and two.

Between treatments two and five: 7.5 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 24 ≥ 16.42. The result was declared significant.

Therefore for group A extension improved significantly by treatment two and treatment five, with no significant improvement occuring between treatment two and five.

3) Right Rotation:

Rank Totals are:
Rank 1 (R1) = 50.4
Rank 2 (R2) = 57
Rank 5 (R5) = 72.6

R1 -R2	50.4 – 57 =	6.6
R2 -R5	57 – 72.6 =	15.6
R1 -R5	50.4 – 72.6 =	22.2

Between treatments one and two: 6.6 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 15.6 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 22.2 ≥ 16.42. The result was declared significant.

Therefore for group A right rotation improved by treatment five.

4) Left Rotation:

Rank Totals are:
Rank 1 (R1) = 47.4
Rank 2 (R2) = 63.6
Rank 5 (R5) = 69

R1 -R2	47.4 – 63.6 =	16.2
R2 -R5	63.6 – 69 =	5.4
R1 -R5	47.4 – 69 =	21.6

Between treatments one and two: 16.2 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 5.4 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 21.6 ≥ 16.42. The result was declared significant. Therefore for group A left rotation improved by treatment five.

5) Right Lateral Flexion:

Rank Totals are:
Rank 1 (R1) = 50.4
Rank 2 (R2) = 62.1
Rank 5 (R5) = 67.5

R1 -R2	50.4 – 62.1 =	11.7
R2 -R5	62.1 – 67.5 =	5.4
R1 -R5	50.4 – 67.5 =	17.1

Between treatments one and two: 11.7 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 5.4 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 17.1 ≥ 16.42. The result was declared significant. Therefore for group A right lateral flexion had improved by treatment five.

6) <u>Left Lateral Flexion:</u>

Rank Totals are:
Rank 1 (R1) = 48.9
Rank 2 (R2) = 64.5
Rank 5 (R5) = 66.6

R1 -R2	48.9 – 64.5 =	15.6
R2 -R5	64.5 – 66.6 =	2.1
R1 -R5	48.9 – 66.6 =	17.7

Between treatments one and two: 15.6 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 2.1 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 17.7 ≥ 16.42. The result was declared significant. Therefore for group A left lateral flexion had improved by treatment five.

<u>GROUP B:</u>

1) <u>Flexion:</u>

Rank Totals are:
Rank 1 (R1) = 50.4
Rank 2 (R2) = 59.6
Rank 5 (R5) = 72

R1 -R2	50.4 – 59.6 =	9.2
R2 -R5	59.6 – 72 =	12.4
R1 -R5	50.4 – 72 =	21.6

Between treatments one and two: 9.2 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 12.4 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 21.6 ≥ 16.42. The result was declared significant.

Therefore for group B flexion improved by treatment five.

2) <u>Extension:</u>

Rank Totals are:
Rank 1 (R1) = 46.5
Rank 2 (R2) = 63
Rank 5 (R5) = 70.5

R1 -R2	46.5 – 63 =	16.5
R2 -R5	63 – 70.5 =	7.5
R1 -R5	46.5 – 70.5 =	24

Between treatments one and two: 16.5 ≥ 16.42. The result was then declared significant. Therefore there was a difference between treatment one and two.

Between treatments two and five: 7.5 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 24 ≥ 16.42. The result was declared significant.

Therefore for group B extension improved by treatment two and treatment five, with no significant improvement occuring between treatment two and five.

3) <u>Right Rotation:</u>

Rank Totals are:
Rank 1 (R1) = 45.6
Rank 2 (R2) = 63.9
Rank 5 (R5) = 70.5

R1 -R2	45.6 – 63.9 =	18.3
R2 -R5	63.9 – 70.5 =	6.6
R1 -R5	45.6 – 70.5 =	24.9

Between treatments one and two: 18.3 ≥ 16.42. The result was then declared significant. Therefore there was a difference between treatment one and two.

Between treatments two and five: 6.6 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 24.9 ≥ 16.42. The result was declared significant.

Therefore for group B right rotation improved by treatment two and treatment five, with no significant improvement occuring between treatment two and five.

4) <u>Left Rotation:</u>

Rank Totals are:

Rank 1 (R1) = 42.6
Rank 2 (R2) = 63
Rank 5 (R5) = 74.4

R1 -R2	42.6 – 63 =	20.4
R2 -R5	63 – 74.4 =	11.4
R1 -R5	42.6 – 74.4 =	31.8

Between treatments one and two: 20.4 ≥ 16.42. The result was then declared significant. Therefore there was a difference between treatment one and two.

Between treatments two and five: 11.4 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 31.8 ≥ 16.42. The result was declared significant.

Therefore for group B left rotation improved by treatment two and treatment five, with no significant improvement occuring between treatment two and five.

5) <u>Right Lateral Flexion:</u>

Rank Totals are:
Rank 1 (R1) = 45
Rank 2 (R2) = 58.5
Rank 5 (R5) = 76.5

R1 -R2	45 – 58.5 =	13.5
R2 -R5	58.5 – 76.5 =	18
R1 -R5	45 – 76.5 =	31.5

Between treatments one and two: 13.5 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments two and five: 18 ≥ 16.42. The result was then declared significant. Therefore there was a difference between treatment two and five.

Between treatments one and five: 31.5 ≥ 16.42. The result was declared significant.

Therefore for group B right lateral flexion improved by treatment two and treatment five, with no significant improvement occuring between treatment two and five.

6) Left Lateral Flexion:

Rank Totals are:
Rank 1 (R1) = 43.5
Rank 2 (R2) = 61.5
Rank 5 (R5) = 75

R1 -R2	43.5 – 61.5 =	18
R2 -R5	61.5 – 75 =	13.5
R1 -R5	43.5 – 75 =	31.5

Between treatments one and two: 18 ≥ 16.42. The result was then declared significant. Therefore there was a difference between treatment one and two.

Between treatments two and five: 13.5 was not ≥ 16.42. The result was then declared insignificant. Therefore there was no difference between treatment one and two.

Between treatments one and five: 31.5 ≥ 16.42. The result was declared significant. Therefore for group B left lateral flexion improved by treatment two and five, with no significant improvement occurring between treatment two and five.

In summary, group A showed a significant improvement in terms of active cervical range of motion by treatment five with only extension improving by treatment two. Group B showed a significant improvement in terms of active cervical range of motion by treatment two and five, with only flexion improving by treatment five.

4.5.2.3. Non-parametric Wilcoxen- Signed Rank test for the subjective data

4.5.2.3.1. CMCC Neck Disability Index

Table 4.17. – Intra-group analysis of the results obtained from the CMCC Neck Disability Index at treatments one and five.

CMCC Neck Disability Index:						
	Group A			**Group B**		
Treatment	**Mean**	**Std. Diviation**	**P-value**	**Mean**	**Std. Diviation**	**P-value**
1	22.93	9.55	0.00 (< 0.001)	23.87	14.86	0.00 (< 0.001)
5	8.13	9.21		9.27	14.24	

The Null hypothesis Ho was rejected for the CMCC Neck Disability Index, indicating that at the $\propto = 0.05$ level of significance, there was a statistically significant difference between the consultations. This indicates that for both treatments the patients disability index improved.

4.5.2.3.2. Numerical Pain Rating Scale – 101

Table 4.18. – Intra-group analysis of the results obtained from the Numerical Pain Rating Scale – 101 at treatments one and five.

NRS-101:						
	Group A			**Group B**		
Treatment	**Mean**	**Std. Diviation**	**P-value**	**Mean**	**Std. Diviation**	**P-value**
1	38.8	15.13	0.00 (< 0.001)	41.17	13.6	0.00 (< 0.001)
5	20.12	16.56		21.11	18.75	

The Null hypothesis Ho was rejected for the Numerical Pain Rating Scale-101, indicating that at the $\propto = 0.05$ level of significance, there was a statistically significant difference between the consultations. This indicates that both treatments effectively decreased the patients perception of pain.

4.5.2.3.3. McGill Short-form Pain Questionnaire

Table 4.19. – Intra-group analysis of the results obtained by the McGill Short-form Pain Questionnaire at treatment one and five.

McGill Short Form Pain Questionnaire:						
	Group A			Group B		
Treatment	**Mean**	**Std. Diviation**	**P-value**	**Mean**	**Std. Diviation**	**P-value**
1	23.67	16.74	0.00	27.93	11.82	0.00
5	8.57	11.65	(< 0.001)	10.33	12.59	(< 0.001)

The Null hypothesis Ho was rejected for the McGill Short-form Pain Questionnaire**,** indicating that at the $\propto = 0.05$ level of significance, there was a statistically significant difference between the consultations. This indicates that both treatments effectively improved the quality of pain experienced by the patients.

5. <u>DISCUSION</u>

5.1. INTRODUCTION

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

5.2. INTRA – GROUP ANALYSIS

5.2.1. SUBJECTIVE DATA

5.2.1.1. CMCC Neck Disability Index

Statistical analysis of the CMCC Neck Disability Index for the first to fifth treatment period showed that there was an improvement in both groups, the p-value for group A was $p = < 0.001$ and for group B it was $p = < 0.001$ (table 4.17).

Therefore both treatments were effective in decreasing the patients disability.

5.2.1.2. Numerical Pain Rating Scale – 101

Statistical analysis of the NRS – 101 for the first to fifth treatment period showed that there was a improvement in both groups, the p-value for group A was $p = < 0.001$ and for group B it was $p = < 0.001$ (table 4.18).

Therefore both treatments were effective in decreasing the patients perception of pain intensity.

5.2.1.3. McGill Short Form Pain Questionnaire

Statistical analysis of the McGill Short Form Pain Questionnaire for the first to fifth treatment period showed that there was an improvement in both groups, the p-value for group A was p = < 0.001 and for group B it was p = < 0.001 (table 4.19).

Therefore both treatments were effective in decreasing the quality of pain perceived by the patient.

5.2.2. OBJECTIVE DATA

5.2.2.1. Digital Algometer

Statistical analysis of the data obtained before and after treatment one indicates that there was no statistically significant difference in either of the groups after one treatment, the p-value for group A was p = 0.117 and for group B it was p = 0.187 (table 4.13).

Therefore after one treatment (the short-term effect), neither treatment protocol was statistically effective in increasing pain threshold.

Statistical analysis of readings taken from the Digital Algometer for group A (p = 0.598) at treatments one, two and five showed no statistically significant difference between the three treatments (table 4.15).

Therefore at the end of the treatment period (the medium-term effect), group A showed no statistically significant improvement in pain threshold.

Statistical analysis of the readings taken from the Digital Algometer for group B (p = 0.187) at treatments one, two and five showed that there was a statistically significant difference between the treatments (table 4.15). Dunn's Procedure revealed that the difference occurred between treatments one and five.

Therefore by treatment five (the medium-term effect), group B showed an improvement in pain threshold.

5.2.2.1.2. CROM Goniometer

Statistical analysis of the data obtained before and after treatment one indicates that both groups showed a statistically significant improvement in all active cervical range of motions after one treatment (refer to table 4.14 for p-values).

Therefore active cervical range of motion improved for both groups after one treatment, indicating the short-term efficacy of both treatments on active cervical range of motion.

Statistical analysis of the readings taken from the CROM Goniometer at treatments one, two and five showed that both groups improved in all active range of motions (refer to table 4.16 for p-values).

Dunn's procedure for group A revealed that there was an increase in all active cervical ranges of motion by the fifth treatment with only extension showing a significant improvement by the second treatment.

Dunn's procedure for group B revealed that there was an increase in all the active ranges of motion by the second and fifth treatments, except for flexion, which only improved by the fifth. Although not statistically significant, group B showed a greater clinical improvement than group A by treatment two.

Therefore both treatments were equally effective in increasing all active cervical range of motions in terms of the medium-term effect of the treatments.

5.3. INTER – GROUP ANALYSIS

5.3.1. SUBJECTIVE DATA

5.3.1.1. CMCC Neck Disability Index

Statistical analysis of the results from the CMCC Neck Disability Index for treatments one, for both group A and B revealed that there was no statistically significant difference ($p = 0.63$) in the degree of disability suffered by the patients (table 4.10). This implies that both groups were similar in terms of disability at the beginning of the research period.

Analysis of the data from treatment five for both groups revealed that there was no statistically significant difference ($p = 0.84$) between the groups. This indicates that both groups responded equally well to their respective treatment protocols (table 4.10).

Therefore both treatment protocols were equally effective in decreasing the patients pain and disability.

5.3.1.2. Numerical Pain Rating Scale – 101

Statistical analysis of the results from the Numerical Pain Rating Scale – 101 for treatments one, for both group A and B revealed that there was no statistically significant difference ($p = 0.824$) in pain intensity suffered by the patients (table 4.11). This implies that both groups were similar in terms of pain intensity at the beginning of the research period.

Analysis of the data from treatment five for both groups revealed that there was no statistically significant difference ($p = 0.894$) between the groups. This indicates that both groups responded equally well to their respective treatment protocols (table 4.11).

Therefore both treatment protocols were equally effective in decreasing the patients level of pain.

5.3.1.3. McGill Short Form Pain Questionnaire

Statistical analysis of the results from the McGill Short Form Pain Questionnaire for treatments one, for both group A and B revealed that there was no statistically significant difference ($p = 0.05$) in the quality of the pain suffered by the patients (table 4.12). This implies that both groups were similar in terms of pain intensity at the beginning of the research period.

Analysis of the data from treatment five for both groups revealed that there was no statistically significant difference ($p = 0.62$) between the groups. This indicates that both groups responded equally well to their respective treatment protocols (table 4.12).

Therefore both treatment protocols were equally effective in decreasing the patients quality of pain.

5.3.2. OBJECTIVE DATA

5.3.2.1. Digital Algometer

Statistical analysis of the results obtained from the Digital Algometer at treatment one indicates that there was no statistically significant difference between the groups ($p = 0.100$) in terms of pain threshold levels at the beginning of the study (table 4.8). This indicates that the groups were similar at the beginning of the study.

Statistical analysis of the results at treatment five indicate that there was no difference between the groups ($p = 0.934$) in terms of pain threshold at the last consultation (table 4.8.). This indicates that the groups were similar at the last consultation.

Therefore both treatment protocols were equally effective in decreasing pain threshold.

5.3.2.2. CROM Goniometer

Statistical analysis of the results obtained from the CROM Goniometer at treatment one indicates that there was no statistically significant difference between the groups for each active cervical range of motion. This indicates that the groups had similar range of motions at treatment one (table 4.9).

Analysis of the results at treatment five showed no statistically significant difference in active cervical range of motions between the groups. This indicates that both groups responded equally well to their respective treatment protocols (table 4.9). Therefore both treatment protocols were equally effective in increasing active cervical range of motion.

5.4. DISCUSSION

5.4.1. INTRA – GROUP HYPOTHESIS

It was hypothesised that there would be an improvement between treatment one and five in terms of subjective clinical findings. This hypothesis was accepted as both groups showed an improvement in terms of the subjective clinical findings.
It was hypothesised that that there would be an improvement in terms of the objective clinical findings taken before and after treatment one. This hypothesis was rejected for the Digital Algometer as no change in pain threshold occurred and accepted for the CROM Goniometer as both groups showed an increase in active cervical range of motion.

It was hypothesised that there would be an improvement between treatments one, two and five in terms of the objective clinical findings. For the Digital Algometer this hypothesis was rejected for group A, as no statistically significant difference in pain threshold occurred and accepted for Group B, as a statistically significant difference in pain threshold occurred by treatment five.
For the CROM Goniometer the hypothesis was accepted for both groups as there was an improvement in active cervical range of motion.
It can be concluded that both treatment protocols are equally effective in terms of the subjective clinical findings and the objective range of motion findings and that the treatment protocol used for group B was more effective in increasing pain threshold than the treatment used in group A.

Therefore the use of P.N.F. stretching on the posterior cervical muscles resulted in a greater patient response in terms of pain threshold than manipulation alone.

5.4.2. INTER – GROUP HYPOTHESIS

It was hypothesised that there would be a difference between the two groups with respect to the subjective and objective clinical findings, showing that one treatment protocol was more effective than the other. The hypothesis was rejected as there was no statistically significant difference between the two groups at treatment five according to the subjective and objective clinical findings.

It can be concluded that both treatment protocols used in this study were equally effective in the treatment of mechanical neck pain.

5.5. CONCLUSION

Both groups showed an improvement as a result of their respective treatments. Intra-group analysis revealed that group B showed a statistically greater improvement in terms of increased pain threshold levels and although not statistically significant group B also showed a clinically greater improvement in terms of increased active cervical range of motion. At the final consultation where the groups were compared to each other neither group showed a statistically greater improvement over the other.

Therefore, based on these results chiropractic manipulation combined with P.N.F. stretching of the Posterior Cervical muscles has no statistically significant benefit over

chiropractic manipulation alone in the treatment of chronic mechanical neck pain. Although during the treatment the P.N.F. stretching contributed to improved pain threshold levels.

According to Basmanjian and Wolf (1990: 305) the primary reason for P.N.F. being effective is due to the manipulation of the stretch reflex (its effect on the muscle spindles and golgi tendon organs). Bergman (1993:139) explains the effectiveness of manipulation as a result of stimulation of the joint nociceptor and mechanoreceptor, which result in the stimulation of the golgi tendon organs and muscle spindles which breaks down the pain cycle. It was therefore hypothesized by the researcher that no significant difference occurred between the two groups as P.N.F. stretching and chiropractic manipulation both act on the same structures in order to improve range of motion and decrease pain. Therefore when combining P.N.F. stretching and chiropractic manipulation no further benefit will be given to the treatment protocol. Another explanation for an insignificant difference occurring between the two groups could be due to the fifth consultation occurring after a period when no treatment was administered. This could have allowed the effect of the stretch to be minimized. Similar findings were found by McCarthy et al. (1997) who found the effect of the P.N.F. stretching to be significantly diminished by the one week follow up consultation indicating that P.N.F. stretching was only effective in the short term or while the stretches were being performed regularly.

5.6. LIMITATIONS OF THE STUDY

1) Demographic Data – The racial distribution was poor, with most patients coming from the white sector (73%). This is not a good representation of the general population of the greater Durban area.
2) Questionnaires – It is possible that some of the patients may not have fully understood the questionnaires. This may have affected their responses and altered the outcome measurements. Patients may have recorded false results in order to please the researcher.

3) Objective measurements – Human error may account for any incorrect measurement recordings or incorrect equipment usage. The accuracy of the researcher on subsequent visits to find the cervical facet joint used to take Digital Algometer readings must be taken into account. When using the CROM Goniometer one can not be sure that there was no thoracic spine movement.
4) Placebo control – There was no suitable placebo stretch to be administered to group A to account for the placebo effect.
5) Treatment –. There was no standardised interval times between the treatment sessions and the fifth consultation had no specific time limit, although the researcher tried to make the fifth consultation during the week following the fourth treatment, this did not always occur.
6) Data collection and administration of treatment - The treatment and data collection was done by a undergraduate chiropractic student, perhaps if a more qualified practitioner had performed the study the results may have been different

5.7. COMPARISION OF THE RESULTS WITH OTHER STUDIES

In a review of the literature no studies were found that compared Proprioceptive Neuromuscular Facilitation stretching of the Posterior Cervical muscles combined with Chiropractic cervical manipulation for the treatment of Mechanical Neck pain. These studies however show similarities:

<u>Cassidy, Lopes and Yong-Hing (1992)</u>

They conducted a controlled randomized trial comparing the immediate effect of cervical manipulation and mobilization in terms of pain and range of motion in the

treatment of mechanical neck pain. Their study revealed that both treatments improved range of motion significantly and that the group receiving manipulation had an 85% decrease in pain according to the Numerical Pain Rating Scale – 101.
It was concluded that a single cervical manipulation was more effective than mobilization in decreasing pain in patients with mechanical neck pain. Both treatments improved range of motion immediately after treatment.

The findings in this study correlate with Cassidy et al. in that after cervical manipulation there was a decrease in pain and an improved cervical range of motion. Although the studies were designed differently both indicate the cervical manipulation decreases pain and increase range of motion of the cervical spine.

McCarthy, Olsen and Smeby (1997)

They conducted a single-blinded trial to test the effect of the C.R.A.C. technique of P.N.F. stretching on active range of motion in the cervical spine. The technique was done in lateral flexion with contra-lateral rotation and in forward flexion. They found that by day seven active cervical range of motion had increased significantly, but once the exercises were discontinued the patients reverted to pre-stretch values.

They concluded that performing P.N.F. stretching on the cervical spine increased cervical range of motion in the short term.

In this study group B received P.N.F. stretching and cervical manipulation. This group showed an increase in cervical range of motion after one treatment and at the fifth treatment. Group A received cervical manipulation alone and there appeared to be no significant difference between the groups at treatment five. However during the treatment period intra-group analysis revealed that group B, although not statistically significant, had earlier improvements of active cervical range of motion than group A. This indicates some correlation between the finding of McCarthy et al. that P.N.F. stretching increases cervical range of motion in the short-term.

6. <u>RECOMMENDATIOS AND CONCLUSIONS</u>

6.1 RECOMMENDATIONS

The author of this dissertation suggests the following changes for anyone wanting to repeat this study:

1) A larger sample size for better population representation.
2) The validity of the study would increase if the readings were taken by a person other than the researcher. The researcher had knowledge of the pre-treatment results which may have introduced bias to the post-treatment results – an independent non-biased observer should carry out the data collection.
3) The age limit could be narrowed to allow for consistency in the stage of degenerative of the population sample.
4) The duration of the symptoms for this study was six weeks or greater, if the symptom duration was limited (e.g. six weeks to one year) the sample population would have been at approximately the same level of chronicity.
5) The treatment period was four treatments in two weeks with a fifth consultation for data collection. There was no specific time period between the four treatments in the two weeks and the fifth consultation was not set within a certain period of time after the fourth treatment. It was recommended that the first four treatments occur with a minimum of a two-day interval between them. The fifth consultation should be done at a one week follow-up (seven days) or even longer (one month or six weeks) to determine the long-term effect of the treatment after the fourth consultation. This allows for consistency and therefore validity of the treatments.

6) The researcher feels that a more accurate pain threshold measurement would have occurred if a different algometer was used (e.g. Wagner FDK20 Force Dial). The digital algometer was found to be inconsistent as it required the researcher to apply a constant pressure at a constant rate. The researcher found that this pressure varies from day to day and could never be set at a constant rate.
7) The subjective measurements should have been taken after the first treatment to see if there was any short-term subjective improvement.

6.2. CONCLUSIONS

The results of this study indicate that both groups showed significant improvements in the condition of mechanical neck pain. Analysis of the subjective data revealed that a statistically significant improvement occurred in terms of the patient's disability, pain perception and the quality of pain experienced by the patients. Analysis of the objective data revealed that both groups showed an increase in active cervical range of motion, and that group B showed an increase in pain threshold. Neither group showed a statistically significant improvement in terms of one treatment protocol over the other group.

In conclusion, this study demonstrated that P.N.F. stretching of the Posterior Cervical muscles combined with Chiropractic cervical manipulation was as effective as Chiropractic cervical manipulation alone in the treatment of mechanical neck pain. Therefore the addition of the P.N.F. stretching technique to the Posterior Cervical muscles adds no benefit to the treatment protocol of cervical manipulation in the treatment of chronic mechanical neck pain.

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