THE RELATIVE EFFECTIVENESS OF ADJUSTING THE IPSILATERAL SIDE OF A FIXATION VERSUS ADJUSTING THE CONTRALATERAL SIDE OF A FIXATION IN THE MANAGEMENT OF FACET SYNDROME OF THE CERVICAL SPINE

by

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I, Brett Gidon Kavonic, do declare that the dissertation is representative of my own work.

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DEDICATION

This dissertation is dedicated to my family and parents, Glenda and Kevin Kavonic, for their endless generosity, continuous support and infinite love.

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ABSTRACT

The purpose of this study was to determine the relative effectiveness of adjusting the ipsilateral side of the fixated segment versus adjusting the side contralateral to that of the fixated segment, in patients with facet syndrome of the cervical spine, in terms of subjective and objective clinical findings, as well as patient comfort.

The rationale for adjusting the cervical spine on the side contralateral to fixation is that the spinal dysfunction is of a soft tissue nature, as opposed to joint or bone. Thus the effectiveness of the spinal adjustment may be due to a reprogramming of the central nervous system, whereby the principal effect seems to be to stretch muscles to their normal resting length before spinal mobility can be restored.

Adjusting the side opposite to the fixation may cause a sudden stretch of the muscle spindle resulting in a barrage of afferent impulses to the central nervous system, which reflexly turns down the gamma motor neuron tone. The resetting of the gamma motor neuron tone and resultant restoration of the muscle spindle's normal resting length, thereby helps to relieve the associated muscle spasm and possibly removes the fixation.

This study was comprised of 30 subjects, all of whom were diagnosed with cervical facet syndrome. The subjects were randomly divided into two groups of 15 each with an average age of 24 years per group. The average male:female ratio was 1,1:1.

Group 1 received an adjustment on the ipsilateral side of the fixated segment, whereas group 2 received an adjustment on the side contralateral to the fixated segment.

The type of adjustment (Diversified Technique) used was selected according to the type of fixation diagnosed by motion palpation.

Both groups received a maximum of eight treatments over a period of four weeks, or until asymptomatic. There was a one-month follow-up period for reassessment.

Each subject was assessed subjectively by means of the CMCC Neck Disability Index, Short-Form McGill Pain questionnaire, Numerical Rating Scale-101 questionnaire and Comfort Index, as well as by objective measurements from the CROM and Algometer. In addition, all patients were motion palpated immediately after treatment in order to assess whether the spinal fixation was present or not.

A pre-test of the Comfort Index was conducted on 6 patients prior to the initiation of the study in order to determine whether the patients found the Comfort Index understandable and clear.

Subjective and objective statistical analysis was completed using the non-parametric Wilcoxon's Signed Rank Test and Mann-Whitney's U-Test comparing intra-group and inter-group data respectively. This was conducted at a 95% confidence interval ($\alpha = 0,05$). Data was also recorded in the form of tables and graphs for visual interpretation.

From the data it can be seen that both groups demonstrated a significant subjective improvement in terms of functional disability, pain intensity and sensory dimensions of pain, indicating that both treatment approaches were effective in the treatment of cervical facet syndrome ($\alpha = 0,05$). However no significant objective improvement in cervical ranges of motion and pressure-pain threshold within the two groups was demonstrated, aside from group 2 which did reveal a significant improvement in pressure-pain threshold on the side contralateral to the fixated segment ($\alpha = 0,05$).

In general, no significant difference in efficacy could be demonstrated between the two treatment approaches, with the exception of the motion palpation findings which showed the first treatment protocol to be more effective than the second approach in the alleviation of spinal fixations ($\alpha = 0,05$).

Although statistically there was no significant improvement nor significant difference in patient comfort during the set up and thrust of adjustment, clinically there did appear to be a 25% subjective improvement in patient comfort for both groups. In addition, group 2 seemed to display a greater level of patient comfort in comparison to group 1.

In conclusion, sufficient clinical and statistical evidence exists to demonstrate a significant improvement within each group in response to both treatment protocols. However, with the exception of the motion palpation findings, there was no statistical evidence to support the alternate hypothesis that one treatment approach would be more effective than the other. It is interesting to note that the second treatment approach seemed clinically more effective than the first approach in terms of patient comfort.

Thus for patients with an extremely acute cervical facet syndrome, it may be beneficial adjusting them on the side contralateral to the potentially tender fixated segment, and thus avoiding the risk of further irritating the inflamed facet joint.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CMCC	-	CMCC Neck Disability Index
McGill	-	Short-Form McGill Pain Questionnaire
NRS-101	-	Numerical Rating Scale-101 Questionnaire
CI - set up	-	Comfort Index - set up (i.e. level of discomfort noted during set up of adjustment)
CI - thrust	-	Comfort Index - thrust (i.e. level of discomfort noted during thrust of adjustment)
Flex	-	Flexion
Ext	-	Extension
L.Rot	-	Left Rotation
R.Rot	-	Right Rotation
L.Lat Flex	-	Left Lateral Flexion
R.Lat Flex	-	Right Lateral Flexion

Algom-fixated side	-	Algometer-ipsilateral side of fixation (i.e. reading noted on ipsilateral side of fixation)
Algom-non-fixated side	-	Algometer-contralateral side of fixation (i.e. reading noted on side contralateral to fixation)
MP	-	Motion palpation
S.E.	-	Standard Error
S.D.	-	Standard Deviation
One-month	-	One-month follow-up
s	-	Significant
ns	-	Non-significant
Power	-	Power Statistics
Fig.	-	Figure

DEFINITION OF TERMS

Adjustment

The chiropractic adjustment is a specific form of direct articular manipulation using either long or short lever techniques with specific contacts and is characterized by a dynamic thrust of controlled velocity, amplitude and direction (Haldeman 1992:621).

Manipulation

A manual procedure involving a directed thrust which moves a joint past the physiological range of motion without exceeding its anatomic limit (Gatterman 1995:12).

Fixation

The state whereby an articulation has become temporarily immobilized in a position that it may normally occupy during any phase of physiological movement (Haldeman 1992:623).

Facet Syndrome

The term "facet syndrome" pertains to the condition characterized by an overriding of the facets of adjacent vertebra, whereby the intervertebral foramina are narrowed from superior to inferior. It also relates to a state of tension, stretching, irritation or pressure of the joint capsule, due to postural strain or trauma, but without intervertebral foraminal narrowing. (Peters 1984.)

Motion Palpation

Motion palpation is defined as palpation of the human spine in the diagnosis of muscular, discal or articular mechanical changes (Alley 1983).

Subluxation Complex

Pathology of the spine results in limitation of movement in that part of the spine in which it is situated. Pain arising from within or around any synovial joint results in reflex muscular spasm in an attempt to prevent painful movement of the joint. Muscle pathology produces local muscle spasm that produces secondary loss of movement in the joint (Mennell 1990).

CHAPTER ONE

1.0. INTRODUCTION

1.1. *THE PROBLEM AND ITS SETTING*

Neck pain is a common complaint affecting 40% - 50% of the population at some stage of their lives (Kelsey 1982:146). A study undertaken by Takala et al. (1982) indicated the prevalence of neck pain amongst a middle-aged population as being 16% in men and 18% in women. Even though the majority of patients recover from mechanical neck pain, as many as one third can continue to suffer from moderate to severe pain 15 years after the initial occurrence (Gore et al. 1987).

Dishman (1985) states that even though chiropractic has existed in the USA and Canada for a century, it has been hardly subject to scientific research. Many different treatment protocols are administered to patients with mechanical neck pain, yet there are few controlled clinical trials to demonstrate the efficacy of these treatments (Cassidy et al. 1992a).

In a randomized controlled trial determining the effectiveness of manual therapy, physiotherapy and treatment by general practitioners for non-specific back and neck complaints, it was found that both manual therapy and physiotherapy produced a more favourable outcome than treatment by the general practitioner. Although there were no different outcome measures between the physiotherapy and manual therapy groups, the latter required a significantly less number of treatments. (Koes et al. 1992.) In another randomized controlled trial comparing manipulation versus mobilization of the cervical spine, Cassidy et al. (1992a) found that the manipulated group demonstrated pain improvement 1,5 times greater than the mobilized group.

Approximately 1 million people suffer from neck pain annually at a cost of 2 billion dollars per year (Osterbauer et al. 1992). Johnson et al. (1989) compared the cost of care and number of workdays lost amongst patients receiving treatment from chiropractic, medical and osteopathic practitioners for work related sprains and strains of the back and neck. They found that chiropractic treatment resulted in lesser workdays lost and lower amounts of disability compensation and provider care costs compared to the osteopathic and medical practitioners.

Since its inception, the primary treatment method used by chiropractors is spinal manipulation, commonly used to normalize joint and muscle fixation (Fitz-Ritson 1990; Reggars and Pollard 1995).

There are a large variety of manipulative techniques used to remove spinal fixations and their associated muscle hypertonus. These include direct techniques whereby the thrust is applied directly toward the side of restriction, and exaggeration techniques, whereby the joint is moved away from the dysfunctional barrier up to the opposite end of its normal range, and a thrust is applied to the same vertebra as in the first instance, but to the end of normal movement, i.e. in the direction of no pain and free movement. (Bourdillon et al. 1992:121-122.)

Currently, no research comparing one form of manipulation with another has been published (Reggars and Pollard 1995).

The current belief that the spinal dysfunction is of a soft tissue nature, as opposed to joint or bone, raises the question as to what an adjustment achieves. The concept that the effectiveness of spinal manipulative therapy may be due to a reprogramming of the central nervous system helps offer an explanation. Thus, the principal effect of manipulative technique seems to be to stretch muscles to their normal resting length before spinal mobility can be restored. (Bourdillon et al. 1992:39,129.)

Adjusting the side opposite to the fixation may cause a sudden stretch of the muscle spindle resulting in a barrage of afferent impulses to the central nervous system, which reflexly turns down the gamma motor neuron tone. The resetting of the gamma motor neuron tone and resultant restoration of the muscle spindle's normal resting length, thereby helps to relieve the associated muscle spasm and possibly removes the fixation. In addition, by adjusting the neck on the non-fixated side and thus avoiding applying a contact over the hypertonic musculature on the side of fixation, the patient should be more relaxed, which could allow for a less forceful, more comfortable, easier, and therefore potentially more effective adjustment.

1.2. *THE PROBLEM STATEMENT*

The purpose of the study was to determine the relative effectiveness of adjusting the ipsilateral side of the fixated segment versus adjusting the side contralateral to that of the fixated segment, in patients with facet syndrome of the cervical spine, in terms of subjective and objective clinical findings, as well as patient comfort.

1.2.1. The first subproblem

The first subproblem was to determine the relative effectiveness of adjusting the ipsilateral side of the fixated segment versus adjusting the side contralateral to that of the fixated segment, in patients with facet syndrome of the cervical spine, in terms of subjective clinical findings.

1.2.2. The second subproblem

The second subproblem was to determine the relative effectiveness of adjusting the ipsilateral side of the fixated segment versus adjusting the side contralateral to that of the fixated segment, in patients with facet syndrome of the cervical spine, in terms of objective clinical findings.

1.2.3. The third subproblem

The third subproblem was to determine the relative effectiveness of adjusting the ipsilateral side of the fixated segment versus adjusting the side contralateral to that of the fixated segment, in patients with facet syndrome of the cervical spine, in terms of patient comfort.

1.2.4. The fourth subproblem

The fourth subproblem was to integrate the results of subproblems one, two and three, in order to determine the relative effectiveness of the two modes of treatment, in patients with facet syndrome of the cervical spine.

1.3. *HYPOTHESES*

1.3.1. The first hypothesis

It is hypothesized that by adjusting the ipsilateral side of the fixated segment, versus adjusting the side contralateral to that of the fixated segment, there will be a statistically significant difference in patients with facet syndrome of the cervical spine, in terms of subjective clinical findings.

1.3.2. The second hypothesis

It is hypothesized that by adjusting the ipsilateral side of the fixated segment versus adjusting the side contralateral to that of the fixated segment, there will be a statistically significant difference, in patients with facet syndrome of the cervical spine, in terms of objective clinical findings.

1.3.3. The third hypothesis

It is hypothesized that by adjusting the ipsilateral side of the fixated segment versus adjusting the side contralateral to that of the fixated segment, there will be a statistically significant difference, in patients with facet syndrome of the cervical spine, in terms of patient comfort.

1.3.4. The fourth hypothesis

Upon integrating the results of subproblems one, two and three, it is hypothesized that there will be a statistically significant difference regarding the two modes of treatment, in patients with facet syndrome of the cervical spine.

1.4. *SIGNIFICANCE OF THE STUDY*

Spinal joint dysfunction is considered to be a common and important source of spinal pain and a possible cause of spinal degeneration (Sandoz 1976; Dishman 1985; Dishman 1988).

Spinal manipulation is commonly used by chiropractors, osteopaths, and the manual therapists for the treatment of joint dysfunction and other musculoskeletal disorders (Reggars and Pollard 1995).

Chiropractic manipulation has been considered a cost-effective (Johnson et al. 1989) and effective treatment for a wide variety of conditions, but especially for disorders of the neuromusculoskeletal system (Bergmann et al. 1993:39).

There are a large variety of manipulative techniques used to remove spinal fixations and their associated muscle hypertonicity. These include direct techniques whereby the thrust is applied directly toward the side of restriction, and exaggeration techniques, whereby the joint is moved away from the dysfunctional barrier up to the opposite end of its normal range, and a thrust is applied to the same vertebra as in the first instance, but to the end of normal movement, i.e. in the direction of no pain and free movement. (Bourdillon et al. 1992:121-122). A principle that has some following is that the manipulation must be carried out in the direction opposite to that which is painful and/or restricted, with regard to the cervical spine as a whole. This is called "the rule of no pain and free movement". (Maigne 1972:138.)

Chiropractic research has yet to establish which of the many chiropractic techniques possess unique characteristics of efficacy, indications and contraindications etc. Thus deciding on which chiropractic technique to utilize for a specific clinical situation is a difficult and highly subjective task. (Kawchuk and Herzog 1993.) Currently, no research comparing one form of manipulation with another has been published (Reggars and Pollard 1995).

By comparing adjusting the ipsilateral side of fixation versus adjusting the contralateral side of fixation, information was obtained which helped determine which manipulative approach was more beneficial in terms of effectiveness, cost-effectiveness, as well as patient comfort.

CHAPTER TWO

2.0. REVIEW OF THE RELATED LITERATURE

2.1. *INCIDENCE AND PREVALENCE OF NECK PAIN*

Neck pain is a common complaint affecting 40% - 50% of the population at some stage of their lives (Kelsey 1982:146). An industrial study showed that 5% of workers were unable to work because of neck pain (Hult 1954).

A study undertaken by Takala et al. (1982) indicated the prevalence of neck pain amongst a middle-aged population in South Western Finland as being 16% in men and 18% in women.

Even though the majority of patients recover from mechanical neck pain, as many as one-third can continue to suffer from moderate to severe pain 15 years after the initial occurrence (Gore et al. 1987).

In another study, 11 423 patients with neck pain were analyzed by Dvorak et al. (1989) and it was found that 87,5% of these cases were soft tissue injuries; 53% were as a result of motor vehicle accidents and 45% were caused by falls and sports-related injuries.

It is thought that a third of all automobile accidents are responsible for 85% of whiplash injuries. Approximately 1 million patients suffer from neck pain annually at a cost of 2 billion dollars per year. (Osterbauer et al.1992.)

In a study assessing the prevalence of cervical zygapophyseal joint pain in 318 subjects with chronic neck pain, Aprill and Bogduk (1992) found that 25% of the neck pain was as a result of symptomatic zygapophyseal joints, and concluded that zygapophyseal joints as a source of pain was fairly common.

Studies have indicated a 25% - 30% incidence of single or multiple attacks of cervical stiffness amongst working individuals within the 25 - 29 year old age group and this figure climbs to 50% amongst individuals past the age of 45 (Bland 1994:6). Bland (1994:6) further claims that although cervical pain occurs slightly less frequently than low back pain, the disability level of neck pain is substantially less.

2.2. *ANATOMY*

The cervical spine is a long lever with the head balancing on top, comprising approximately 10% of the body weight. This arrangement predisposes the cervical spine to traumatic forces. (Gatterman 1990:205.)

The vertebrae of the cervical spine are classified into typical vertebrae (C_3 – C_6) and atypical vertebrae (C_1, C_2 and C_7). Each vertebral segment contains spinous and transverse processes acting as levers to which various muscle groups attach to enable cervical spine motion. (Foreman and Croft 1995:262.)

The intervertebral discs provide 25% of the vertical height of the cervical spine, as well as adequate spacing to enable safe exit of the spinal nerves from the intervertebral foramina (Foreman and Croft 1995:276).

The individual vertebral segments are connected by the facet (zygapophyseal) joints posteriorly and the intervertebral discs anteriorly. The facet joints are made up of the superior and inferior articular processes of adjacent vertebrae. They are lined with hyaline cartilage and enveloped by a loose synovial-lined fibrous capsule and are thus classified as true diarthrodial joints. The joints are innervated by nociceptive as well as proprioceptive nerve fibres arising from the medial branch of the dorsal primary ramus. (Mooney and Robertson 1976; Lippitt 1984; Gatterman 1990:14.)

The zygapophyseal joints are orientated approximately 45° to the horizontal and 90° to the sagittal plane (Haldeman 1992:138; Milne 1993.) The inferior facets are flat and oval, and are orientated antero-inferiorly, while the superior facets are of similar shape and orientated postero-superiorly (Gatterman 1990:206).

The cervical facet joint capsules are more lax than other areas of the spinal column to enable free gliding motion (Sherk et al. 1989:15).

Meniscoid synovial folds have been observed in the facet joints of the cervical spine. Although the anatomical nature of these folds have been extensively studied, knowledge is seriously lacking about their function and potential involvement in inflammatory neck pain. In addition to entrapment of these folds within facet joints, fibrosis of these meniscoids have also been observed. (Haldeman 1992:66.)

The muscles, ligaments and joint capsules provide postural stability, while allowing for adequate spinal motion, and it is these components that are commonly injured during trauma (Gatterman 1990:14, 205).

The most common cervical injury is the joint sprain with articular fixation and associated muscle strain (Gatterman 1990:205).

2.3. *BIOMECHANICS*

The cervical spine is considered the most mobile area of the spinal column, sacrificing stability for mobility (Gatterman 1990:214). It thus has an increased susceptibility of incurring disabling injuries due to its wide range of mobility in contrast to other regions of the body (Haldeman 1992:137).

The upper cervical spine (occipito-atlanto-axial complex) is regarded as a transitional area between the skull and remaining segments of the cervical spine (Gatterman 1990:214). These transitional segments ($C_o - C_1 - C_2$) are exposed to greater static and dynamic strains than other spinal segments (Grieve 1994:318).

Extension of the cervical spine occurs by posterior tilting and translation of each vertebral segment. Extension is limited by the superior articular process of the inferior vertebra, anterior longitudinal ligament and the posterior arches. In contrast, anterior tilting and translation of each vertebral segment occurs during flexion. The ligamentum nuchae, ligamentum flavum, posterior longitudinal ligament, capsular ligaments and posterior cervical ligaments aid in restricting flexion. (Lenhart 1988.)

Hyperflexion and hyperextension injuries can cause disruption of these ligaments (Kapandji 1974). These ligamentous injuries are significant because they may be contributing to localized and referred pain patterns to the head and associated reflex muscle spasm (Lenhart 1988).

The primary movement occurring at the atlanto-occipital joint is flexion (Gatterman 1990:215), whereas 40% - 50% of the total range of rotation in the cervical spine occurs at the atlanto-axial joint (Gatterman 1990:216; Haldeman 1992:64). In contrast, the primary motion in the lower cervical spine is flexion-extension (Gatterman 1990:218).

Pronounced coupling of movements have been observed in the cervical spine, especially between rotation and lateral flexion (Haldeman 1992:137).

The coupling of lateral flexion and axial rotation is described as the composite motion of the cervical spine. It is believed that this composite motion occurs about an oblique axis in the sagittal plane. It has been suggested that due to the position and orientation of the axis of composite motion, the anterior aspect of each cervical disc acts as a pivot, while the posterior aspect of the disc and uncinate processes on either side act as a socket within which the upper vertebral body rolls. (Milne 1993.)

It has been further noted that pure lateral flexion or axial rotation can occur in the lower cervical spine, whereas an equal ratio of lateral flexion and rotation occurs in the upper cervical spine regardless of the applied moment. Thus the axis of applied motion is less variable in the upper than the lower cervical spine. (Milne 1993.)

2.4. *FACET SYNDROME*

Neck pain is a poorly understood symptom, the source of which is often difficult to diagnose (Dwyer et al. 1990). Neck pain with no neurological signs is still often incorrectly diagnosed as "cervical spondylosis" or "soft tissue injury". The radiographic evidence of cervical spondylosis is equally prevalent in symptomatic and asymptomatic subjects, and thus cannot be the cause of pain. The diagnosis of soft tissue injury is often based upon a history of trauma in conjunction with normal radiographic findings. The type of soft tissue injury is very rarely specified. For these reasons, more attention has been turned to the zygapophyseal joints as a specific source of pain. (Aprill and Bogduk 1992.) According to Dwyer et al. (1990), the cervical zygapophyseal joints can be a source of neck pain.

Facets were first noted as a source of pain by Goldthwait in 1911, and in 1927 reinforced by Putti (Lippitt 1984). The term "facet syndrome" was first referred to by Dr. Ralph Ghormley at the 84th Annual Session of the American Medical Association in Milwaukee on 15 June 1933 and published on 2 December 1933 (Peters 1984).

The term facet syndrome is characterized by overriding of the facets of adjacent vertebrae and associated narrowing of the intervertebral foramina. It also relates to a state of tension, stretching, irritation or pressure of the joint capsule, due to postural strain or trauma, but without intervertebral foraminal narrowing. (Peters 1984.) According to Roy et al. (1988), facet syndrome is a disorder of the zygapophyseal joints causing local and radiating pain.

2.4.1. Aetiology

Facet syndrome can be caused by three possible factors. These include: chronic synovial and/or capsular inflammatory reaction to trauma, spinal instability, and degenerative conditions. (Mooney and Robertson 1976; Lippitt 1984.)

2.4.2. Signs and symptoms

Experimental studies have shown that injection of cervical zygapophyseal joints produce local and referred patterns of pain similar to patients exhibiting neck pain (Aprill and Bogduk 1992).

There are two primary facet syndromes determined by the level of the affected joints. The cervical headache syndrome correlates with C_2 - C_3 and C_3 - C_4 joints and is characterized by a hemi-occipital headache with or without supra-orbital radiation. This is due to the anastomoses between the trigeminal nucleus and dorsal rami of the upper cervical nerves. The second syndrome, cervical dorsalgia, correlates with the C_5 - C_6 and C_6 - C_7 facet joints and is characterized by interscapular thoracic pain with or without cervical and brachial pain. (Roy et al. 1988.)

Inflammation as a result of overstretched joint capsules and stretched/ruptured ligaments may be a continuous source of pain. This may result in increased muscular hypertonicity causing abnormal cervical motion as well as affecting the fine intersegmental movements of the cervical spine. Although hypertonicity of the intersegmental muscles that function to co-ordinate fine intersegmental movements occurs first, it is only the muscle spasm of the larger postural neck muscles that are normally clinically visible. (Foreman and Croft 1995:313.)

The classic signs of facet syndrome are focal tenderness, palpable muscle spasm, headaches and restricted range of motion over the affected facet joint (Dishman 1988; Gatterman 1990:162; Osterbauer et al. 1992).

2.4.3. Diagnosis

The evaluation of joint dysfunction is not a specific science and examination procedures may yield false negative, false positive and equivocal results (Bourdillon et al. 1992:39). The diagnosis is primarily based upon clinical evaluation as opposed to radiographic evidence which is invariably negative (Roy et al. 1988).

According to Bourdillon et al. (1992:49), the five diagnostic criteria for spinal dysfunction are as follows :

i) Pain and tenderness - the quality, location and intensity of pain is evaluated by means of percussion and palpation of bony and soft tissue structures of the spine.

ii) Alignment/asymmetry - the alignment of the spinal column may be assessed by observing and palpating bony landmarks of the individual vertebrae.

iii) Range of motion abnormalities - active, passive and accessory joint motions are evaluated for increased, decreased and abnormal movements.

iv) Tissue texture, tone and temperature abnormalities - soft tissue changes such as oedema and thickening of the skin, fascia, ligaments and muscles, around a dysfunctional joint, are known to occur. These are evaluated by means of observation and palpation.

v) Special tests - these are orthopaedic tests that may be necessary to obtain a final diagnosis. Examples include cervical compression, Kemp's tests, etc.

During examination, neurological abnormalities are not usually found, although deep tendon reflexes may be repressed due to noxious stimuli from the irritated facets inhibiting the anterior horn cells (Peters 1984).

A study of 17 patients was conducted to assess whether cervical medial branch blocks were diagnostically specific and selective for cervical facet joint pain. Fourteen of the patients obtained complete relief and it was concluded that cervical medial branch blocks are specific for the diagnosis of cervical facet joint pain, and the anaesthetic does not affect any other adjacent structures. (Barnsley and Bogduk 1992.)

Jull et al. (1988) evaluated the ability of a manipulative therapist to accurately diagnose cervical facet syndrome in 20 patients. All 20 patients were assessed for the presence of cervical facet syndrome by means of radiologically-controlled diagnostic nerve blocks. The manipulative therapist correctly identified all 15 patients with already medically proven symptomatic zygapophyseal joints, and correctly located the affected segmental level. The remaining 5 subjects with asymptomatic facet joints were not misdiagnosed as being symptomatic. This indicates that manual diagnosis by a competent manipulative therapist can be as accurate as radiologically-controlled nerve blocks in the diagnosis of cervical facet syndrome. In the case of the trial, it can be said that the diagnostic techniques used by this manipulative therapist had a sensitivity and specificity of 100%. The criteria used for making the diagnosis of cervical facet syndrome were :

i) Abnormal end feel - increased/decreased springiness at end range of motion.
ii) Abnormal quality of resistance to motion - i.e. increased/decreased resistance to motion.
iii) Reproduction of pain - by palpation.

Radiographic evidence of facet syndrome may include articular cartilage thinning and roughening and sclerosis of the posterior facet joints with possible overriding of the facet joints (Gatterman 1990:161). It is important to note however that the clinical findings of facet syndrome are more diagnostic than the radiological findings (Alley 1983; Gatterman 1990:163).

2.4.4. Prognosis

Gore et al. (1987) evaluated 205 patients over a 10 year follow-up period and it was noted that the presence or severity of neck pain bore no relation to degenerative changes, sagittal spinal canal diameter and the degree of cervical lordosis. The above authors further state that minimal information is available to adequately predict the final prognosis of neck pain. It was found however that injured patients with severe pain were more likely to have a poor prognostic outcome than injured patients with milder pain; this did not apply to patients whose neck pain was not caused by injury.

2.4.5. Treatment

Since its inception, the primary treatment method used by chiropractors is spinal manipulation, commonly used to normalize joint and muscle function (Fitz-Ritson 1990). The histological components (i.e. scar tissue and intra-articular adhesions) and biochemical components (i.e. kinins, histamine, prostaglandins and leukotrienes, etc.) of facet syndrome help authorities understand the tissue changes and pain mechanisms and the need for multiple spinal manipulations. Repetitive spinal manipulations may break down scar tissue and intra-articular adhesions and thus help restore joint mobility. (Dishman 1988.) Anaesthetic injection of the facet joints has proven effective in the management of facet syndrome, but it is not recommended until conservative therapy has failed (Mooney and Robertson 1976).

2.5. *SPINAL DYSFUNCTION*

2.5.1. Introduction

Dishman (1988) defines intervertebral dysfunction as a biomechanical fault with abnormal static and dynamic components.

According to Dishman (1985), the five components of the chiropractic subluxation complex are: neuropathophysiology (i.e. abberant neurological activity), kinesiopathology (i.e. abnormal joint motion such as hypomobility or hypermobility), myopathology (i.e. muscle spasm), biochemical (i.e. release of inflammatory agents such as kinins, histamine, etc.) and histopathology (i.e. connective tissue changes such as scar tissue and intra-articular adhesions).

There are multiple terms describing the lesion that practitioners adjust (Reggars and Pollard 1995). These terms include vertebral subluxation complex (Schafer and Faye 1990:133-134), joint dysfunction (Mennell 1990), and manipulable lesion (Dishman 1988). These various terms are considered by their authors to have specific features, but one characteristic common to all these terms is restricted or limited vertebral motion (Reggars and Pollard 1995).

Similarly, there are numerous manipulative techniques used by different practitioners to treat joint dysfunction (Reggars and Pollard 1995).

Joint dysfunction is usually accompanied by the absence of mechanical joint play which is necessary for normal efficient motion for any joint in the body (Mennell 1990). In addition, Schafer and Faye (1990:7) claim that loss of joint play results in a painful joint with associated secondary muscle spasm.

While there is some proof that manipulable lesions exist, it still remains inconclusive (Dishman 1988). However, the mounting volume of evidence supporting the spinal fixaton describes the malfunction of the vertebral motion units and paves the way toward further research regarding how manipulation and restoration of hypomobility may reduce degenerative joint disease and improve the prognosis for spinal health (Dishman 1985).

2.5.2. Aetiology of spinal dysfunction

Neck pain associated with limited mobility is a common condition. The majority of cases are due to mechanical dysfunction of the cervical spine, but the exact pathological nature is not fully understood (Gore et al. 1987).

Many doctors of chiropractic use the mechanical model to describe disease production. Although the relationship of structural abnormality to function is described in terms of the neurological component, the precise mechanism of how this occurs continues to remain obscure. (Dishman 1985.)

To date the precise causes of spinal fixation are still not agreed upon, but there is some agreement that possible causes include muscle spasm, ligamentous shortening, tightened fascia or articular capsules, meniscoid entrapment, disc displacement, disc resorption, annular disc tears, mechanical joint locking, intra-articular adhesions and chemical irritation (Dishman 1988; Bourdillon et al. 1992:23).

Although data is generally lacking, studies do suggest a significant correlation between varying levels and types of spinal mobility changes, with pathologies such as osteoarthritis, trauma, ankylosing spondylitis, spondylolisthesis and cervical angina (Alley 1983).

Dishman (1988) claims that adhesion formation between ligaments, tendons and muscles as a result of trauma, may result in soft tissue contractures and associated joint hypomobility. It is also important to note that any segmentally related structure sending afferent impulses, such as pain, to the spinal cord may be an important factor in the initiation or maintenance of the spinal subluxation complex (Dishman 1985).

Immobility promotes biochemical changes within the matrix of connective tissue structures. In contrast, mobility prevents the formation of adhesions and contractures within the joint. (Dishman 1985.)

Upon inspection of immobilized synovial joints using internal fixation devices, Woo et al. (1975) found fatty fibrous depositions which eventually matured into scar tissue and fibrous adhesions. These biomechanical changes resulted in reduced motion.

Rubak et al. (1982) observed the effects of joint immobilization in 6-month old rabbits. After 3 weeks of immobilization, intra-articular adhesions and defects were visible, and after 6 weeks, muscular atrophy and joint stiffness had occurred.

Nansel et al. (1992) questioned whether asymmetric efferent impulses involving the paraspinal musculature are due to erroneous capsular afferent discharges by means of complex spinal reflex arcs.

Fitz-Ritson (1985) describes the paraspinal musculature as having the highest density of muscle spindles in the body. Due to the cervical muscles having such a rich supply of muscle spindles which are their sensors, any proprioceptive change in the muscles (eg. trauma, tension, etc.) will cause a barrage of afferent information and could thus result in postural imbalances.

The phenomenon whereby nervous impulses can be elicited with minimal stimulation is called facilitation. The chiropractic spinal fixation represents a facilitated segment of the spinal cord maintained by afferent impulses entering the dorsal nerve root. This may result in excessive excitation or inhibition of structures receiving efferents from the affected segment. (Dishman 1985.)

Muscle proprioceptors are the most significant source of afferent impulses which may result in spinal cord changes and associated spinal fixations.

Evidence of pathophysiological changes in a spinal fixation includes abnormal action potentials measured by electrode needle insertion, low reflex thresholds, abnormal muscle contraction, motorneuron pool facilitation and microscopic tissue abnormalities. (Dishman 1985.)

Fitz-Ritson (1990) claims that proprioceptive changes in the muscles and joints, and the development of abnormal neural reflexes, have an effect on the central nervous system, and thus can lead to further problems. It is thus necessary to restore joint and muscle function of the cervical spine as rapidly and specifically as possible.

Resting muscle fibre length is controlled by muscle spindles, which in turn are set by the gamma motor neurons. Muscle guarding after injury appears to be due to resetting of the "gamma gain", such that the spindles become shorter and thus cause the muscle fibres to shorten too. These muscle fibres will contract normally, even with the shortened resting length, but are unable to relax enough to allow full movement of the affected joint. (Bourdillon et al. 1992:298.)

Fixations may also be produced by muscle contraction, which produces pain. Contrary to popular thought, this is not a reflex contraction, but a biomechanical phenomenon whereby the injured muscle releases calcium ions which combine with ATP (adenosine triphosphate) to produce involuntary muscle contraction, pain, tenderness and vasoconstriction etc. This limited joint mobility, tendon and fascial shortening, are due to the inflammatory process and reduced muscle length. (Dishman 1988.)

The associated pain of the spinal subluxation may initiate reflex muscle spasm leading to local ischaemia, release of inflammatory products and possible muscle splinting. This eventually results in a continuous cycle of pain and muscle spasm. (Dishman 1988; Maigne 1972:33,34; Gatterman 1990:43,44.) The inflammatory process may exacerbate the pain response, lengthen the recovery time and perpetuate joint dysfunction. Muscle contractures infiltrated with fibrotic tissue may eventually develop from persistent muscle contraction. (Kirkaldy-Willis 1992:52.)

It is thus thought that spinal joint dysfunctions and their associated inflammatory and pain responses are capable of initiating chronically altered proprioceptive and nociceptive input (Dishman 1985; Gillete 1987).

The three usual aetiological factors associated with joint dysfunction are: immobilization, trauma, and factors associated with a pathological condition. Due to the mechanical nature of joint dysfunction, the mechanical treatment used to restore joint play is manipulation. (Mennell 1990.)

2.5.3. Effect of adjustment

Chiropractic manual therapy has been considered an effective treatment for a wide variety of conditions, but especially for disorders of the neuromusculoskeletal system (Bergmann et al. 1993:39).

Despite the widespread use of spinal adjustments, there have been few clinical controlled trials investigating the effects of manipulation (Mierau et al. 1988).

Unfortunately, not much is known about the mechanisms of action or effects of a spinal manipulation (Haldeman 1992:434).

The effect that manipulative treatment has on the vertebral joints is not fully understood. The following effects have been hypothesized or observed to occur:

i) Absolute or relative vertebral movements.
ii) Reflex muscle response in the vicinity of the manipulative thrust. (Herzog 1994.)

Current thought has suggested that the primary mechanical effect of the diversified type adjustment is to impart greater mobility to a spinal articulation. Theoretically, any adjustive technique should be directed specifically in the direction of a spinal joint's hypomobility. (Good 1992.)

The remittance of symptoms and tissue texture changes following spinal manipulation, suggests that the soft tissues may be very much involved in maintaining spinal fixation. The immediate release of the fixation following spinal manipulation, suggests that there is most likely a change in the mechanism by which the central nervous system controls muscle tone (Bourdillon et al. 1992:39.)

The question that is often asked is, if the soft tissues are the cause of the problem, why does a high speed adjustment restore motion to a restricted joint? A muscle spindle that is stretched, reflexly causes the involved muscle to tighten. However, high velocity thrusting appears to help overcome this tendency, and this may be due to the sudden lengthening of the muscle spindles. It seems that this may also cause a resetting of the tone of the gamma motor neurons and allow the muscle spindles to resume their normal resting length. (Bourdillon et al. 1992:301.)

This is supported by Nansel et al. (1992) who suggest that abnormal afferent and efferent impulses involved in spinal passive end range asymmetries are possibly musculature in nature, and spinal adjustments normalize spinal motion restriction and hypertonic musculature by stimulating muscle spindles and golgi tendon organs known to influence dynamic and static contractile states.

If two spinal units are fixated because of unilateral hypertonicity of the intervertebral muscles, a dynamic thrust that aims to relieve the fixations will thus stretch the contracted muscles (increase the distance between muscle origin and insertion). Chronic fixations are thought to be caused by ligament and soft tissue shortening. Therefore the type of thrust utilized must also be designed to lengthen ligamentous tissue. (Schafer and Faye 1990:15-16.)

Reflex responses of the thoracic musculature during spinal manipulation were measured using bipolar electrodes placed over the muscles on the side contralateral to the side of the thrusting force. These reflex responses were measured for fast and slow thrusts. It was found that high speed adjustments caused a reflex response associated with stretching of the muscle spindles (measured in the form of an electromyographical signal), whereas no such response was observed for slow speed adjustments. It thus appears that the speed of the adjusting thrust is of significant importance in initiating reflex responses. (Herzog 1994.)

2.6. *MOTION PALPATION*

The two general types of palpation used are static palpation and motion palpation (Russell 1983).

Static palpation is used to assess tissue tone, tender areas, temperature and osseous alignment. The disadvantage of this technique is that bony prominences may be misshapen creating asymmetries that falsely reflect abnormal mechanical function. In addition, static palpation does not account for the dynamic nature of the body's articulations. (Russell 1983.)

Motion palpation is defined as palpatory diagnosis of passive and active segmental joint range of motion (Haldeman 1992:625). Motion palpation thus assesses dynamic compliance of the musculoskeletal system. It is further divided into active and passive motion palpation. Active motion is performed actively by the patient and occurs within the patient's normal physiological range. It is assessed by palpating vertebral prominences while the patient actively performs flexion, extension, rotation and lateral flexion. Passive motion exceeds the patient's normal physiological range of motion and is performed by the examiner. During passive motion palpation, the joint is stressed beyond the physiological barrier up to the elastic barrier and the quality of end feel is assessed. (Russell 1983.)

Detecting motion disturbances is considered extremely important. The functional demands placed upon a motion segment may not be met in the presence of abnormal motion. If such a condition is not ameliorated, pathological changes may occur within the joint. (Russell 1983.)

Motion palpation is becoming more widely utilized throughout the chiropractic profession. There is general agreement amongst most experienced examiners that motion palpation plays an integral role in locating hypomobilities and hypermobilities. (Dishman 1988.)

Russell (1983) claims there is inadequate data regarding the intra- and inter-examiner reliability and validity of motion palpation.

However, Dishman's (1988) search of the literature indicates that this procedure has been successfully and repetitively tested, using interexaminer reliability research protocols, thus showing its validity and accuracy.

Nansel et al. (1989) found interexaminer reliability in identifying spinal fixation to be fairly inconsistent (0 – 1,0), whereas Mior et al. (1985) found intraexaminer reliability to be relatively consistent (0,45 – 0,53).

Deboer et al. (1985) conducted a reliability study amongst 40 asymptomatic individuals in order to determine the intra- and inter-examiner reliability of static and motion palpation of their cervical spines by 3 different chiropractors. All 3 chiropractors showed a statistically significant level of agreement regarding intra- and inter-examiner comparison of fixations in the lower cervical spine. There was no statistical agreement of fixation findings in the middle cervical spine for both the intra- and inter-examiner comparisons. There was an intermediate level of agreement for fixation findings in the upper cervical spine, with a high level of intraexaminer reliability and an extremely low level of interexaminer reliability.

Techniques which use cervical x-rays to diagnose static/positional vertebral misalignments are questionable due to the unreliability of x-ray marking, and the inherent x-ray distortions (Alley 1983).

Further research assessing technique and interexaminer reliability will help validate improved methods of motion palpation and reject others (Alley 1983).

2.7. *SPINAL ADJUSTMENT*

Since its inception, the primary treatment used by chiropractors is spinal manipulation, commonly used to normalize joint and muscle function (Fitz-Ritson 1990; Reggars and Pollard 1995).

Mierau et al. (1988) define spinal manipulation as a high velocity, low amplitude thrust applied to a specific segment for the purpose of increasing range of motion of that segment. This is usually accompanied by an audible cracking sound.

Some practitioners consider the cracking sound an incidental component of the adjustment whereas others consider this phenomenon necessary (Dishman

1988). According to Sandoz (1976), the audible crack occurs after the elastic barrier has been breached.

A spinal adjustment is typically broken down into two phases: a preload phase which results in a preload force, immediately preceding the adjustive thrust; and the thrusting phase, resulting in the peak thrusting force (Herzog et al. 1993a; Kawchuk and Herzog 1993).

In a study comparing the relationship between preload and peak forces, Herzog et al. (1993b) found that since preload forces are used to move a joint to the end range of passive motion, a "stiff" joint needs greater preload force than a "soft" joint. Thus it appears that a "soft" joint requires a lesser thrusting force than a "stiff" joint.

The "Diversified Technique" of adjustment requires the joint slack to be taken out to reach the elastic barrier prior to delivering the thrust (Good 1992).

The quickness of adjustment consists of two components: high velocity and brevity. High velocity uses inertia to facilitate joint distraction, whereas brevity uses inertia to facilitate joint isolation. The force is thus focused into the joint of interest, thus minimizing force requirements to produce synovial joint cavitation, and thus facilitating a more gentle adjustment. Low amplitude protects the joint from distracting past the anatomical barrier. (Haas 1990.)

Countertension is used when quickness alone cannot produce adequate joint distraction. Preadjustive tension helps dampen forces and thus limits dissipation of energy. (Haas 1990.)

Theoretically, any adjustive technique should be directed specifically in the direction of a spinal joint's hypomobility in order to increase the mobility of the affected joint (Good 1992).

Although a specific threshold speed and force of thrust appear to produce significant positive mechanical and biological effects during the treatment process, excessive magnitudes of force thrust may result in injuries to the patient. Therefore control of force thrust appears to be of significant importance during the thrusting phase of spinal manipulation. (Maigne 1965; Herzog et al. 1993b.)

2.8. *EFFECTIVENESS AND COST-EFFECTIVENESS OF SPINAL MANIPULATION*

Mierau et al. (1988) has stated that "the large variety of techniques within the field of spinal manipulation have different therapeutic goals and are administered according to different biomechanical or physiological principles. There is currently no published research comparing one method of manipulation with others". This is supported by Cassidy et al. (1992a) who states that although many differing treatment protocols are given to patients with mechanical neck pain, there are few clinically controlled trials to establish the efficacy of these treatments.

Haldeman (1992:421,423) states further that almost all of the studies conducted on cervical pain and/or headache have been shown to be significantly effective. Most of these studies however have only evaluated the short term effects.

The most rigorous study design is considered to be the randomized control trial. Several major flaws have been identified in some of these trials. These include observer bias, non-blinding, inconsistent inclusion and exclusion criteria, lack of specificity as to level of spinal involvement, prejudice and subject's biological variation. (Brunarski 1984.)

Lippitt (1984) injected lidocaine and cortizone into facet joints as a method of identifying the source of pain, as well as treating facet syndrome. Seventeen percent received total relief of pain for 3 months, whereas 44% were unresponsive to treatment. Conservative treatment has been relatively effective in comparison to invasive techniques which have provided a relatively low success rate (Hourigan and Bassett 1989).

Nordemar and Thorner (1981) studied pain and global range of motion in 30 neck pain subjects. The subjects were treated with either a cervical collar, TENS or manipulation by a physiotherapist. Overall, the TENS group demonstrated the highest mean improvement in range of motion and pain.

In a randomized controlled trial of chronic neck pain sufferers, Sloop et al. (1982) gave 39 subjects an amnesic dose of diazepam. Twenty-one of these subjects received a single manipulation to the cervical spine. Eighteen of these subjects fell into the control group and received no manipulation. After 3 weeks, 57% of the manipulated group and 28% of the control group reported a clinical improvement in their pain, although these results were not statistically significant. After a further 12 weeks, the results still favoured the manipulated group.

Leach (1983) compared the efficacy of spinal manipulation versus the use of a cervical pillow in the correction of cervical hypolordosis/kyphosis. The manipulated group showed significant improvement in the correction of cervical hypolordosis and thus helps verify that spinal manipulation can be significantly effective in the correction of biomechanical disorders of the spine.

A study comparing the efficacy of manipulation versus mobilization of 62 metacarpophalangeal joints demonstrated a significant increase in metacarpopholangeal joint flexion of the manipulated group versus the mobilized group. These results help demonstrate that manipulation and mobilization have differing effects on joint function and should not be considered equivalent therapies. (Mierau et al. 1988.)

In a study comparing the efficacy of manipulation versus mobilization, Cassidy et al. (1992a) demonstrated that both groups had equally increased ranges of motion, but the manipulated group had a 1,5 times greater decrease in pain intensity than the mobilized group. This study demonstrated that manipulation appears to be more beneficial than mobilization in reducing pain in patients suffering from mechanical neck pain.

Koes et al. (1992) evaluated the effectiveness of manipulative therapy, physiotherapy, placebo and treatment by the general practitioner for non-specific back and neck complaints in 256 patients. It was found that both the manipulative therapy and physiotherapy had a significantly greater effect compared to treatment administered by the general practitioner. It is interesting to note that the placebo group had a more positive response when compared to the group treated by the general practitioner. The placebo group however had a lesser response than the manipulated and physiotherapy groups.

Howe et al. (1983) conducted a pilot study assessing the efficacy of cervical manipulation carried out on 52 patients in general practice. They found manipulation to yield an immediate significant improvement in patients with neck pain/stiffness, and paraesthesia/pain in the shoulder, and a near significant improvement in patients with paraesthesia/pain in the arm or hand. There was also a measured increase in cervical rotation which was maintained for a three-week period, and an immediate increase in lateral flexion that was not maintained.

Terrett and Vernon (1984) conducted a study amongst 50 patients equally divided into experimental and control groups. After manipulation the experimental group demonstrated a significant increase in pain tolerance (140%) as compared to the control group. This supports previous authors' hypotheses with regard to the efficacy of manipulation in the relief of spinal pain.

One hundred patients with neck pain were assessed by means of standard orthopaedic procedures. Eighty-three percent of these patients were manipulated. Of those manipulated, 34% felt marked improvement and 30% reported complete resolution of symptoms. These empirical results may aid in validating the presence of joint dysfunction as a manipulable condition. (Mennell 1990.)

Nansel et al. (1990) studied the initial efficacy and temporary stability of lower cervical adjustments with respect to the resolution of cervical lateral-flexion passive end-range asymmetries. The responses of pain-free patients exhibiting end-range asymmetries of greater than 10^0 with a history of cervical trauma were compared with patients having end-range asymmetries of greater than 10^0 and no previous history of cervical trauma over a period of 30 minute, 4 hour and 48 hour intervals, following a single lower cervical adjustment. Similar effects were observed for both groups, 30 minutes and 4 hours post-manipulation with a resolution of asymmetry. However, after 48 hours the group with a previous history of neck trauma tended to re-establish their lateral-flexion end-range asymmetries in contrast to the group with no previous neck trauma.

In a further study comprising the efficacy of upper versus lower cervical adjustments in relation to the resolution of passive rotational versus lateral-flexion end-range asymmetries, Nansel et al. (1992) found that lower cervical adjustments were significantly more effective than upper cervical adjustments in resolving lateral-flexion asymmetries, whereas upper cervical adjustments were far more effective than lower cervical adjustments in resolving rotational asymmetries. These findings suggest that passive rotational movement restrictions are primarily related to the upper cervical spine, whereas lateral-flexion passive end-range asymmetries are more related to the lower cervical spine.

Cassidy et al. (1992b) conducted a pilot study amongst 50 patients with neck pain to determine the effect of manipulation on pain and range of motion in the cervical spine. The results demonstrated an increase in all planes of range of motion and a decrease in pain scores immediately after manipulation. It was interesting to note that manipulation had the greatest effect on rotation and the improved rotation was associated with increased pain reduction.

In a study assessing cervical intersegmental mobility in 58 cases before and after manipulation, Yeomans (1992) found that mobility was significantly greater after manipulation as compared to before manipulation.

Johnson et al. (1989) compared the cost of care and number of days lost amongst patients receiving treatment from chiropractic, medical and osteopathic practitioners for work related sprains and strains of the back and neck. For those treated by chiropractors, the mean number of compensated days lost from work was at least 2,3 days less than those receiving treatment by medical doctors, and at least 3,8 days less than those treated by osteopaths. Patients treated by chiropractors had the highest median provider cost, but the mean was highest for those who saw medical doctors. Thus chiropractic treatment resulted in fewer workdays lost and lower amounts of disability compensation and provider cost payments.

Johnson et al. (1989) further states that the Florida Chiropractic Association reported an average of 3 days lost from work for chiropractic patients and 9 days for patients treated by medical doctors.

The average number of days lost for chiropractic patients was 5,8 and for medical patients 13,1, according to the American Chiropractic Association's study of Kansas (Johnson et al. 1989).

Chiropractic research has yet to establish which of the many chiropractic techniques possess unique characteristics of efficacy, indications and contraindications etc. Thus deciding on which chiropractic technique to utilize for a specific clinical situation is a difficult and highly subjective task. (Kawchuk and Herzog 1993.)

2.9. *DIRECTION OF THRUST*

Two alternative adjustive techniques used to treat joint pain are "assisted" and "resisted" adjustments. During an assisted adjustment, the thrust moves the vertebra in the same direction as the set up, whereas during a resisted adjustment, the thrust is opposite to the direction of the set up. (Good 1992.)

Similar techniques include direct techniques whereby the thrust is applied directly toward the side of restriction, and exaggeration techniques whereby the joint is moved away from the dysfunctional barrier up to the opposite end of its normal range, and the thrust is applied to the same vertebra as in the first instance, but to the end of normal movement (Bourdillon et al. 1992:121-122).

Another manipulative method used involves "the concept of painlessness and opposite motion". This method consists of manipulating in the direction opposite to that which is painful and/or restricted. It is further thought that although forcing the spine in a painful and/or restricted direction may offer improvement, it is often accompanied by pain and makes symptoms worse. Thus although forcing the spine in a specific direction may break adhesions, there is a chance of initiating inflammation and irritation which could worsen symptoms. (Maigne 1965.) This concept is supported by Schneider et al. (1988:6) and Kenna and Murtagh (1989:48) who also adjust in the pain free direction.

According to Schafer and Faye (1990:56), the adjusting thrust should be applied in the direction of restriction (i.e. on the fixated side). In addition, if more than one plane of motion is restricted or blocked, it may be necessary to adjust in more than one plane on the side of fixation.

Information is lacking regarding manual force, mechanically-assisted articular chiropractic techniques, and controlled clinical trials are needed to evaluate the relative efficacy of these techniques (Bergmann 1993).

2.10. *COMPLICATIONS*

The mortality rate from cerebral infarction has diminished in recent years but cerebrovascular accident and cerebrovascular disease are still significant health problems (Thiel 1991).

The majority of published articles mention serious complications following chiropractic spinal manipulation to the cervical spine (Terrett 1987).

Compromise of the vertebral artery between axis and atlas during head rotation has been cited by several authors as the cause of cerebrovascular accidents after manipulation. The aetiology is thought to be due to stretching of the segment between atlas and axis during head rotation and thus resultant intraluminal vertebral artery narrowing. Due to the structural locking mechanisms of C_2 - C_6, excessive rotation does not occur in this area of the cervical spine, thus safeguarding compression and stretching of the vertebral artery. (Thiel 1991.)

One possible cause of vertebrobasilar arterial insufficiency (VBAI), is manipulation of the cervical spine, whereby both extension and rotation are involved. However. other activities whereby a combination of rotation and extension occur, including yoga, ceiling painting, archery, motor vehicle accidents and intubation, are also possible causes. (Thiel 1991.)

Other possible mechanisms of vertebral artery injury include arterial wall vasospasm due to trauma (Terrett 1987) and decreased vertebral artery diameter making them more susceptible to compression and trauma (Kleynhans 1980:366). In addition, degenerative changes of the upper cervical spine may predispose the vertebral artery to mechanical impingement and further damage (Terrett 1987).

To help minimize the risk of vascular accidents following cervical manipulation, no more than 45^0 of head rotation should occur during a rotary type adjustment, and thus shear and stretch of the vertebral artery at the C_1 – C_2 articulation can be avoided (Byfield 1991).

The symptoms of vertebrobasilar arterial insufficiency are often vague, which makes diagnosis difficult. The symptoms include dizziness, vertigo, ataxia, tinnitus, nausea, syncope and visual disturbances. (Thiel 1991.)

According to Terrett (1987), cervical manipulation as an aetiological factor of strokes appears extremely uncommon. In his review of 107 cases of postmanipulative cerebrovascular accidents, he reported mild neurological complications of one in 40 000 manipulations, and one significant complication in 400 000 cervical manipulations.

In a study assessing the incidence of complications following 228 050 manipulations by South African physiotherapists between 1971 and 1989, it was found that 25 patients reported a 92% incidence of the following minor complications after cervical manipulation. These were classified as follows: 12 dizziness, 11 nausea, 10 severe headaches, 3 nystagmus, 3 blurring of vision, 3 vomiting, 3 brachialgia, 1 brachialgia with neurological deficit, 1 loss of consciousness, 1 acute wry neck. Seventy-five percent of the 25 cases of complications following cervical manipulation involved a rotary type adjustment. (Michaeli 1993.)

Thus Terrett (1990) stresses the importance of developing the clinical expertise in order to reduce the potential of post-manipulative complications.

Further examples of conditions which contraindicate spinal manipulation include osteoporosis, infection, neoplasms, massive disc extrusions and hypermobility (Bourdillon et al. 1992:286-289).

2.11. *CONCLUSION*

Neck pain with restricted mobility is a common problem. Forty to fifty percent of the general population are affected at some stage during their lives. (Kelsey 1982:146.) Approximately 1 million patients suffer from neck pain annually at a cost of 2 billion dollars per year (Osterbauer et al. 1992).

In a study assessing the prevalence of cervical zygapophyseal joint pain in 318 subjects with chronic neck pain, Aprill and Bogduk (1992) found that 25% of the neck pain was as a result of symptomatic zygapophyseal joints, and concluded that zygapophyseal joints as a source of neck pain was fairly common.

The cervical spine has been a neglected entity as far as research is concerned (Grieve 1994:39). Although many differing treatment protocols are given to patients with mechanical neck pain, there are few clinically controlled trials to establish the efficacy of these treatments (Mierau et al. 1988; Cassidy et al. 1992a).

Since its inception, the primary treatment method used by chiropractors is spinal manipulation, commonly used to normalize joint and muscle function (Fitz-Ritson 1990; Reggars and Pollard 1995).

There have been a number of studies in the recent past demonstrating the effectiveness and cost-effectiveness of spinal manipulation in the relief of spinal pain (Sloop et al. 1982; Howe et al. 1983; Leach 1983; Terrett and Vernon 1984; Johnson et al. 1989; Mennell 1990; Cassidy et al. 1992a; Cassidy et al. 1992b; Nansel et al. 1992; Yeomans 1992).

Currently, no research comparing one form of manipulation with another has been published (Reggars and Pollard 1995).

Some procedures include direct techniques whereby the thrust is applied directly toward the side of restriction, and exaggeration techniques whereby the joint is moved away from the dysfunctional barrier up to the opposite end of its normal range, and a thrust is applied to the same vertebra as in the first instance, but to the end of normal movement (Bourdillon et al. 1992:121-122).

According to Schafer and Faye (1990:56), the adjusting thrust should be applied in the direction of the restricted segment (i.e. on the fixated side). In contrast, Maigne (1965) believes that the adjustment should be applied in the direction opposite to that which is painful and/or restricted.

The current belief that the spinal dysfunction is of a soft tissue nature, as opposed to joint or bone, raises the question of what an adjustment achieves.

The concept that the effectiveness of spinal manipulation may be due to a reprogramming of the central nervous system by suddenly stretching the muscle spindle, helps offer an explanation. Thus the principal effect of manipulation seems to be to stretch muscles to their normal resting length before spinal mobility can be restored. (Bourdillon et al. 1992:39,129.) Others believe that joint dysfunction may be due to peri-articular and intra-articular adhesions and these fixations are relieved by applying the adjustive thrust in the direction of the restriction (Schafer and Faye 1990:17).

Unfortunately, not much is known about the mechanisms of action or effects of a spinal manipulation (Haldeman 1992:434). It is therefore necessary to determine the relative effectiveness and cost-effectiveness of adjusting on the same side of fixation versus adjusting on the side opposite to the fixation.

CHAPTER THREE

3.0. MATERIALS AND METHODS

3.1. *THE DATA*

3.1.1. The primary data

This consisted of subjective and objective data.

The subjective data included the following questionnaires:

- CMCC Neck Disability Index (Appendix D) – which assesses the patient's ability to manage daily activities.
- Short-Form McGill Pain questionnaire (Appendix E) – which provides information on the sensory, affective and quality of pain.
- Numerical Rating Scale–101 questionnaire (Appendix F) – which measures pain intensity.
- Comfort Index (Appendix G) – which measures level of patient discomfort during set up prior to adjustment and during thrust of adjustment.
- Pre-Test questionnaire (Appendix H) – which assesses clarity and ambiguity of the Comfort Index.

The objective data included the following :

- CROM (Appendix I) – used to measure cervical range of motion.
- Algometer (Appendix J) – used to measure pressure-pain threshold.
- Motion Palpation - used to determine presence or absence of spinal fixation.

3.1.2. The secondary data

This consisted of a review of the related literature. Articles containing relevant information that supported this study or that were related to this study were obtained to help reveal the gaps in the literature and motivate this study.

3.2. *THE STUDY DESIGN*

3.2.1. Allocation of subjects

A minimum number of 30 patients were randomly divided into two equal groups, using convenience sampling. Numbers drawn randomly out of a hat determined which group each patient was allocated to.

Group 1 received an adjustment with the contact on the ipsilateral side of the fixated segment.

Group 2 received the same type of adjustment at the same level, with the contact on the side contralateral to the fixated segment.

3.2.2. Patient admissibility procedure

Prospective individuals underwent a full case history (Appendix A), physical examination (Appendix B), and cervical regional examination (Appendix C). Selected subjects had to meet the criteria for the study, which were as follows:

- Patients had to be diagnosed with cervical facet syndrome as determined by Bourdillon et al. (1992:49).
- Patients had to be over 15 years of age and literate. Parental consent had to be obtained for patients under 18 years of age.
- Patients could not partake in any other treatment for neck pain during the concurrent treatment period.
- Patients could not utilize any form of analgesic or anti-inflammatory medication during the treatment period. If patients developed concurrent illness and took anti-inflammatory and analgesic medication as a result, they were excluded from the study.
- Any co-existing mechanical conditions, such as myofasciitis, were not treated during the treatment period.
- Any patients with a positive response to Wallenberg's Test were excluded from this study.
- Radiographic examination was used only where clinically indicated, to rule out contraindications to spinal manipulation. If any conditions which contraindicate spinal manipulation were present, such patients were rejected from the study. Examples of contraindications to spinal manipulation include: vertebral basilar arterial insufficiency, osteoporosis, infection, neoplasms, massive disc extrusions, and hypermobility (Bourdillon et al. 1992:286-289).

3.2.3. Intervention

The type of adjustment (Diversified Technique) used was selected according to the type of fixation diagnosed by motion palpation. The researcher only adjusted the most fixated segment/s in patients with more than one fixation and/or adjusted the most fixated side in patients with a bilateral fixated vertebral segment, as determined by motion palpation (Schafer and Faye 1990:59).

The types of cervical adjusting techniques used include the following: Supine Occiput Flexion, Supine Occiput Extension, Occiput Rotation - Mastoid Contact, Occiput Lateral Flexion - Mastoid Contact, Lateral Atlas - Pisiform, Lateral Atlas - Index Contact, Rotary Atlas - Index Contact, Rotary Cervical - Index Contact, Rotary Cervical - Hypothenar Contact, Bedside Cervical and Supine Lateral Break (Szaraz 1990: 18,25,27,31,37,39,41,47,49,51,53).

Both groups received a maximum of eight treatments over a period of four weeks. There was a one-month follow-up period for reassessment. If a patient became asymptomatic before the eighth treatment, or before the four-week treatment period was over, treatment was discontinued. If that patient became symptomatic again during the treatment period, treatment was continued as before, during the four-week treatment period. Patients were reassessed one month after the final consultation.

Both groups were required to complete the CMCC Neck Disability Index, Numerical Rating Scale–101 questionnaire, and Short-Form McGill Pain questionnaire, prior to the initial and final treatments, and at the termination of the one-month follow-up period. Both groups also completed the Comfort Index after the initial and final treatment.

A description of the above questionnaires follows:

CMCC Neck Disability Index

This assesses the patient's ability to manage activities of daily living. It is comprised of 10 questions, with each question scoring a minimum of 0 and a maximum of 5 points. The total score is 50 points and is represented as a percentage disability.

In a study assessing the validity and reliability of this questionnaire, Vernon and Mior (1991) claim that the CMCC Neck Disability Index had a high degree of internal consistency and reliability. It also appeared to be sensitive to the changes in disability during the treatment period as well as to the severity of the problem.

Vernon and Mior (1991) stated further that the questionnaire was applicable to a wide age distribution, was unaffected by gender and had an acceptable level of validity.

Numerical Rating Scale-101 Questionnaire

This measures pain intensity. The patient is required to indicate by means of a percentage the intensity of the pain experienced prior to treatment when (a) it is at its least, and (b) when it is at its worst. The average between these two percentages gives an indication as to the pain intensity experienced by the patient.

A study was conducted whereby six methods of assessing pain intensity were compared. The scales were evaluated according to 5 criteria:

i) Ease of administration of the scoring.

ii) Relative rates of incorrect responding.

iii) Sensitivity as defined by the number of available response categories.

iv) Sensitivity as defined by statistical power.

v) The magnitude of the relationship between each scale and a linear combination of pain intensity indices.(Jensen et al. 1986.)

Jensen et al. (1986) claimed that the Numerical Rating Scale-101 questionnaire had practical advantages over the other scales because :

(i) It can be used in either the written or verbal form.

(ii) It appears unaffected by age.

(iii) It is easy and simple to administer and score.

The superior measure thus seems to be the Numerical Rating Scale-101 questionnaire.

This is supported by Downie et al. (1978), who found the Numerical Rating Scale-101 questionnaire to be the most preferable when compared to three other questionnaires.

Short-Form McGill Pain Questionnaire

This provides information on the sensory, affective and quality dimensions of pain. The Short-Form McGill Pain questionnaire was developed because the Standard McGill Pain questionnaire took too long to administer. The questionnaire consists of 15 representative descriptors which were selected according to their frequency of endorsement by patients. Each descriptor was rated on a scale of: 0 = none; 1 = mild; 2 = moderate; 3 = severe. (Melzack 1987.)

According to Melzack (1987) the questionnaire has been used in studies measuring chronic pain, and the results correlated highly with the Standard McGill Pain questionnaire. Melzack and Katz (1992:164) noted that because pain is a subjective quality, the most accurate measurement is one where the patient provides a "self-report". This questionnaire has been successful in measuring the sensory dimension of pain.

The Short-Form McGill Pain questionnaire is one of the most widely utilized measures for the evaluation of pain and is sensitive to clinical therapy (Melzack 1987).

Comfort Index

The Comfort Index was fully explained to the patient before commencing treatment.

The Comfort Index had been designed to give the researcher information as to the level of discomfort experienced by the patient during the set up prior to adjustment and during the thrust of adjustment. There were five boxes from which to choose. The patients were required to mark the one box that most closely applied to them. Boxes numbered 0 to 4 indicated a level of discomfort ranging from 0 (no discomfort) to 4 (severe discomfort). The individual scores were tallied up out of a sum total of 4 and represented as a percentage.

A pre-test of the Comfort Index was conducted on six patients prior to the initiation of the study in order to determine whether the patients found the Comfort Index understandable and clear, and whether there was difficulty in choosing the most applicable box. This was assessed by having the patient complete the Comfort Index after treatment and thereafter having the patient complete the Pre-Test questionnaire which questioned whether:

- The Comfort Index was easily understandable.
- The Comfort Index was ambiguous or not.
- There was any difficulty in choosing the most applicable box.

As already mentioned, objective measurements included the CROM and Algometer which were taken prior to the initial and final treatments, and at the termination of the one-month follow-up period. All objective measurements were recorded by the researcher.

A description of the CROM and Algometer follows:

Cervical Range of Motion (CROM)

This instrument is used to measure the following cervical ranges of motion in degrees: flexion, extension, bilateral lateral flexion and bilateral rotation.

A study of 40 patients with orthopaedic disorders was conducted to determine the reliability of the Cervical Range of Motion instrument in comparison to two other instruments. It was demonstrated that the CROM showed a higher degree of reliability in comparison to the other two instruments. (Youdas et al. 1991.)

The CROM was also demonstrated to be reliable when two physiotherapists took repeated measurements on the same patient. In addition, the measuring procedures did not appear to aggravate the patient's neck pain. (Youdas et al. 1991.)

Algometer

This instrument was used to measure the pressure-pain threshold of the ipsilateral and contralateral sides of the fixated segment. The Algometer was placed over the articular pillar on both sides of the cervical spine at the affected level. The force readings were measured in kilograms per square centimetre. A higher reading meant less tenderness felt by the patient, and thus a higher tolerance to pain. (Fischer 1986.)

Fischer (1986) stated that the Algometer is equipped with a rubber disc with a surface area proven adequate for the quantification of deep soft tissue tenderness. Thus outcomes to various forms of treatment can be assessed qualitatively.

In a study of 50 patients (26 females and 24 males), Fischer (1986) established the normal threshold values at 9 different sites commonly affected by trigger points. The reliability and validity of the pressure-pain threshold measurements were excellent.

The reliability of the Algometer between different locations, occasions and investigators, has been established (Fischer 1986).

In addition, patients were motion palpated immediately after the initial and final treatment and at the termination of the one-month follow-up period to assess whether the spinal fixation was present or not. This was noted as 1 = present and 0 = absent.

3.2.4. Analysis and interpretation of the data

3.2.4.1. *Non-parametric paired hypothesis tests*

The subjective data

The data of the questionnaires (calculated as percentages) for the initial, final and one-month follow-up consultations, were compared within each of the two treatment groups and statistically analyzed, using the Wilcoxon's Signed Rank Test.

The objective data

Each plane of cervical range of motion (measured in degrees), motion palpation findings and bilateral pressure-pain threshold readings (measured in kg/cm^2) for the initial, final and one-month follow-up consultations, were compared within each of the two treatment groups and statistically analyzed, using the Wilcoxon's Signed Rank Test.

3.2.4.2. *Non-parametric unpaired hypothesis tests*

The subjective data

The data of the questionnaires for the initial, final and one-month follow-up consultations were compared between the two treatment groups and statistically analyzed, using the Mann-Whitney's U-Test.

The objective data

Each plane of cervical range of motion (measured in degrees), motion palpation findings and bilateral pressure-pain threshold readings (measured in kg/cm^2) for the initial, final and one-month follow-up consultations, were compared between the two treatment groups and statistically analyzed, using the Mann-Whitney's U-Test.

The Wilcoxon's Signed Rank Test and Mann-Whitney's U-Test were both conducted at a 95% confidence interval.

Medians, means, standard errors, standard deviations and bar charts were recorded to look for possible trends, as well as to determine whether there was a significant difference in data, thus indicating which treatment approach was more effective.

Power analysis was utilized to assess the sensitivity of the non-parametric tests and the likelihood of a Type II error (i.e. accepting a false null hypothesis) (Portney and Watkins 1993:656).

In addition, bar charts were also used to demonstrate the relationship between the pressure-pain threshold reading and the side of spinal fixation.

All statistical data was analyzed by computer using the program "Statsgraphics Plus – Version 6.0".

CHAPTER FOUR

4.0. THE RESULTS

4.1. *INTRODUCTION*

The results obtained from groups 1 and 2 are stated in this chapter. The data was collected in the form of subjective questionnaires (CMCC Neck Disability Index, Numerical Rating Scale-101 questionnaire, Short-Form McGill Pain questionnaire, Comfort Index - set up and Comfort Index - thrust) and objective measures (CROM, algometer - ipsilateral side of fixation, algometer - contralateral side of fixation and motion palpation).

The sample size per group was small ($n_1 = 15$, $n_2 = 15$). Hence, non-parametric methods were used for statistical analysis. (van den Honert 1997:213.) The tests used for the intra-group and inter-group comparisons were the Wilcoxon's Signed Rank Test and Mann-Whitney's U-Test respectively. In each Wilcoxon's Signed Rank Test, the null hypothesis stated that there was no significant improvement between the two related samples being compared, at the $\alpha = 0,05$ level of significance. The alternative hypothesis stated that there was a significant improvement. In each Mann-Whitney's U-Test, the null hypothesis stated that there was no significant difference between groups 1 and 2 with respect to the variable in charge, at the $\alpha = 0,05$ level of significance. The alternative hypothesis stated that there was a significant difference.

The null hypothesis was rejected for both tests at the α level of significance if $P \leq {}^{\alpha}/_{2}$ where P was the observed significance level or P-value. Otherwise, the null hypothesis was accepted at the same level.

The power of a statistical test is a measure of how sensitive the test is. The power of a test depends on the sample size, the accuracy of the measurements involved in the study and the level of significance of the study, α. The smaller the power of a test, the larger becomes the likelihood of a Type II error, i.e. accepting a false null hypothesis. (Portney and Watkins 1993:656.)

The power of non-parametric tests are usually low, thereby indicating that results obtained from non-parametric tests are not necessarily reliable as a decision-making tool (Portney and Watkins 1993:656).

The tables in this chapter display the median, mean, standard deviation, standard error, P-value and the results from power analysis.

In addition, demographic data was obtained from the study and represents the average age and gender distributions of both groups.

The results of the Pre-Test questionnaire are also presented in this chapter.

4.2. *DEMOGRAPHIC DATA*

4.2.1. Age and gender percentages

Table 4.1 : ***The age distribution within the sample of 30***

Age	Group 1	Group 2	Total
10 - 19	13,3%	0,0%	6,7%
20 - 29	66,7%	53,3%	60,0%
30 - 39	6,7%	13,3%	10,0%
40 - 49	6,7%	13,3%	10,0%
50 - 59	6,7%	0,0%	3,3%
60 - 69	0,0%	13,3%	6,7%
70 - 79	0,0%	6,7%	3,3%

The median age for group 1 was 24. The median age for group 2 was 24. The median age overall was 24.

Table 4.2 : ***The gender distribution within the sample of 30***

Gender	Group 1	Group 2	Total
Male	46,7%	60,0%	53,3%
Female	53,3%	40,0%	46,7%

The overall male:female ratio was 1,1:1.

4.3. *INTRA-GROUP ANALYSIS USING WILCOXON'S SIGNED RANK TEST*

4.3.1. Subjective data for group 1

Table 4.3 : *Comparison of the results from the subjective data using the Wilcoxon's Signed Rank Test between treatments one and eight for group 1*

GROUP 1									
	Treatment 1					Treatment 8			
	Median	***Mean***	***S.E.***	***S.D.***	***P-Value***	***Median***	***Mean***	***S.E.***	***S.D.***
CMCC	22,0	23,5	2,1	8,3	0,0003 (s)	10,0	10,0	1,7	6,5
McGill	26,4	28,4	3,2	12,3	0,0003 (s)	7,2	7,8	1,7	6,7
NRS-101	48,0	41,6	3,2	12,5	0,0003 (s)	15,0	16,9	3,5	13,5
CI - set up	50,0	46,7	9,1	35,2	0,0704 (ns)	25,0	21,7	6,4	24,8
CI - thrust	75,0	61,7	10,9	42,1	0,0269 (ns)	50,0	38,3	7,7	29,7

Power	
CMCC	0,9965
McGill	0,9994
NRS-101	0,9995
CI - set up	0,5795
CI - thrust	0,3881

The null hypothesis is rejected for the CMCC Neck Disability Index, Short-Form McGill Pain questionnaire and Numerical Rating Scale-101 questionnaire, as there was a significant subjective improvement between treatments one and eight at the $\alpha = 0,05$ level of significance.

The null hypothesis is accepted for the Comfort Index - set up and Comfort Index - thrust, as there was no significant improvement between treatments one and eight.

Table 4.4 : ***Comparison of the results from the subjective data using the Wilcoxon's Signed Rank Test between treatment one and the one-month follow-up for group 1***

GROUP 1									
	Treatment 1					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	22,0	23,5	2,1	8,3	0,0055 (s)	6,0	10,7	3,0	11,7
McGill	26,4	28,4	3,2	12,3	0,0019 (s)	4,2	11,9	3,9	15,3
NRS-101	48,0	41,6	3,2	12,5	0,1213 (ns)	18,0	26,7	5,4	21,0

Power	
CMCC	0,9170
McGill	0,8813
NRS-101	0,6218

The null hypothesis is rejected at the $\alpha = 0,05$ level of significance for the CMCC Neck Disability Index and Short-Form McGill Pain questionnaire, as there was a significant improvement between treatment one and the one-month follow-up for group 1.

There was no significant improvement for the NRS-101 questionnaire between treatment one and the one-month follow-up, and thus the null hypothesis is accepted at the $\alpha = 0,05$ level of significance.

Table 4.5 : *Comparison of the results from the subjective data using the Wilcoxon's Signed Rank Test between treatment eight and the one-month follow-up for group 1*

GROUP 1									
	Treatment 8					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	10,0	10,0	1,7	6,5	0,7728 (ns)	6,0	10,7	3,0	11,7
McGill	7,2	7,8	1,7	6,7	1,0000 (ns)	4,2	11,9	3,9	15,3
NRS-101	15,0	16,9	3,5	13,5	0,1489 (ns)	18,0	26,7	5,4	21,0

Power	
CMCC	0,0540
McGill	0,1440
NRS-101	0,3018

For the CMCC Neck Disability Index, Short-Form McGill Pain questionnaire and NRS-101 questionnaire, there was no statistically significant improvement between treatment eight and the one-month follow-up, and hence the null hypothesis is accepted at the $\alpha = 0,05$ significance level.

4.3.2. Objective data for group 1

Table 4.6 : *Comparison of the results from the objective data using the Wilcoxon's Signed Rank Test between treatments one and eight for group 1*

GROUP 1									
	Treatment 1					Treatment 8			
	Median	Mean	S.E.	S.D.	P-Value	Median	Mean	S.E.	S.D.
Flex	68,0	62,8	3,7	14,2	1,0000 (ns)	60,0	62,7	2,6	9,9
Ext	70,0	70,9	3,6	13,8	0,6056 (ns)	73,0	75,7	4,1	15,8
L.Rot	70,0	68,5	3,4	13,0	0,0614 (ns)	72,0	73,2	3,4	13,0
R.Rot	70,0	65,9	3,5	13,5	0,7518 (ns)	70,0	69,4	2,3	8,8
L.Lat Flex	40,0	42,4	3,2	12,2	0,2673 (ns)	49,0	45,5	3,0	11,8
R.Lat Flex	40,0	41,0	3,3	13,0	0,0614 (ns)	49,0	47,6	2,6	10,0
Algom-fixated side	1,8	2,0	0,2	0,9	0,1489 (ns)	2,1	2,5	0,3	1,3
Algom-non-fixated side	2,1	2,1	0,2	0,8	0,0961 (ns)	2,1	2,6	0,3	1,1
MP	0,0	0,2	0,1	0,4	0,6171 (ns)	0,0	0,2	0,1	0,4

Power	
Flex	0,0500
Ext	0,1310
L.Rot	0,1517
R.Rot	0,1223
L.Lat Flex	0,1004
R.Lat Flex	0,3145
Algom-fixated side	0,2188
Algom-non-fixated side	0,2566
MP	0,0500

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

For Table 4.6, the null hypothesis is accepted in all instances, thus demonstrating no significant improvement between treatments one and eight at $\alpha = 0{,}05$ level of significance.

Table 4.7 : *Comparison of the results from the objective data using the Wilcoxon's Signed Rank Test between treatment one and the one-month follow-up for group 1*

GROUP 1									
	Treatment 1					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	68,0	62,8	3,7	14,2	0,5791 (ns)	65,0	62,7	2,6	9,9
Ext	70,0	70,9	3,6	13,8	0,4227 (ns)	72,0	73,1	3,1	11,9
L.Rot	70,0	68,5	3,4	13,0	0,7893 (ns)	70,0	66,9	3,5	13,4
R.Rot	70,0	65,9	3,5	13,5	0,3865 (ns)	70,0	70,0	1,9	7,4
L.Lat Flex	40,0	42,4	3,2	12,2	0,5791 (ns)	45,0	44,3	2,7	10,5
R.Lat Flex	40,0	41,0	3,3	13,0	0,1814 (ns)	48,0	47,7	2,8	10,9
Algom-fixated side	1,8	2,0	0,2	0,9	0,1489 (ns)	2,0	2,4	0,3	1,0
Algom-non-fixated side	2,1	2,1	0,2	0,8	0,4227 (ns)	2,3	2,6	0,3	1,0
MP	0,0	0,2	0,1	0,4	0,1138 (ns)	1,0	0,6	0,1	0,5

Power	
Flex	0,0500
Ext	0,0715
L.Rot	0,0607
R.Rot	0,2649
L.Lat Flex	0,0706
R.Lat Flex	0,3058
Algom-fixated side	0,1908
Algom-non-fixated side	0,2907
MP	0,6293

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

There is no statistical improvement between treatment one and the one-month follow-up for Table 4.7 in all instances, and therefore the null hypothesis is accepted at the $\alpha = 0{,}05$ significance level.

Table 4.8 : ***Comparison of the results from the objective data using the Wilcoxon's Signed Rank Test between treatment eight and the one-month follow-up for group 1***

GROUP 1									
	Treatment 8					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	60,0	62,7	2,6	9,9	0,3865 (ns)	65,0	62,7	2,6	9,9
Ext	73,0	75,7	4,1	15,8	1,0000 (ns)	72,0	73,1	3,1	11,9
L.Rot	72,0	73,2	3,4	13,0	1,0000 (ns)	70,0	66,9	3,5	13,4
R.Rot	70,0	69,4	2,3	8,8	1,0000 (ns)	70,0	70,0	1,9	7,4
L.Lat Flex	49,0	45,5	3,0	11,8	0,1489 (ns)	45,0	44,3	2,7	10,5
R.Lat Flex	49,0	47,6	2,6	10,0	0,7893 (ns)	48,0	47,7	2,8	10,9
Algom-fixated side	2,1	2,5	0,3	1,3	1,0000 (ns)	2,0	2,4	0,3	1,0
Algom-non-fixated side	2,1	2,6	0,3	1,1	0,3017 (ns)	2,3	2,6	0,3	1,0
MP	0,0	0,2	0,1	0,4	0,0412 (ns)	1,0	0,6	0,1	0,5

Power	
Flex	0,0500
Ext	0,0757
L.Rot	0,2326
R.Rot	0,1002
L.Lat Flex	0,0584
R.Lat Flex	0,0501
Algom-fixated side	0,0556
Algom-non-fixated side	0,0500
MP	0,6293

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

The null hypothesis is accepted for Table 4.8 in all of the above cases, as there was no significant improvement between treatment eight and the one-month follow-up at $\alpha = 0,05$ level of significance.

4.3.3. Subjective data for group 2

Table 4.9 : ***Comparison of the results from the subjective data using the Wilcoxon's Signed Rank Test between treatments one and eight for group 2***

GROUP 2									
	Treatment 1					Treatment 8			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	20,0	22,0	3,1	12,2	0,0005 (s)	8,0	8,8	2,3	9,0
McGill	10,6	11,8	2,0	7,9	0,0614 (ns)	3,2	9,6	5,5	21,1
NRS-101	38,0	38,1	3,3	12,6	0,0033 (s)	20,0	19,3	4,1	15,7
CI - set up	25,0	25,0	6,9	26,7	0,0771 (ns)	0,0	11,7	5,9	22,9
CI - thrust	25,0	35,0	10,0	38,7	0,2888 (ns)	0,0	25,0	9,1	35,4

Power	
CMCC	0,9024
McGill	0,0639
NRS-101	0,9358
CI - set up	0,2826
CI - thrust	0,1052

The CMCC Neck Disability Index and Numerical Rating Scale-101 questionnaire demonstrate a significant improvement between treatments one and eight. The null hypothesis is thus rejected at the $\alpha = 0,05$ level of significance.

The null hypothesis is accepted for the Short-Form McGill Pain questionnaire, Comfort Index - set up and Comfort Index - thrust at $\alpha = 0,05$ significance level, thus indicating no significant improvement between treatments one and eight.

Table 4.10 : *Comparison of the results from the subjective data using the Wilcoxon's Signed Rank Test between treatment one and the one-month follow-up for group 2*

GROUP 2									
	Treatment 1					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	20,0	22,0	3,1	12,2	0,0019 (s)	6,0	9,7	2,6	10,1
McGill	10,6	11,8	2,0	7,9	0,1213 (ns)	1,5	4,4	1,5	5,6
NRS-101	38,0	38,1	3,3	12,6	0,0265 (ns)	8,0	17,1	4,4	17,2

Power	
CMCC	0,8265
McGill	0,8147
NRS-101	0,9556

For the CMCC Neck Disability Index, the null hypothesis is rejected at α = 0,05 level of significance. This indicates that there was a statistical significant improvement between treatment one and the one-month follow-up for group 2.

For the Short-Form McGill Pain questionnaire and Numerical Rating Scale-101 questionnaire, there was no demonstrable significant improvement between treatment one and the one-month follow-up at the α = 0,05 significance level. The null hypothesis is thus accepted.

Table 4.11 : *Comparison of the results from the subjective data using the Wilcoxon's Signed Rank Test between treatment eight and the one-month follow-up for group 2*

GROUP 2									
	Treatment 8					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	8,0	8,8	2,3	9,0	0,5465 (ns)	6,0	9,7	2,6	10,1
McGill	3,2	9,6	5,5	21,1	0,7237 (ns)	1,5	4,4	1,5	5,6
NRS-101	20,0	19,3	4,1	15,7	0,7728 (ns)	8,0	17,1	4,4	17,2

Power	
CMCC	0,0564
McGill	0,1374
NRS-101	0,0631

In all of the above instances, the null hypothesis for Table 4.11 is accepted at the $\alpha = 0,05$ significance level. Hence, no significant subjective improvement was demonstrated for group 2 between treatment eight and the one-month follow-up.

4.3.4. Objective data for group 2

Table 4.12 : ***Comparison of the results from the objective data using the Wilcoxon's Signed Rank Test between treatments one and eight for group 2***

GROUP 2									
	Treatment 1					Treatment 8			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	60,0	55,7	3,4	13,2	0,3865 (ns)	60,0	58,7	3,3	12,8
Ext	69,0	66,3	5,7	22,2	1,0000 (ns)	70,0	65,8	4,5	17,3
L.Rot	70,0	64,2	3,4	13,2	0,5465 (ns)	61,0	64,2	2,9	11,0
R.Rot	69,0	65,4	3,8	14,6	0,7893 (ns)	70,0	65,1	3,4	13,2
L.Lat Flex	41,0	40,4	2,9	11,2	0,7728 (ns)	45,0	42,8	3,0	11,5
R.Lat Flex	40,0	40,6	3,0	11,5	0,1824 (ns)	45,0	42,6	3,2	12,3
Algom-fixated side	2,2	2,3	0,2	0,6	0,0614 (ns)	3,2	3,2	0,3	1,0
Algom-non-fixated side	2,6	2,5	0,2	0,6	0,0162 (s)	3,1	3,2	0,3	1,0
MP	1,0	1,0	0,0	0,0	0,4793 (ns)	1,0	0,9	0,1	0,4

Power	
Flex	0,0899
Ext	0,0505
L.Rot	0,0500
R.Rot	0,0503
L.Lat Flex	0,0835
R.Lat Flex	0,0708
Algom-fixated side	0,7991
Algom-non-fixated side	0,6238
MP	0,1877

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

The null hypothesis is accepted for forward flexion, extension, left rotation, right rotation, left lateral flexion, right lateral flexion, algometer-ipsilateral side of fixation and motion palpation at the $\alpha = 0,05$ level of significance.

Therefore, statistically, there was no significant improvement between treatments one and eight.

However, there was a statistically significant improvement between treatments one and eight for the algometer-contralateral side of fixation. The null hypothesis is thus rejected at the $\alpha = 0,05$ significance level.

Table 4.13 : ***Comparison of the results from the objective data using the Wilcoxon's Signed Rank Test between treatment one and the one-month follow-up for group 2***

GROUP 2									
	Treatment 1					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	60,0	55,7	3,4	13,2	0,5791 (ns)	60,0	60,6	3,6	14,0
Ext	69,0	66,3	5,7	22,2	1,0000 (ns)	65,0	62,9	4,2	16,2
L.Rot	70,0	64,2	3,4	13,2	0,7518 (ns)	60,0	64,1	2,7	10,4
R.Rot	69,0	65,4	3,8	14,6	0,3865 (ns)	70,0	68,5	4,1	15,7
L.Lat Flex	41,0	40,4	2,9	11,2	0,7728 (ns)	40,0	40,5	1,9	7,5
R.Lat Flex	40,0	40,6	3,0	11,5	0,5465 (ns)	40,0	38,4	2,9	11,4
Algom-fixated side	2,2	2,3	0,2	0,6	0,0389 (ns)	3,3	3,0	0,2	0,9
Algom-non-fixated side	2,6	2,5	0,2	0,6	0,0098 (s)	3,2	3,3	0,3	1,0
MP	1,0	1,0	0,0	0,0	0,4795 (ns)	1,0	0,9	0,1	0,4

Power	
Flex	0,1507
Ext	0,0727
L.Rot	0,0501
R.Rot	0,0811
L.Lat Flex	0,0501
R.Lat Flex	0,0774
Algom-fixated side	0,6688
Algom-non-fixated side	0,7310
MP	0,1877

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

The null hypothesis is accepted for all the cervical ranges of motion, algometer-ipsilateral side of fixation and motion palpation at the $\alpha = 0{,}05$ significance level. There was thus no significant objective improvement between treatment one and the one-month follow-up for group 2.

There was however a significant improvement between treatment one and the one-month follow-up for the algometer-contralateral side of fixation at the $\alpha = 0{,}05$ significance level. The null hypothesis is thus rejected.

Table 4.14 : ***Comparison of the results from the objective data using the Wilcoxon's Signed Rank Test between treatment eight and the one-month follow-up for group 2***

GROUP 2									
	Treatment 8					One-Month			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	60,0	58,7	3,3	12,8	0,7518 (ns)	60,0	60,6	3,6	14,0
Ext	70,0	65,8	4,5	17,3	0,5791 (ns)	65,0	62,9	4,2	16,2
L.Rot	61,0	64,2	2,9	11,0	0,7728 (ns)	60,0	64,1	2,7	10,4
R.Rot	70,0	65,1	3,4	13,2	0,5791 (ns)	70,0	68,5	4,1	15,7
L.Lat Flex	45,0	42,8	3,0	11,5	0,3865 (ns)	40,0	40,5	1,9	7,5
R.Lat Flex	45,0	42,6	3,2	12,3	0,0961 (ns)	40,0	38,4	2,9	11,4
Algom-fixated side	3,2	3,2	0,3	1,0	1,0000 (ns)	3,3	3,0	0,2	0,9
Algom-non-fixated side	3,1	3,2	0,3	1,0	0,7893 (ns)	3,2	3,3	0,3	1,0
MP	1,0	0,9	0,1	0,4	-	1,0	0,9	0,1	0,4

Power	
Flex	0,0647
Ext	0.0721
L.Rot	0,0501
R.Rot	0,0913
L.Lat Flex	0,0923
R.Lat Flex	0,1478
Algom-fixated side	0,0817
Algom-non-fixated side	0,0574
MP	0,0500

<u>KEY</u>:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

There was no statistical significant improvement for all the above cervical ranges of motion, algometer-ipsilateral side of fixation and algometer-contralateral side of fixation between treatment eight and the one-month follow-up. The null hypothesis is hence accepted at the $\alpha = 0{,}05$ level of significance, thus demonstrating neither treatment approach to be significantly effective.

The Wilcoxon's Signed Rank Test could not be performed for motion palpation, and thus a P-Value could not be established.

4.4. *INTER-GROUP ANALYSIS USING MANN-WHITNEY'S U-TEST*

4.4.1. Analysis of subjective data

Table 4.15 : *Comparison of groups 1 and 2 using the Mann-Whitney's U-Test to analyze results collected from the subjective data at treatment one*

TREATMENT 1									
	Group 1					Group 2			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	22,0	23,5	2,1	8,3	0,5254 (ns)	20,0	22,0	3,1	12,2
McGill	26,4	28,4	3,2	12,3	0,0003 (s)	10,6	11,8	2,0	7,9
NRS-101	48,0	41,6	3,2	12,5	0,1967 (ns)	38,0	38,1	3,3	12,6
CI - set up	50,0	46,7	9,1	35,2	0,0934 (ns)	25,0	25,0	6,9	26,7
CI - thrust	75,0	61,7	10,9	42,1	0,0843 (ns)	25,0	35,0	10,0	38,7

Power	
CMCC	0,0652
McGill	0,9867
NRS-101	0,1090
CI - set up	0,4427
CI - thrust	0,4059

At treatment one, the null hypothesis is accepted for the CMCC Neck Disability Index, Numerical Rating Scale-101 questionnaire, Comfort Index - set up and Comfort Index - thrust, which indicates that at $\alpha = 0{,}05$ significance level, there was no significant difference between groups 1 and 2.

In contrast, the null hypothesis is rejected for the Short-Form McGill Pain questionnaire at $\alpha = 0{,}05$ significance level as there was a significant difference between the two groups, indicating a difference in congruency of the initial sensory, affective and quality dimensions of pain between the two treatment protocols.

Table 4.16 : ***Comparison of groups 1 and 2 using the Mann-Whitney's U-Test to analyze results collected from the subjective data at treatment eight***

TREATMENT 8									
	Group 1					Group 2			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	10,0	10,0	1,7	6,5	0,4400 (ns)	8,0	8,8	2,3	9,0
McGill	7,2	7,8	1,7	6,7	0,2742 (ns)	3,2	9,6	5,5	21,1
NRS-101	15,0	16,9	3,5	13,5	0,7708 (ns)	20,0	19,3	4,1	15,7
CI - set up	25,0	21,7	6,4	24,8	0,1791 (ns)	0,0	11,7	5,9	22,9
CI - thrust	50,0	38,3	7,7	29,7	0,1501 (ns)	0,0	25,0	9,1	35,4

Power	
CMCC	0,0671
McGill	0,0596
NRS-101	0,0699
CI - set up	0,1897
CI - thrust	0,1814

In this comparison of the two treatment groups, the null hypothesis is accepted at $\alpha = 0{,}05$ level of significance, as there was no statistical difference in efficacy at treatment eight.

Table 4.17 : ***Comparison of groups 1 and 2 using the Mann-Whitney's U-Test to analyze results collected from the subjective data at the one-month follow-up***

ONE-MONTH									
	Group 1					Group 2			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
CMCC	6,0	10,7	3,0	11,7	0,7535 (ns)	6,0	9,7	2,6	10,1
McGill	4,2	11,9	3,9	15,3	0,0748 (ns)	1,5	4,4	1,5	5,6
NRS-101	18,0	26,7	5,4	21,0	0,1697 (ns)	8,0	17,1	4,4	17,2

Power	
CMCC	0,0561
McGill	0,3972
NRS-101	0,2523

In all of the above cases, the null hypothesis is accepted for both groups at α = 0,05 significance level. There was thus no statistically significant difference in efficacy of the two treatment protocols at the one-month follow-up.

4.4.2. Analysis of objective data

Table 4.18 : ***Comparison of groups 1 and 2 using the Mann-Whitney's U-Test to analyze results collected from the objective data at treatment one***

TREATMENT 1									
	Group 1					Group 2			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	68,0	62,8	3,7	14,2	0,1241 (ns)	60,0	55,7	3,4	13,2
Ext	70,0	70,9	3,6	13,8	0,7236 (ns)	69,0	66,3	5,7	22,2
L.Rot	70,0	68,5	3,4	13,0	0,5304 (ns)	70,0	64,2	3,4	13,2
R.Rot	70,0	65,9	3,5	13,5	0,8024 (ns)	69,0	65,4	3,8	14,6
L.Lat Flex	40,0	42,4	3,2	12,2	0,8679 (ns)	41,0	40,4	2,9	11,2
R.Lat Flex	40,0	41,0	3,3	13,0	0,9834 (ns)	40,0	40,6	3,0	11,5
Algom-fixated side	1,8	2,0	0,2	0,9	0,2614 (ns)	2,2	2,3	0,2	0,6
Algom-non-fixated side	2,1	2,1	0,2	0,8	0,0675 (ns)	2,6	2,5	0,2	0,6
MP	0,0	0,2	0,1	0,4	0,0000 (s)	1,0	1,0	0,0	0,0

Power	
Flex	0,2677
Ext	0,0968
L.Rot	0,1332
R.Rot	0,0509
L.Lat Flex	0,0715
R.Lat Flex	0,0508
Algom-fixated side	0,1695
Algom-non-fixated side	0,2948
MP	1,0000

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

The null hypothesis is accepted for all the cervical ranges of motion, algometer-ipsilateral side of fixation and algometer-contralateral side of fixation, as there was no significant difference at treatment one for both groups. This result indicated that there was no significant difference in congruency of the initial objective measures between the two treatment protocols at the $\alpha = 0,05$ significance level.

For motion palpation however, there was a statistically significant difference in efficacy between groups 1 and 2 at the first treatment. The null hypothesis is therefore rejected at $\alpha = 0,05$ level of significance.

Table 4.19 : ***Comparison of groups 1 and 2 using the Mann-Whitney's U-Test to analyze results collected from the objective data at treatment eight***

TREATMENT 8									
	Group 1					Group 2			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	60,0	62,7	2,6	9,9	0,4145 (ns)	60,0	58,7	3,3	12,8
Ext	73,0	75,7	4,1	15,8	0,2473 (ns)	70,0	65,8	4,5	17,3
L.Rot	72,0	73,2	3,4	13,0	0,0407 (ns)	61,0	64,2	2,9	11,0
R.Rot	70,0	69,4	2,3	8,8	0,4905 (ns)	70,0	65,1	3,4	13,2
L.Lat Flex	49,0	45,5	3,0	11,8	0,7062 (ns)	45,0	42,8	3,0	11,5
R.Lat Flex	49,0	47,6	2,6	10,0	0,5454 (ns)	45,0	42,6	3,2	12,3
Algom-fixated side	2,1	2,5	0,3	1,3	0,0536 (ns)	3,2	3,2	0,3	1,0
Algom-non-fixated side	2,1	2,6	0,3	1,1	0,1244 (ns)	3,1	3,2	0,3	1,0
MP	0,0	0,2	0,1	0,4	0,0004 (s)	1,0	0,9	0,1	0,4

Power	
Flex	0,1454
Ext	0,3429
L.Rot	0,4970
R.Rot	0,1654
L.Lat Flex	0,0905
R.Lat Flex	0,2088
Algom-fixated side	0,3481
Algom-non-fixated side	0,3117
MP	0,9972

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

There was no statistical significant difference in efficacy between both groups for all cervical ranges of motion, algometer-ipsilateral side of fixation and algometer-contralateral side of fixation at treatment eight. Hence at $\alpha = 0,05$ level of significance, the null hypothesis is accepted.

At treatment eight, there was a significant difference for motion palpation between the two groups at the $\alpha = 0,05$ significance level. Due to this significant difference in efficacy, the null hypothesis is rejected.

Table 4.20 : ***Comparison of groups 1 and 2 using the Mann-Whitney's U-Test to analyze results collected from the objective data at the one-month follow-up***

ONE-MONTH									
	Group 1					Group 2			
	Median	*Mean*	*S.E.*	*S.D.*	*P-Value*	*Median*	*Mean*	*S.E.*	*S.D.*
Flex	65,0	62,7	2,6	9,9	0,5735 (ns)	60,0	60,6	3,6	14,0
Ext	72,0	73,1	3,1	11,9	0,0845 (ns)	65,0	62,9	4,2	16,2
L.Rot	70,0	66,9	3,5	13,4	0,3786 (ns)	60,0	64,1	2,7	10,4
R.Rot	70,0	71,5	1,9	7,4	0,6956 (ns)	70,0	68,5	4,1	15,7
L.Lat Flex	45,0	44,3	2,7	10,5	0,2690 (ns)	40,0	40,5	1,9	7,5
R.Lat Flex	48,0	47,7	2,8	10,9	0,0370 (ns)	40,0	38,4	2,9	11,4
Algom-fixated side	2,0	2,4	0,3	1,0	0,0887 (ns)	3,3	3,0	0,2	0,9
Algom-non-fixated side	2,3	2,6	0,3	1,0	0,0487 (ns)	3,2	3,3	0,3	1,0
MP	1,0	0,6	0,1	0,5	0,1103 (ns)	1,0	0,9	0,1	0,4

Power	
Flex	0,0721
Ext	0,4681
L.Rot	0,0918
R.Rot	0,0949
L.Lat Flex	0,1877
R.Lat Flex	0,5932
Algom-fixated side	0,3698
Algom-non-fixated side	0,4484
MP	0,4290

KEY:

Note for MP: A median of 0 = fixation absent after treatment.

A median of 1 = fixation present after treatment.

For Table 4.20, the null hypothesis is accepted for the above results, as there was no significant difference between both groups, thus indicating that both treatment approaches were equally effective at the one-month follow-up.

4.5. RESULTS OF THE PRE-TEST QUESTIONNAIRE

Table 4.21 : ***Answers to the following questions of the Pre-Test questionnaire***

Questions	Yes	No
Is the Comfort Index easily understandable?	100%	0%
Is the Comfort Index ambiguous?	0%	100%
Do you have any difficulty in choosing the box most applicable to you?	0%	100%

4.6. CONCLUSION

The results displayed in this chapter, represent the statistical analysis of all the data gathered in this study.

Analysis of the demographic data demonstrated a fairly even age distribution and male:female ratio between the two groups. In addition, several significant differences were noted within the intra-group and inter-group analyses.

Furthermore, the results of the Pre-Test questionnaire were consistent throughout.

Fig. **4.1 Comparison between treatments 1, 8 and one-month follow-up for CMCC Neck Disability Index for both groups**

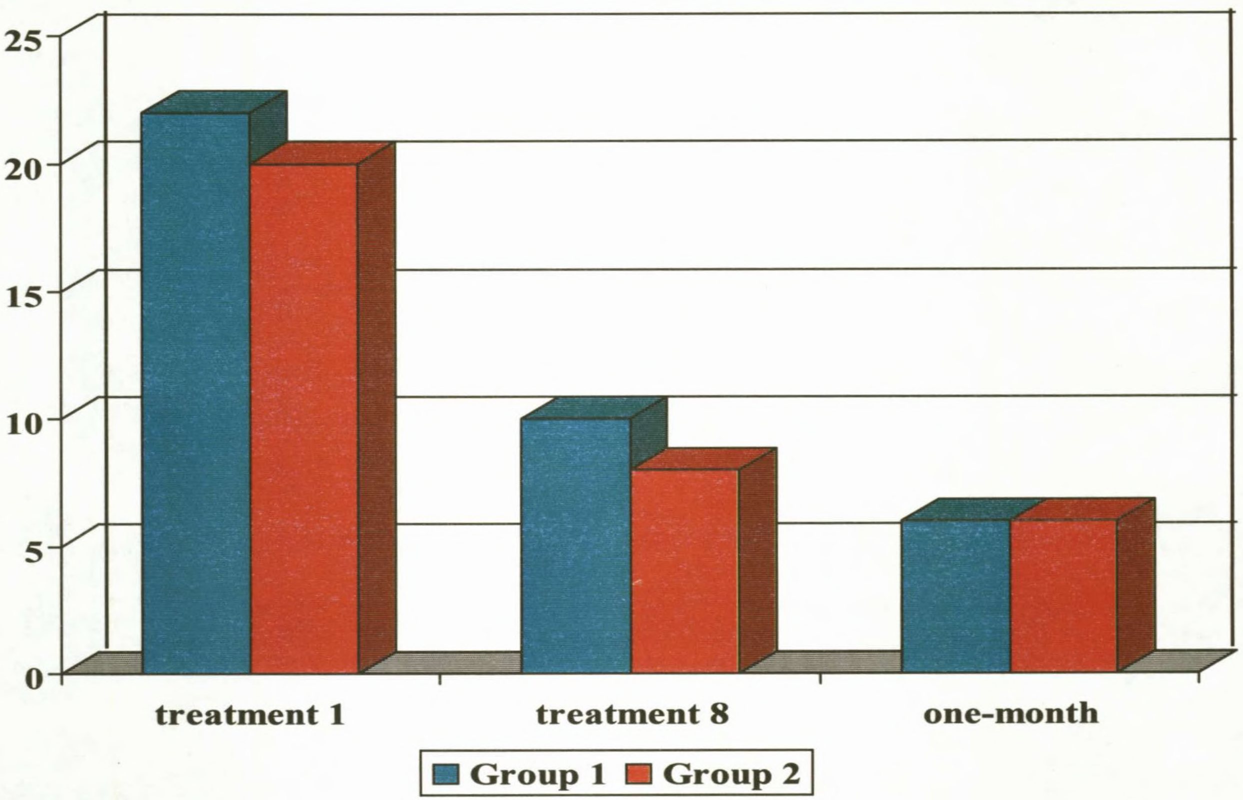


Fig 4.2 **Comparison between treatments 1, 8 and one-month follow-up for Short-Form McGill Pain Questionnaire for both groups**

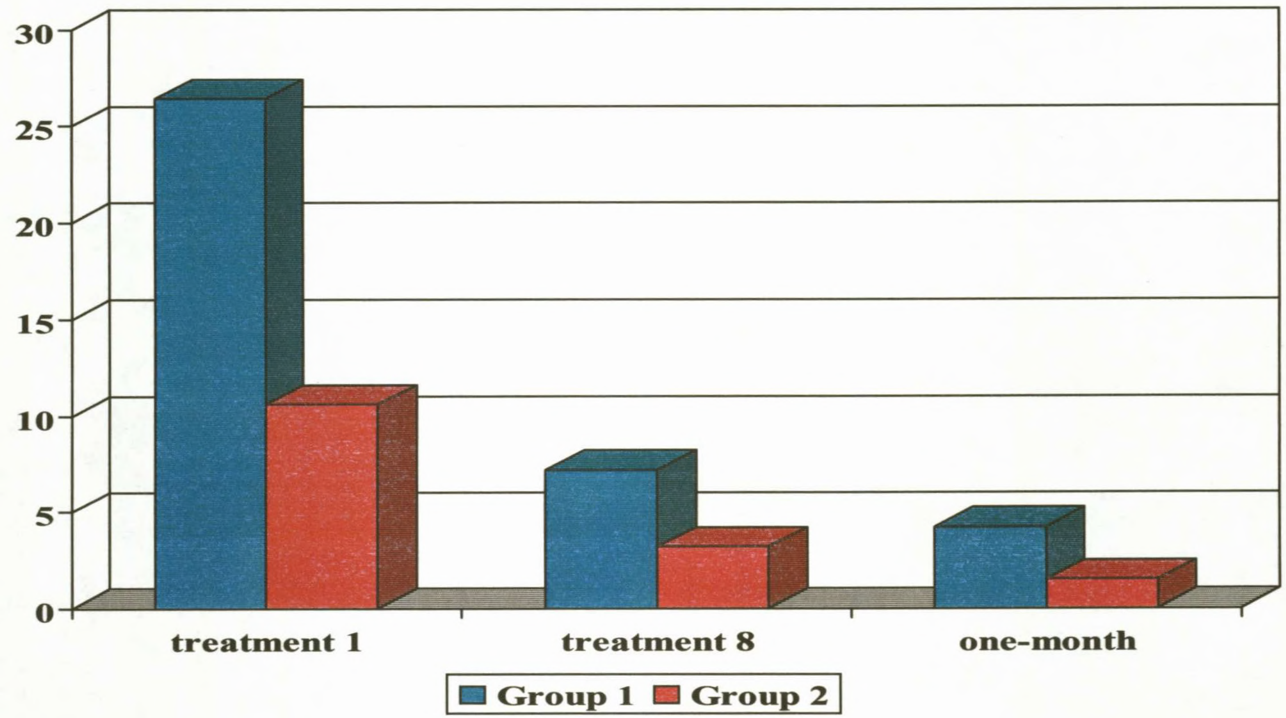


Fig. 4.3 **Comparison between treatments 1, 8 and one-month follow-up for NRS-101 Questionnaire for both groups**

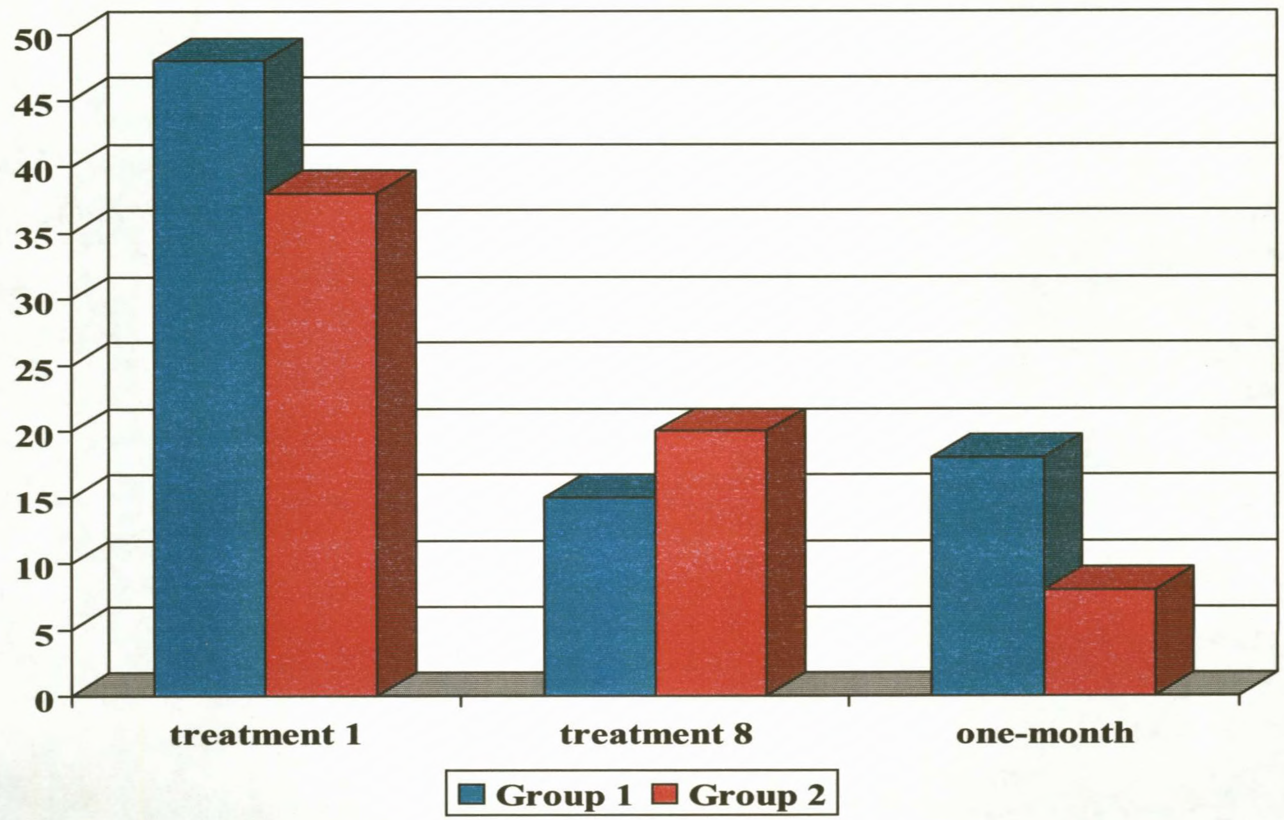


Fig. **4.4 Comparison between groups 1 and 2 for Comfort Index - set up between treatments 1 and 8**

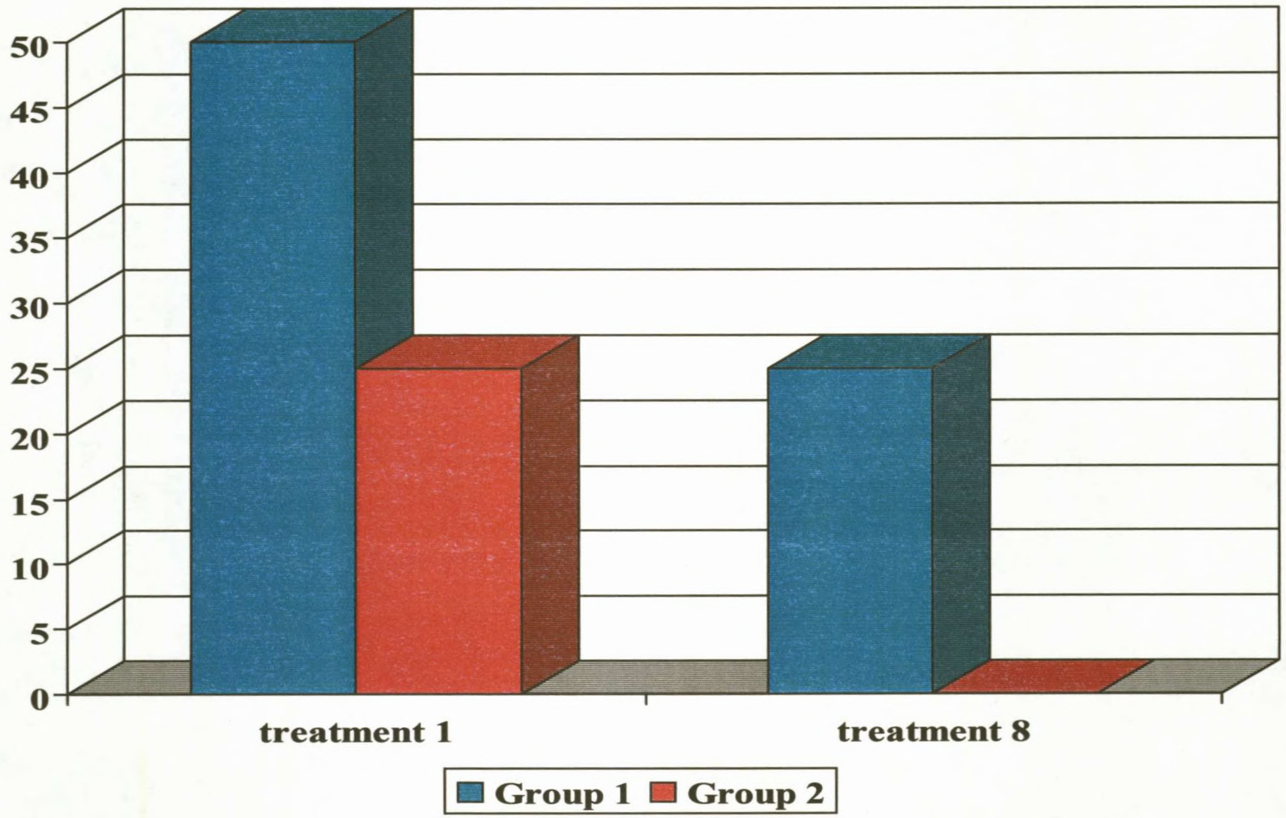


Fig. 4.5 **Comparison between groups 1 and 2 for Comfort Index - thrust between treatments 1 and 8**

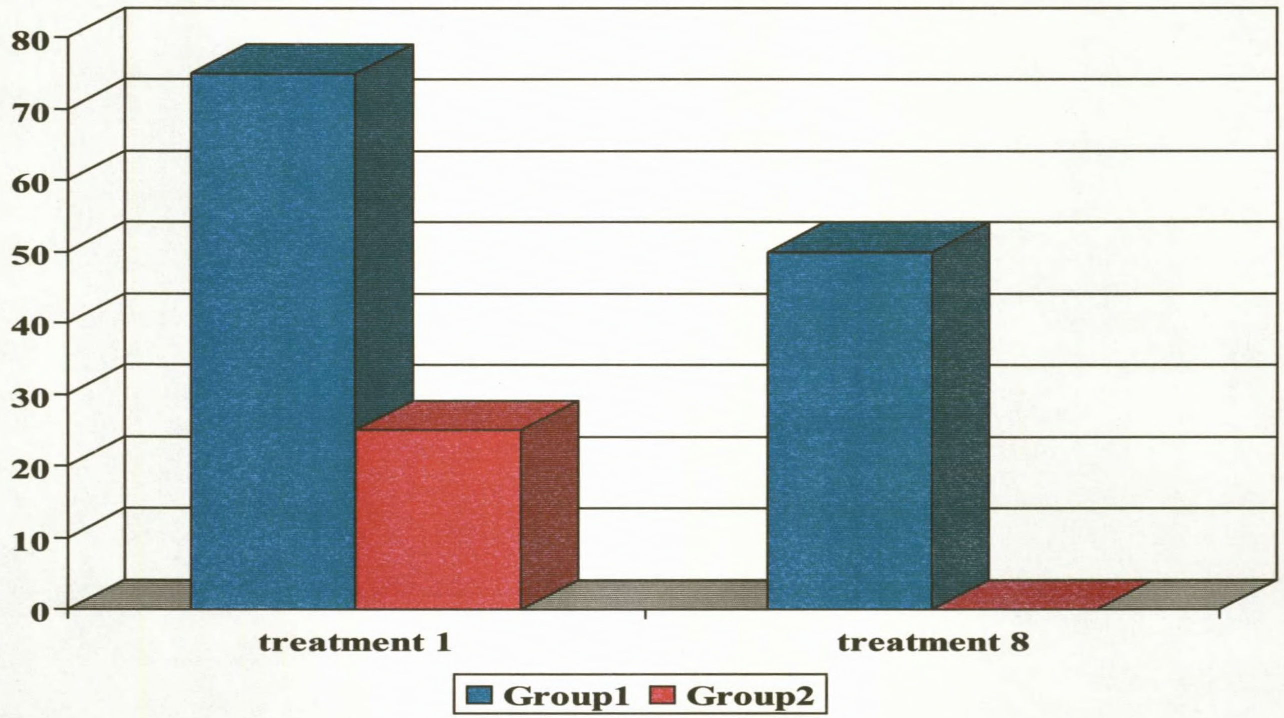


Fig. **4.6 Comparison between groups 1 and 2 for cervical ranges of motion at treatment 8**

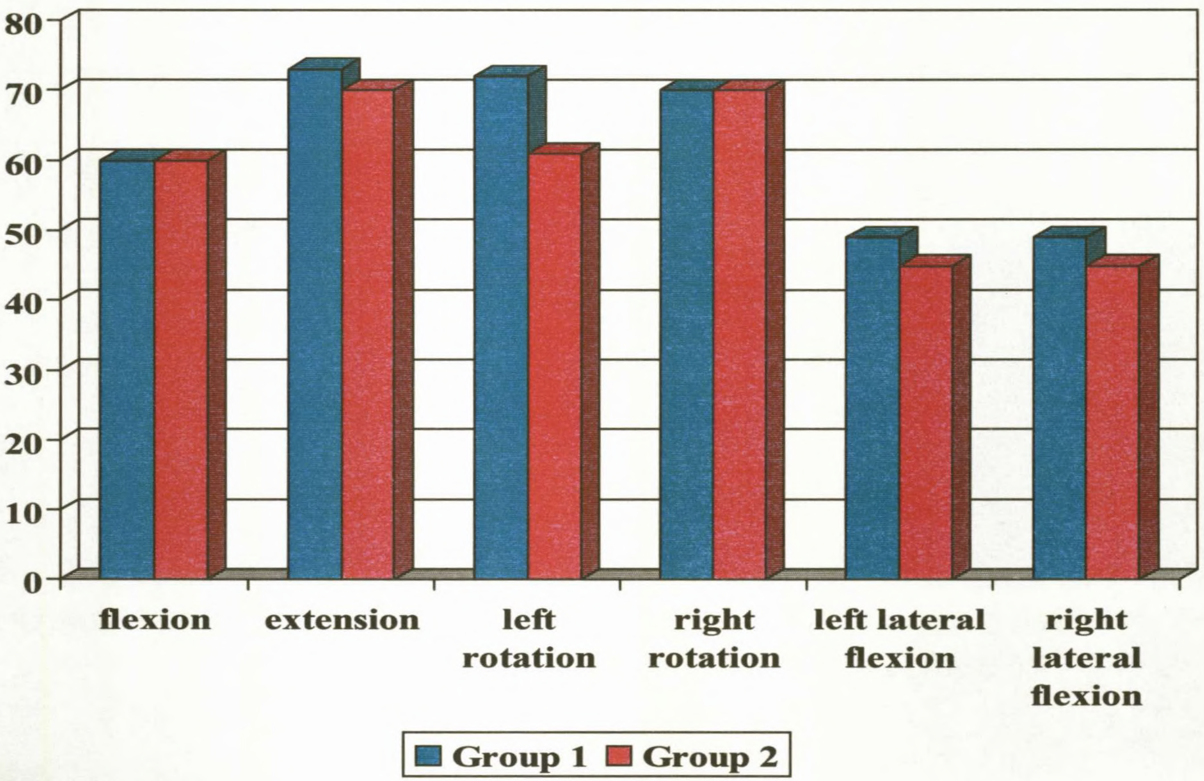


Fig. **4.7 Comparison between treatments 1, 8 and one-month follow-up for motion palpation for both groups**

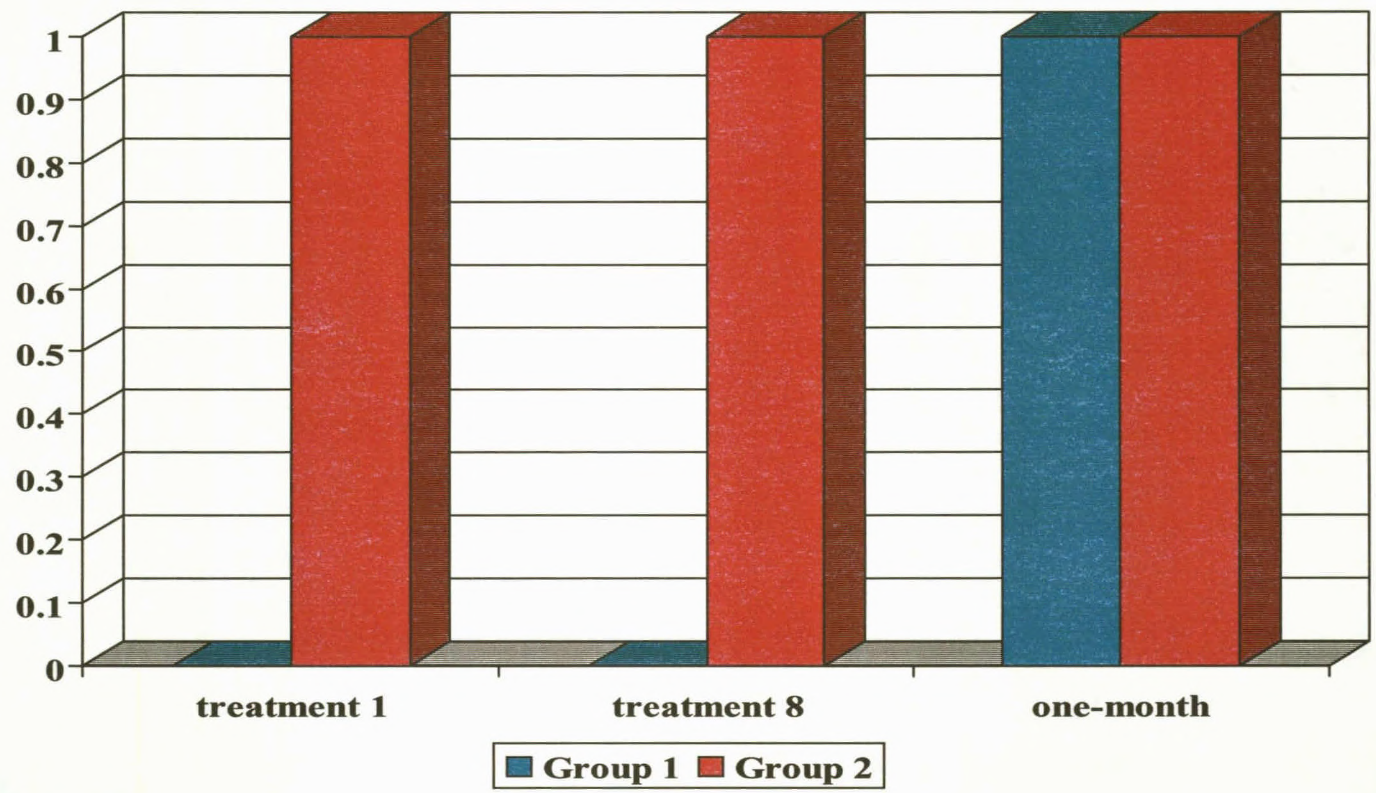
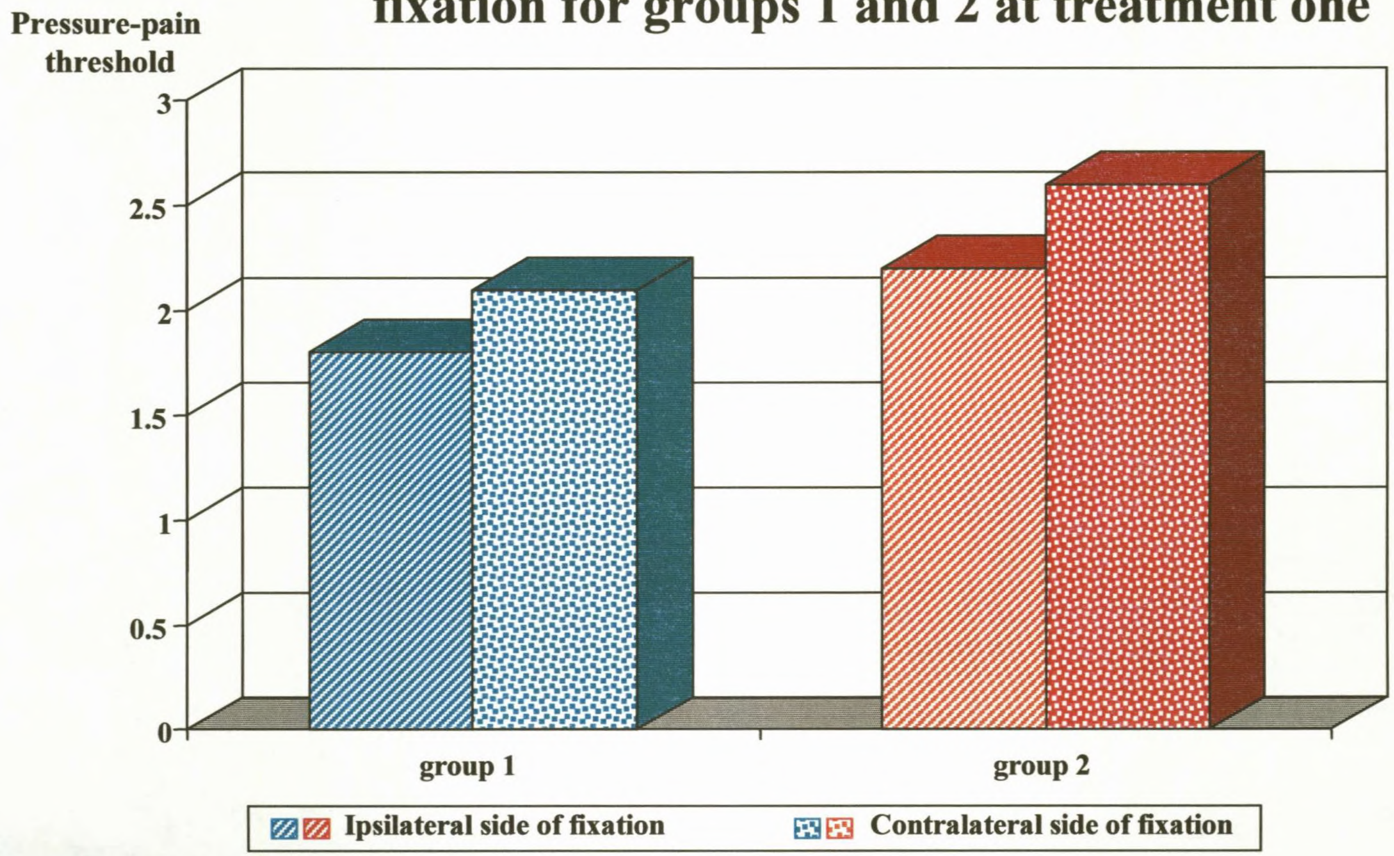


Fig. **4.8 Comparison of pressure-pain threshold readings between ipsilateral and contralateral sides of fixation for groups 1 and 2 at treatment one**



CHAPTER FIVE

5.0. DISCUSSION OF RESULTS

5.1. *INTRODUCTION*

This chapter will discuss the results obtained from the subjective and objective data.

The analysis of the subjective and objective intra-group results of treatments one and eight represent the efficacy of each treatment regime. Evaluation of the results at the one-month follow-up gives an indication of the benefit of each treatment approach after a four-week period.

Evaluation of the inter-group data, assessing the first treatment measurements, gives an indication of any difference in subjective and objective findings between the two groups, in terms of their original signs and symptoms. The inter-group comparison at the eighth treatment indicates which treatment protocol is more effective. In addition, assessment of the results at the one-month follow-up gives an indication as to the long term benefits between the two groups, as well as to whether the initial problem has returned.

5.2. *INTRA-GROUP COMPARISON*

5.2.1. The subjective data

5.2.1.1. *CMCC Neck Disability Index* (Appendix D)

Intra-group comparison of the CMCC Neck Disability Index revealed a statistically significant improvement between treatments one and eight (Table 4.3 & Fig. 4.1) and treatment one and the one-month follow-up (Table 4.4 & Fig. 4.1) for both groups. However, for both groups there was no statistically significant improvement between treatments eight and the one-month follow-up (Tables 4.5, 4.11 & Fig. 4.1).

From the above results, it would appear in terms of improvement that both groups experienced a reduction in disability throughout the treatment duration and maintained this improvement at the one-month follow-up.

5.2.1.2. *Short-Form McGill Pain Questionnaire* (Appendix E)

Statistically, group 1 revealed a significant improvement between treatments one and eight (Table 4.3 & Fig. 4.2) and treatment one and the one-month follow-up (Table 4.4 & Fig. 4.2). Group 1, however, did not demonstrate a statistically significant improvement between treatment eight and the one-month follow-up (Table 4.5 & Fig. 4.2).

With the exception of treatment eight and the one-month follow-up, this suggests that there was a significant reduction in the sensory, affective and quality dimensions of pain for group 1.

Although statistically there was no significant improvement throughout the treatment period for group 2, there did appear to be a subjective improvement in the median measurements between all three treatments (treatment 1 - 10,6%; treatment 8 - 3,2%; one-month follow-up - 1,5%), (Tables 4.10, 4.11, 4.12 & Fig. 4.2).

Thus as pertains to the median, affective and quality dimensions of pain, group 1 appeared to respond more favourably clinically to treatment than group 2.

5.2.1.3. *Numerical Rating Scale-101 Questionnaire* (Appendix F)

Comparison between treatments one and eight for groups 1 and 2 revealed a statistically significant improvement with regard to the Numerical Rating Scale-101 questionnaire (Tables 4.3, 4.9, & Fig. 4.3).

This was not demonstrated between treatment one and the one-month follow-up and treatment eight and the one-month follow-up for both groups, which failed to exhibit a statistically significant improvement (Tables 4.4, 4.5, 4.10, 4.11 & Fig. 4.3).

It therefore appears that there was a reduction in pain intensity for both treatment groups. Both treatment approaches were effective on a short term basis, as indicated by the significant improvement between treatments one and eight.

5.2.1.4. *Comfort Index* (Appendix G)

Although statistically the Comfort Index - set up and Comfort Index - thrust could not demonstrate any significant improvement for either group, there did appear to be a clinical improvement for both groups between treatments one and eight (Tables 4.3, 4.9 & Figs. 4.4, 4.5).

For the Comfort Index - set up and Comfort Index - thrust there was a median decrease in discomfort of 25% for both treatment groups.

Although there was a similar subjective clinical improvement in comfort for both groups 1 and 2, this did not meet the statistical level of significance value of $\alpha = 0{,}05$ to warrant further discussion.

5.2.2. The objective data

5.2.2.1. *Cervical Range of Motion (CROM)* (Appendix I)

The statistical analysis disclosed no significant improvement between treatments one, eight and the one-month follow-up, with regard to all cervical ranges of motion for groups 1 and 2 (Tables 4.6, 4.7, 4.8, 4.12, 4.13, 4.14 & Fig. 4.6).

This indicates that both treatment approaches were ineffective in improving the forward flexion, extension, left rotation, right rotation, left lateral flexion and right lateral flexion ranges of motion throughout the treatment period.

5.2.2.2. _Algometer_ (Appendix J)

Intra-group comparison of the algometer readings taken from the ipsilateral side of the fixation revealed no statistical significant improvement for both groups over the entire treatment and one-month follow-up period (Tables 4.6, 4.7, 4.8, 4.12, 4.13, 4.14).

It can thus be said that there was no significant effective median increase in pressure-pain threshold readings on the ipsilateral side of fixation for both treatment regimes over the entire treatment period.

Once again, algometer readings noted from the contralateral side of fixation revealed no significant statistical improvement over the three treatment consultations for group 1 (Tables 4.6, 4.7, 4.8).

However, analysis of the intra-treatment results from group 2 regarding the algometer readings taken from the contralateral side of fixation, did disclose a significant improvement between treatments one and eight (Table 4.12) and treatment one and the one-month follow-up (Table 4.13). In contrast there was no significant improvement between treatment eight and the one-month follow-up (Table 4.14).

The results mentioned above indicate that group 2, which received an adjustment on the contralateral side to the fixated segment, responded more favourably in terms of increased median pressure-pain threshold readings, both short and long term, in comparison to group 1.

In addition, it is interesting to note that the median pressure-pain threshold readings at treatment one were clinically increased on the contralateral side of fixation in comparison to the ipsilateral side of fixation for both groups 1 and 2 (Fig. 4.8). This possibly indicates that the ipsilateral side of fixation may have been more tender to palpation than the side contralateral to the fixation at the initial visit for both groups. However, no statistical comparison was made, therefore warranting further research in this regard.

This may possibly suggest that the use of tenderness as an aid to diagnose the side of fixation may be a reliable tool as an adjunct to motion palpation.

5.2.2.3. *Motion palpation*

In addition, motion palpation findings were noted to look for possible trends, and although the findings were statistically insignificant for both groups, it is interesting to note that, for group 1 the fixation was found to be absent after treatments one and eight (Table 4.6 & Fig. 4.7) and present after the one-month follow-up (Tables 4.7, 4.8 & Fig. 4.7), whereas for group 2 the fixation was found to be present after all three treatment consultations (Tables 4.12, 4.13, 4.14 & Fig. 4.7).

Hence, although the results were statistically insignificant, it appears that group 1, which received an adjustment on the ipsilateral side of fixation, resulted in disappearance of the spinal fixation over the short term and its reappearance over the long term. Whereas for group 2, which received an adjustment on the contralateral side of fixation, the spinal fixation remained present. This suggests that unlike group 2, the group 1 treatment approach had a clinically significant short term effect, whereas long term, both groups were non-effective.

5.3. *INTER-GROUP COMPARISON*

5.3.1. The subjective data

5.3.1.1. *CMCC Neck Disability Index* (Appendix D)

A comparison of the median measurements at the first treatment indicated that there was no statistically significant difference in the original degree of disability between both groups (Table 4.15 & Fig. 4.1). This suggests that the symptomotology caused by cervical facet syndrome was similar between both groups at treatment one.

Analysis of the median measurements at treatment eight and the one-month follow-up, indicated that the two treatment approaches were equally effective, both short and long term, as there was no statistically significant difference between the groups (Tables 4.16, 4.17 & Fig. 4.1).

5.3.1.2. *Short-Form McGill Pain Questionnaire* (Appendix E)

Inter-treatment comparison of the statistical data at the first treatment, using the median measurements, displayed a significant difference in the initial sensory, affective and quality dimensions of pain between both groups (Table 4.15 & Fig. 4.2). Hence it appears that the treatment groups were not similar in nature at treatment one, and that group 1 demonstrated greater subjective dimensions of pain than group 2.

Analysis of the statistical data also showed a statistically non-significant difference when comparing treatments eight and the one-month follow-up (Tables 4.16, 4.17 & Fig. 4.2). This suggests that both treatment protocols were equally effective over the short term treatment period and that the lasting effects of the treatments were similar with regard to the sensory, affective and quality pain dimensions.

5.3.1.3. *Numerical Rating Scale-101 Questionnaire* (Appendix F)

Statistical comparison between groups 1 and 2 at the first treatment bore no difference in the inceptive degree of pain intensity, thus denoting a similarity in the nature of pain intensity (Table 4.15 & Fig. 4.3).

Analysis of the final and one-month follow-up treatments revealed no statistically significant difference between the two groups, thus indicating groups 1 and 2 to be equally effective, both short and long term (Tables 4.16, 4.17 & Fig. 4.5).

5.3.1.4. *Comfort Index* (Appendix G)

Statistically no significant difference was denoted at treatments one and eight for the Comfort Index - set up and thrust between the two groups. However, clinically it was evident that group 1 appeared to display a 25% greater level of discomfort when compared to group 2 (Tables 4.15, 4.16 & Figs. 4.4, 4.5).

Although statistically insignificant, this did suggest that group 2 experienced a greater level of comfort during the set up and thrust of adjustment in comparison to group 1.

5.3.2. The objective data

5.3.2.1. *Cervical Range of Motion (CROM)* (Appendix I)

No statistically significant difference was evident between groups 1 and 2 for the cervical ranges of motion at all three consultations (Tables 4.18, 4.19, 4.20 & Fig. 4.6).

This similarity in the initial degree of cervical ranges of motion indicated that both groups were fairly linear in nature. The further lack of significance between treatment eight and the one-month follow-up suggests that the two treatment regimes were equally ineffective in increasing cervical ranges of motion throughout the treatment duration.

5.3.2.2. *Algometer* (Appendix J)

Over the three consultations, no statistically significant difference was noted between the two groups for algometer readings taken from both the ipsilateral and contralateral sides of the fixated segment (Tables 4.18, 4.19, 4.20).

Hence the above results suggest that both treatment groups displayed a uniformity in their original pressure-pain thresholds and an equal efficacy in the treatment of cervical facet syndrome.

5.3.2.3. *Motion palpation*

Inter-group comparison at treatment one (Table 4.18 & Fig. 4.7) and treatment eight (Table 4.19 & Fig. 4.7) disclosed a statistically significant difference for motion palpation findings between the two groups, whereas at the one-month follow-up (Table 4.20 & Fig. 4.7) no statistically significant difference was found.

Due to the motion palpation findings being absent at treatments one and eight for group 1, it suggests that the first treatment approach was more effective short term in reducing the spinal fixation when compared to the second treatment approach. However the spinal fixation's reappearance at the one-month follow-up suggests that there was no difference in efficacy between the two treatment protocols long term.

5.4. *PRE-TEST QUESTIONNAIRE* (Appendix H)

The results from the Pre-Test questionnaire indicate that all patients found the Comfort Index easily understandable, non-ambiguous and not difficult in choosing the most applicable box (Table 4.21).

This suggests that the Comfort Index was a reliable method of assessing patient comfort during the set up and thrust of the spinal adjustment.

5.5. *DISCUSSION*

The first hypothesis stated that both treatment groups would be effective in terms of subjective clinical findings. As demonstrated by the results of the CMCC Neck Disability Index (Appendix D), Short-Form McGill Pain questionnaire (Appendix E) and Numerical Rating Scale-101 questionnaire (Appendix F), the first hypothesis is thus accepted.

For the second hypothesis which stated that both treatment protocols would be effective in terms of objective clinical findings, it is rejected for all data except for the results of the algometer - side contralateral to fixation for group 2 where it is accepted.

With regard to the third hypothesis which stated that both treatment regimes would be effective in terms of patient comfort, it is rejected. However, clinically there did appear to be a subjective improvement in patient comfort during the adjustment set up and thrust for both groups and especially within group 2 (Figs. 4.4, 4.5).

The fourth hypothesis, which stated that there would be a significant difference in efficacy between the two treatment approaches, is rejected for all data, except for the motion palpation findings where it is accepted. Thus in terms of the motion palpation findings, the first treatment approach appeared more effective than the second approach. Although statistically insignificant, group 2 did however seem to have a more favourable clinical response than group 1 in terms of all the subjective questionnaires (Figs. 4.1, 4.2, 4.3, 4.4, 4.5).

5.6. *LIMITATIONS OF THIS STUDY*

Inaccuracy of the subjective questionnaires or lack of human understanding may have brought about a biased result due to human error. The patient may have felt the need to please the researcher and thus recorded results that he/she thought the researcher desired. Furthermore the Comfort Index has not been tested using larger patient numbers and subjected to further scrutiny, and thus may/may not be necessarily deemed a valid and reliable method of assessing patient comfort.

The objective measurements, in the form of algometer and CROM readings as well as motion palpation findings, may have been subject to observer error and bias. The increments of the algometer and CROM are $1kg/cm^2$ and 2° respectively and thus the observer may not have noted subtle changes in the readings from these instruments. In addition, as already mentioned, motion palpation is subject to human error and the researcher may not have noted the level or type of fixation correctly.

Another weakness includes the sample size of this study being too small, and thus increased the possibility of a Type II error occurring (i.e. accepting a false null hypothesis).

In addition, it must be noted that no (untreated) control group was included for comparison with the two treatment groups. Thus it cannot be ascertained whether the two treatment groups would have reached a similar level of recovery if no treatment had been administered.

5.7. *COMPARISON OF THE RESULTS WITH OTHER RESEARCH*

Mennell (1990) assessed 100 patients with neck pain by means of standard orthopaedic procedures. Eighty three percent of these patients were manipulated. Of those manipulated, subjectively 34% felt marked improvement and 30% reported complete resolution of symptoms.

Mennell's (1990) pilot study cannot be directly compared with this study as he failed to make use of subjective questionnaires or objective measuring instruments, nor did he compare the manipulated group with a control group. However both treatment groups 1 and 2 did demonstrate a subjective improvement in symptomotology which is difficult to compare with the subjective improvement in Mennell's study.

In a study comparing the efficacy of manipulation versus mobilization of 100 subjects with mechanical neck pain, Cassidy et al. (1992a) demonstrated that both groups had similarly increased ranges of motion, but the manipulated group had a 1,5 times greater decrease in pain intensity than the mobilized group. This study demonstrated that manipulation appears to be more beneficial than mobilization in reducing pain in patients suffering from mechanical neck pain over a short term period. There was no long term follow-up period.

The graph (Fig. 5.1) comparing the mean improvement in NRS-101 scores between group 1, group 2 and the manipulated group of Cassidy et al. (1992a), seemed to reveal that groups 1 and 2 had a lesser pain intensity than the Cassidy et al. (1992a) study, with group 1 responding slightly more favourably than group 2.

From the graph (Fig. 5.2) it can be seen that for forward flexion of the manipulated group Cassidy et al. (1992a) appeared to have a slightly greater improvement than group 2, but a marginally lesser improvement than group 1. For extension, both groups 1 and 2 appeared to have a greater improvement than the Cassidy et al. (1992a) study, with group 1 having an especially more favourable response than group 2.

Although the differing results of the two research studies appear fairly transparent, direct comparison is made difficult because the sample sizes were different and Cassidy et al. (1992a) used mean instead of median averages, and he did not include a long term follow-up.

A pilot study amongst 50 patients with neck pain was conducted by Cassidy et al. (1992b) to determine the effect of manipulation on pain and range of motion in the cervical spine. The results demonstrated an increase in all planes of range of motion and a decrease in pain scores immediately after manipulation. It was interesting to note that manipulation had the greatest effect on rotation and the improved rotation was associated with increased pain reduction.

Comparison of the mean NRS-101 scores of groups 1 and 2 of this study with Cassidy et al. (1992b) (Fig. 5.3) demonstrated that both groups, and especially group 1, had a more substantial reduction in pain intensity in contrast to Cassidy et al. (1992b).

The graph of Fig. 5.4 demonstrates that groups 1 and 2 had a greater mean improvement than Cassidy et al. (1992b) and especially group 1 for extension, whereas for flexion, although group 1 had a greater mean improvement than group 2, Cassidy et al. (1992b) had a better mean improvement than the two treatment groups.

Once again comparison between the two studies was made difficult as the sample sizes were different, means instead of medians were utilized and Cassidy et al. (1992b) did not compare his treatment approach with any other, nor was there any long term follow-up.

In a randomized clinical trial Koes et al. (1992) evaluated the effectiveness of manual therapy, physiotherapy, placebo and treatment by the general practitioner for non-specific back and neck complaints in 256 subjects. It was found that both the manual therapy and physiotherapy groups had a significantly greater effect in reducing the pain and severity of the main complaint compared to treatment administered by the general practitioner. It is interesting to note that the placebo group had a more positive response when compared to the group treated by the general practitioner. The placebo group however had a lesser response than the manipulated and physiotherapy groups.

The study by Koes et al. (1992) cannot be compared directly with this study as he compared four treatment groups with each other, the sample sizes were different and non-specific back and neck complaints were addressed.

However, with regard to the manual therapy group by Koes et al. (1992) and the two treatment groups in this study, it can be seen that both studies demonstrated a significant subjective reduction in pain and severity of the main complaint. This indicates that spinal manipulative therapy has a significant effect above other therapies in the management of neck pain.

Fig. **5.1 Comparison of mean NRS-101 scores with study by Cassidy et al. (1992a)**

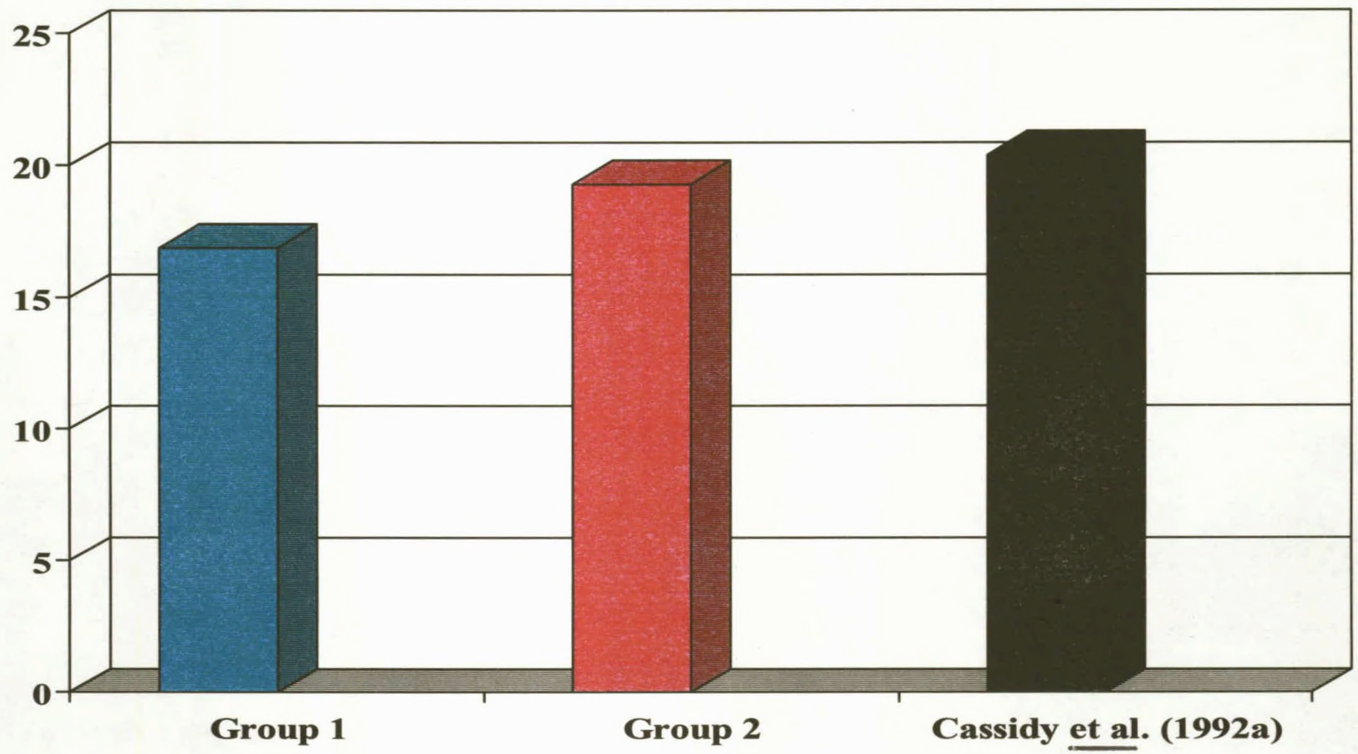


Fig. 5.2 **Comparison of mean cervical ranges of motion between group1, group 2 and Cassidy et al. (1992a)**

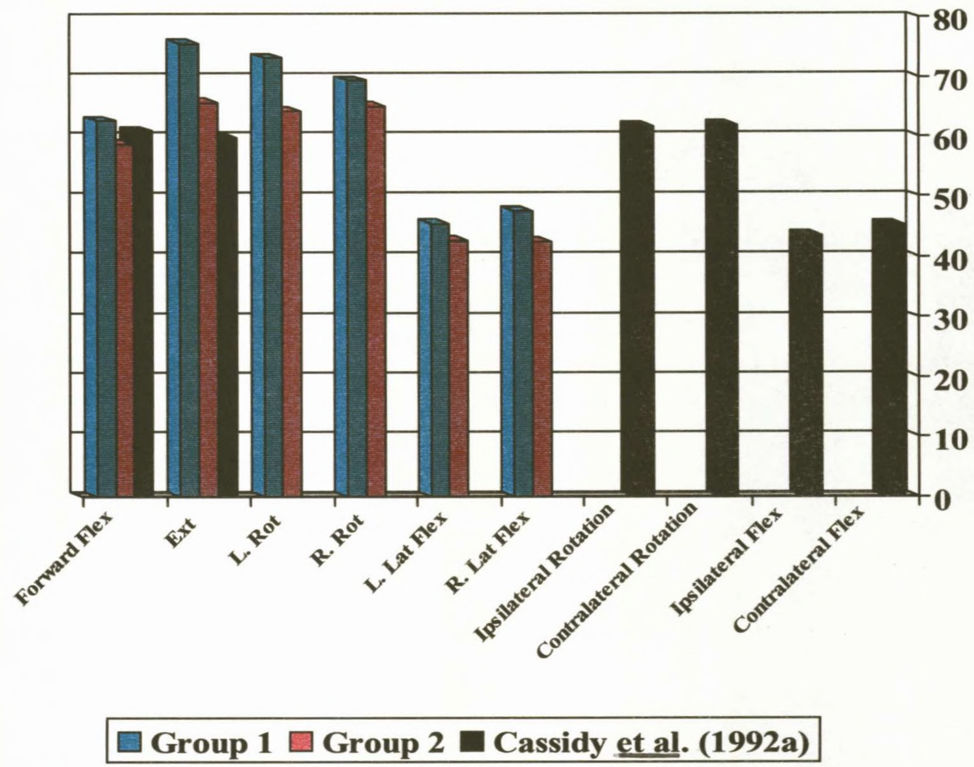


Fig. 5.3 **Comparison of mean NRS-101 scores with study by Cassidy et al. (1992b)**

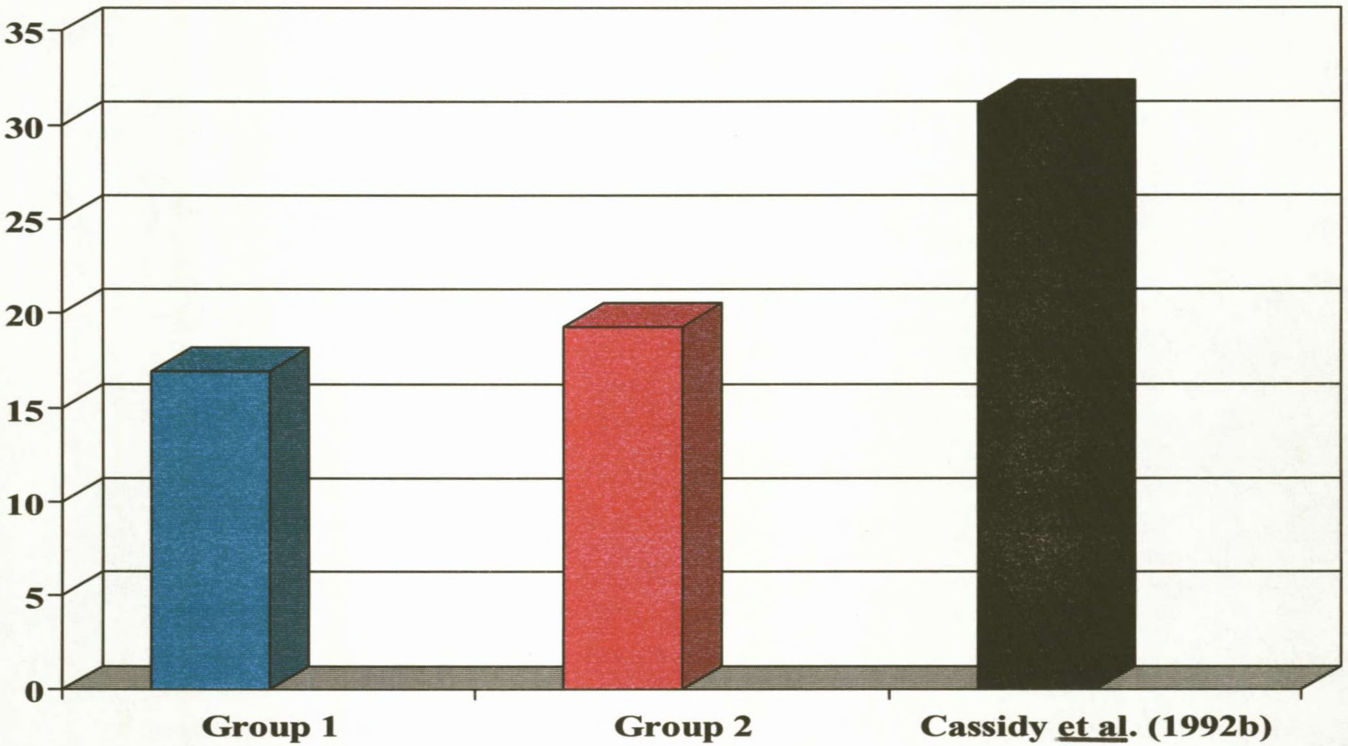
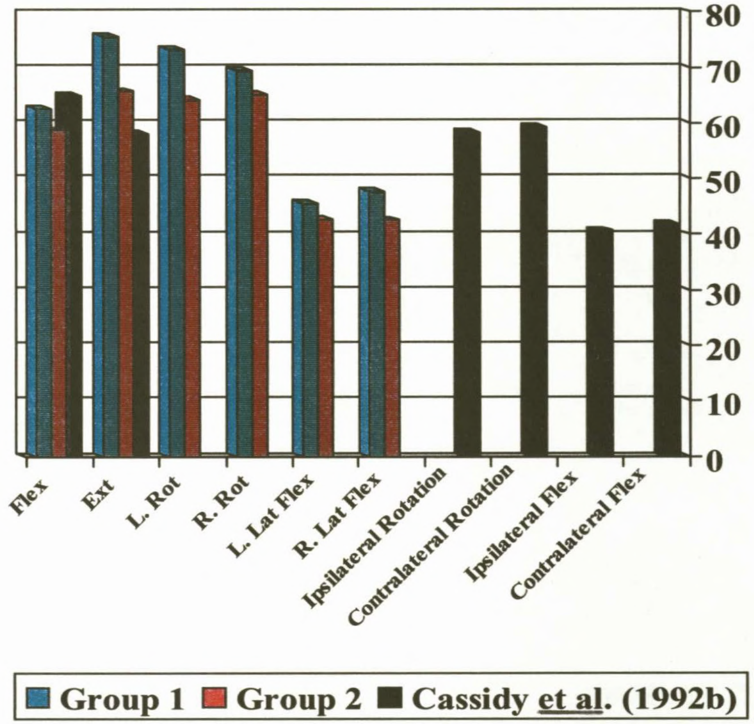


Fig. 5.4 **Comparison of mean cervical ranges of motion with Cassidy <u>et al</u>. (1992b)**



CHAPTER SIX

6.0. CONCLUSIONS AND RECOMMENDATIONS

6.1. *CONCLUSIONS*

This study was comprised of 30 subjects, all of whom were diagnosed with cervical facet syndrome after undergoing an extensive case history, physical and orthopaedic examination. These patients were randomly divided into two groups of 15 each,whereby group 1 received an adjustment on the ipsilateral side of the fixated segment and group 2 received an adjustment on the side contralateral to the fixated segment.

Both groups received a maximum of eight treatments over a period of four weeks.

From the results it can be seen that both groups demonstrated a significant improvement in terms of functional disability, pain intensity and the sensory dimensions of pain, indicating that both treatment approaches were effective in the treatment of cervical facet syndrome. However no significant improvement in cervical ranges of motion and pressure-pain threshold within the two groups was demonstrated, aside from group 2 which did reveal a significant improvement in the pressure-pain threshold on the side contralateral to the fixated segment.

It is also interesting to note that the median pressure-pain threshold readings at treatment one were clinically increased on the contralateral side of fixation in comparision to the ipsilateral side of fixation for both group 1 and group 2, which may indicate that the ipsilateral side of fixation was possibly more tender to palpation than the contralateral side of fixation. This may possibly suggest that using symptomatic tenderness as an aid to diagnose the side of fixation may potentially be a reliable tool as an adjunct to motion palpation.

In general no significant difference in efficacy could be demonstrated between the two treatment approaches, with the exception of the motion palpation findings which showed that the first treatment protocol was more effective than the second approach in the alleviation of spinal fixations over a short term period. However, long term both groups were equally effective in the alleviation of spinal fixations.

Although statistically there was no significant improvement nor significant difference in patient comfort during the set up and thrust of adjustment, clinically there did appear to be a 25% subjective improvement in patient comfort for both groups. In addition group 2 seemed to display a greater level of patient comfort in comparison to group 1. It thus seems that the second treatment protocol was more effective than the first in terms of patient comfort.

It could be explained that this difference in patient comfort may be because the fixated segment was possibly tender and inflamed, and by applying a contact over the ipsilateral side of the fixated segment as in group 1 this could have further irritated the already tender area and thus increased the level of discomfort. In contrast, applying a contact over the side contralateral to the fixated segment as in group 2 could have limited further irritation of the potentially tender area and thus reduced the level of discomfort. This reason may be one possible explanation, but other explanations may be plausible involving unforeseen factors that the observer is not aware of.

Thus for patients with an extremely acute cervical facet syndrome, it may be beneficial adjusting them on the side contralateral to the potentially tender fixated segment, and thus avoiding the risk of further irritating the inflamed facet joint.

6.2. RECOMMENDATIONS

Due to the small sample size selected in this study, the results cannot be recognized as having significant impact in the research pool of knowledge. Therefore a larger sample size should be selected using standard randomized selection techniques and should possibly take into account gender, age, race and morphologic physique. These factors could aid in making the sample more linear in distribution and possibly further validate the results.

Other factors to consider could include chronicity of the problem, severity of the symptoms, mode of onset and radiation of pain patterns, etc. By analyzing such factors, it could not only make the results more reliable but also demonstrate possible trends, which may provide further insight into the management of patients with cervical facet syndrome.

It may be advisable in the future that, when using the CROM and algometer as measuring tools, three consecutive readings be taken and the median reading be used to further improve accuracy and reduce user error.

It is recommended that a larger period of time, such as six months to a year, be allocated to the long term follow-up period, as this will give a clearer indication as to the long term benefits of this study as well as assess the symptomatic progression and regression of the subjects in the study.

It may also be viable to conduct a study assessing the relationship between subjective tenderness and side of fixation in order to determine the reliability and validity of tenderness as a diagnostic adjunct to motion palpation.

In addition, it is recommended that a more extensive controlled trial be conducted with regard to the Comfort Index in order to help support or refute the validity and reliability of this questionnaire.

Further research is needed to compare the two treatment groups with an untreated (control) group in order to determine whether the treatment groups' recovery time differs from that of the natural history of facet syndrome.

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TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient:______________________________ Date: __________________
file #:_______ X-Ray#:__________________
Age:________ Sex:________ Occupation:__________________
Intern:_________________________ Signature:__________________

FOR CLINICIAN'S USE ONLY
Initial visit clinician:________________Signature:__________________

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

Case Status:

PTT: Conditional: Signed Off: Final Sign out:

Recommendations:

Intern's Case History

1. Source of History:

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

3. Present Illness:

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

4. Other Complaints:

5. Past Medical History:

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

6. Current health status and life-style:

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

7. Immediate Family Medical History:

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

8. Psychosocial history:

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

9. Review of Systems:

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

TECHNIKON NATAL

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Patient:______________________ File#: ______________________ Date:__________
Clinician:______________________ Signature:____________________
Intern:______________________ Signature:____________________

1. VITALS

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

2. GENERAL EXAMINATION

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

Urinalysis:

3. CARDIOVASCULAR EXAMINATION

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

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

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

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

Percussion: - borders of heart

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

4. RESPIRATORY EXAMINATION

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

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

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

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

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

5. ABDOMINAL EXAMINATION

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

Inspection
- Shape:
- Scars:
- Hernias:

Palpation
- Superficial:
- Deep = Organomegally:

- Masses (intra- or extramural)
- Aorta:

Percussion
- Rebound tenderness:
- Ascites:
- Masses:

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

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

6. G.U.T EXAMINATION

External genitalia:
Hernias:
Masses:
Discharges:

7. NEUROLOGICAL EXAMINATION

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

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

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

Evidence of head trauma:

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

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

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

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

III Ocular Muscles:
Eye opening strength:

IV Inferior and Medial movement of eye:

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

b. Motor - Masseter:
- Jaw lateral movement:

c. Reflexes - Corneal reflex
- Jaw jerk

VI Lateral movement of eyes

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

b. Taste - Anterior two-thirds of tongue:

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

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

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

XII Inspection of tongue (deviation):

Motor System:

a. Power
- Shoulder = Abduction & Adduction:
  = Flexion & Extension:
- Elbow = Flexion & Extension:
- Wrist = Flexion & Extension:

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

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

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

Sensory System:

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

b. Joint position sense
- Finger:
- Toe:

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

Cerebellar function:

Obvious signs of cerebellar dysfunction:

= Intention Tremor:

= Nystagmus:

= Truncal Ataxia:

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

8. **SPINAL EXAMINATION:**(See Regional examination)

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

9. **BREAST EXAMINATION:**

Summon female chaperon.

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

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

Appendix C

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

Patient: ______________________ File: ____________

Date: ____________ Intern/Resident: ______________________

Clinician: ______________________ Sign: ____________

OBSERVATION:

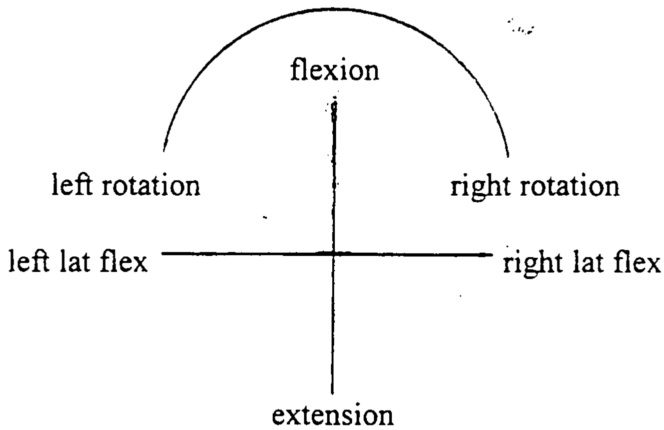
Posture
Swellings
Scars
Discolouration
Hair Line
Bony & Soft Tissue Contours

Shoulder position:
Left:
Right:
Muscle spasm
Facial expression

RANGE OF MOTION:

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

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



PALPATION:

Lymph Nodes
Thyroid Gland

Trachea

ORTHOPAEDIC EXAMINATION:

Tenderness

Trigger Points: SCM
Scalenii
Post Cervicals
Trapezius
Lev Scap

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

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

Dizziness rotation test
Brachial plexus tension

Lhermitte's sign

NEUROLOGICAL EXAMINATION:

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

VASCULAR:

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

MOTION PALPATION & JOINT PLAY:

Left: Motion Palpation:
Joint Play:

Right: Motion palpation:
Joint Play:

Upper T horacics:
Motion Palpation:
Joint Play:

Basic Exam: Shoulder:
Case History:

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

Basic Exam: Thoracic Spine:
Case History:

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

Appendix D

CMCC NECK DISABILITY INDEX

PATIENT NAME:________________ FILE #:______ DATE.________

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

Section 1 - Pain Intensity

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

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

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

Section 3 - Lifting

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

Section 4 - Reading

- ☐ I can read as much as I want to with no pain in my neck.
- ☐ I can read as much as I want to with slight pain in my neck.
- ☐ I can read as much as I want with moderate pain in my neck.
- ☐ I can't read as much as I want because of moderate pain in my neck.
- ☐ I can hardly read at all because of severe pain in my neck.
- ☐ I cannot read at all.

Section 5 - Headaches

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

Section 6 - Concentration

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

Section 7 - Work

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

Section 8 - Driving

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

Section 9 - Sleeping

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

Section 10 - Recreation

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

Appendix E

MEASUREMENT OF PAIN

SHORT-FORM McGILL PAIN QUESTIONNAIRE

RONALD MELZACK

PATIENT'S NAME: ______________________ DATE: ____________

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

NO PAIN |————————————————| WORST POSSIBLE PAIN

PPI

0	NO PAIN	____
1	MILD	____
2	DISCOMFORTING	____
3	DISTRESSING	____
4	HORRIBLE	____
5	EXCRUCIATING	____

FIGURE 10.5. The short-form McGill Pain Questionnaire. Descriptors 1-11 represent the sensory dimension of pain experience and 12-15 represent the affective dimension. Each descriptor is ranked on an intensity scale of 0 = none, 1 = mild, 2 = moderate, 3 = severe. The Present Pain Intensity (PPI) of the standard long-form MPQ and the Visual Analogue Scale are also included to provide overall pain intensity scores. Copyright 1984 Ronald Melzack.

Patient name:__________________ Res.No:_______ Date:________

7.4 NUMERICAL RATING SCALE-101 QUESTIONNAIRE

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

____

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

____

Appendix G

COMFORT INDEX

DATE ____________________

PATIENT NAME ________________________ FILE NO _____

This questionnaire has been designed to give the researcher information as to the level of discomfort experienced by you :

A) during positioning for the adjustment, and
B) during thrust of adjustment.

Please tick one box under A and one box under B, which is most applicable to you.

A. SET UP FOR ADJUSTMENT

0 no discomfort	1	2	3	4 severe discomfort

B. THRUST OF ADJUSTMENT

0 no discomfort	1	2	3	4 severe discomfort

Appendix H

PRE-TEST QUESTIONNAIRE

DATE ___________________

PATIENT NAME _____________________________ FILE NO _______

This questionnaire has been designed to give the researcher information as to whether you have experienced any difficulty in completing the Comfort Index.

Please tick YES or NO as applicable, in answer to the following questions :

1. Is the Comfort Index easily understandable? YES NO
   If your answer is NO, please explain :

   -
   -

2. Is the Comfort Index ambiguous? YES NO
   If your answer is YES, please explain :

   -
   -

3. Do you have any difficulty in choosing the box most applicable to you? YES NO
   If your answer is YES, please explain :

   -
   -

Appendix I

CROM

	Forward Flexion	Extension	Left Rotation	Right Rotation	Left Lateral Flexion	Right Lateral Flexion
Initial Consultation						
Final Consultation						
Follow-up Consultation						

Appendix J

ALGOMETER

Treatment	Left Side	Right Side
1		
8		
Final Consultation		

Appendix K

INFORMED CONSENT FORM

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

TITLE OF RESEARCH PROJECT

____

____

NAME OF SUPERVISOR

____

NAME OF RESEARCH STUDENT

____

PLEASE CIRCLE THE APPROPRIATE ANSWER

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

PATIENT/SUBJECT* Name____________________ Signature____________________
(in block letters)

PARENT/GUARDIAN* Name____________________ Signature____________________
(in block letters)

WITNESS Name____________________ Signature____________________
(in block letters)

RESEARCH STUDENT Name____________________ Signature____________________
(in block letters)