THE RELATIVE EFFECTIVENESS OF AN INSTRUMENTAL AS OPPOSED TO A MANUAL THRUST IN THE TREATMENT OF CERVICAL SPINE DYSFUNCTION

by

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I, Timothy George Wood,
do hereby declare that this dissertation
represents my own work
in both conception
and execution.

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DEDICATION

This work is dedicated to my family and friends, who believed in me.

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ABSTRACT

Purpose

The purpose of this study was to determine the relative effectiveness of two seemingly different approaches to manipulation of the cervical spine in the treatment of cervical spine dysfunction.

The researcher postulated that a manual manipulation would have a greater effect in reducing pain and increasing range of motion that accompanies cervical dysfunction than an instrumental, low force, high velocity thrust delivered by means of an Activator Adjusting Instrument. The reason for this is that it provides greater joint movement.

Methods

This randomised controlled trial consisted of two treatment groups. Each group consisted of 15 subjects, between the ages of 16 and 65 years, selected from the general population and randomly allocated to treatment group A or B.

Group A received instrumental thrusts delivered by an Activator Adjusting Instrument (AAI), while group B received standard diversified manual manipulations to the dysfunctional joints in the cervical spine.

Each subject was assessed by using subjective measures of the CMCC Neck Disability Index, Numerical Pain Rating Scale and McGill Short- Form questionnaire; and the objective measure of degrees of cervical range of motion obtained using a cervical goniometer (CROM).

Two tailed statistical analysis was conducted at $\alpha = 0.05$, using the non-parametric Wilcoxin Signed Rank Test and the Mann-Whitney U Test comparing intra-group and inter-group data respectively. Further assessment of the data was conducted using power analysis. This data as well as the descriptive statistics were presented in tables and bar charts.

Results

Statistically significant results ($p < 0.025$) were noted for both treatment groups, between the initial and the final treatment and between the initial and the 1 month follow-up, with respect to the subjective data. For the objective data over the same time frames, group A (instrumental) showed statistically significant results for lateral flexion and rotation, while group B (manual) showed only statistically significant changes in rotation.

The inter-group comparison revealed no statistical significant results ($p < 0.025$) though it must be noted that the power was weak; so the probability of committing Type II error and falsely accepting the null hypothesis is high.

Conclusions

Both treatment groups responded equally well to the interventions. It can be suggested from this pilot study that both manual manipulation and instrumental thrusts delivered to the cervical spine have a positive impact on reducing pain and disability, and increasing range of motion in patients suffering from chronic cervical spine dysfunction.

Further studies into these interventions are warranted.

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F/u	1 month follow-up
S.D.	Standard deviation
S.E.	Standard error of mean
Rx	Treatment

DEFINITION OF TERMS

Joint dysfunction : Joint mechanics showing area disturbances of function. (Gatterman 1990: 409)

Manipulation : Passive maneuver in which specifically directed manual forces are applied to vertebral and extravertebral articulations of the body, with the object of restoring mobility to restricted areas. (Gatterman 1990: 410)

Adjustment : Specific form of direct articular manipulation utilizing either long or short leverage techniques with specific contacts, characterised by a dynamic thrust of controlled velocity, amplitude, and direction. (Gatterman 1990: 405)

Thrust : Sudden manual application of a controlled directional force upon a suitable part of the patient, the delivery of which effects an adjustment. (Gatterman 1990: 415)

Fixation : Absence of motion of a joint in a position of motion, usually at the extremity of such motion. (Gatterman 1990: 408)

Subjective clinical findings : refers to the pain questionnaires that subjectively assess the patients' condition.

Objective clinical findings : refers to procedures utilised by the practitioner that objectively assess the patients' condition.

CHAPTER ONE

1.0 INTRODUCTION

1.1 The problem and its setting

Bland (1994: 6) states the incidence of one or more attacks of neck pain in working individuals between the ages of 25 and 29 is 25-30%. When looking at the over 45 year old group the figure rises to 50%.

Studies in Sweden showed the prevalence of neck pain ranging from 14 to 18 percent of the working population. (Frymoyer 1991: 137). Back pain, including cervical spine pain, has been labeled, "the most expensive musculoskeletal problem, the most expensive industrial injury and the most common cause of disability under the age of 45". (Frymoyer 1991:147)

Chiropractors have used manual adjustments to treat neck pain since the inception of the profession, yet it is only in the last twenty-five years or so that instrumental thrusts have been looked at as an alternative (Slosberg 1988, Osterbauer and Fuhr 1990).

A common disorder of the cervical spine is that of posterior facet joint dysfunction (Gatterman 1990: 205, 232, Panzer 1995: 426). This facet joint dysfunction is known diagnostically as facet syndrome. (Gatterman and Panzer 1990: 161, 205). The term dysfunction implies that at one anatomical level the components of the joint are not functioning normally. (Kirkaldy-Willis 1992: 105).

Manipulation has been shown to be effective in the treatment of facet syndrome and favourable responses to manipulation may even confirm the diagnosis (Gatterman and Panzer 1990: 163, Kirkaldy-Willis 1992: 203).

Manipulation has two uses, firstly to relieve pain resulting from joint dysfunction and secondly to restore the range of motion to a joint whose function is impaired. (Mennell 1990, Panzer 1995: 424). This is thought to be brought about by mechanical changes within the joint by introducing paraphysiological movement and/or by reflexogenic effects from stimulation of certain neural pathways (Wyke 1973, Korr 1975, Sandoz 1976, 1981).

It seems logical that a manual thrust is capable of producing both mechanical and reflexogenic effects as stated above, however instrumental thrusts do not supply significant joint movement (Smith et al. 1989, Nathan and Keller 1994) and thus any benefit derived from this intervention would seem to be from the stimulation of static and dynamic receptors causing reflex inhibition of pain and muscle activity. (Wyke 1973, Korr 1975, Sandoz 1981).

This study will attempt to address the apparent gaps in the literature regarding concepts such as: cavitation, speed and force of manipulative thrusts; and provide clinical evaluation of manual and instrumental treatment interventions.

1.2 Aims and Objectives of the study

Aims:

The aim of this study is to evaluate the relative effectiveness of instrumental high velocity, low force thrusts delivered by means of an Activator Adjusting Instrument with respect to the patient's perception and objective clinical findings as compared to standard manual adjustment in the treatment of joint dysfunction of the cervical spine in order to determine the more effective adjusting method.

Objectives:

1) To evaluate the effectiveness of manual adjustments and high velocity, low force instrumental thrusts in the treatment of joint dysfunction of the cervical spine in terms of the patient's perception.

2) To evaluate the effectiveness of manual adjustments and high velocity, low force instrumental thrusts in the treatment of joint dysfunction of the cervical spine in terms of the patient's objective clinical findings.

3) To integrate the results obtained from objectives one and two in order to determine the more effective adjusting method.

1.3 Benefits of this study

The scientific community is of the opinion that studies concerning manipulative treatment of neck pain are inconclusive and that there is a strong need for good quality clinical research in this field. (Haldeman 1997, Vernon 1997).

The benefits of this pilot study are that it should add to the current body of knowledge and that it should serve to open the way for future research into this field. It should also serve to open the current models of mechanical and reflex theories within chiropractic for re-evaluation. With concepts such as: cavitation, speed and force of manipulative thrust, and their usefulness within manipulation, revisited.

It must be emphasised that the results of this study will not prove anything because it is a pilot study. What the author hopes to achieve is to point toward possible relevance and the understanding of the practice of manipulation, both mechanical and instrumental thrusts, in the treatment of cervical spine dysfunction.

CHAPTER TWO

2.0 REVIEW OF THE RELATED LITERATURE

2.1 Introduction

Neck pain is a common complaint in the general public (Cassidy, Lopez et al. 1992) and cervical dysfunction is the second most common condition treated by chiropractors (Nyiendo et al. 1989).

This literature review aims to provide an outline of cervical spine dysfunction; its mechanisms, diagnosis and treatment.

2.2 Incidence and Prevalence

Cassidy, Lopez et al. (1992) report that 40-50 % of the general population will have neck pain with some limitation of movement at some time in their lives.

Grieve (1989: 185) states that 46% of rheumatic disease is found in the spine. The most common area affected is the lumbosacral area, the second being the cervical spine.

Epidemiological studies show the prevalence of neck pain between 33-71% (Bland 1994: 3).

Frymoyer (1991: 137) puts the prevalence of cervical spine disorders in the working population at 14-18 %.

While Nygren et al. (1997: 21) state that neck and shoulder disorders are the most common work related diagnosis in Sweden.

Hagburg (1982) in Grieve (1989: 190) has surveys recording incidence of neck pain ranging from 18-67%.

Bland (1994: 6) states the incidence of one or more attacks of neck pain in working individuals between the ages of 25 and 29 at 25-30%. When looking at the over 45 year old group the figure rises to 50%. He also states that at least 45% of working men have had at least one attack.

A comparative study between six chiropractic colleges in the U.S.A. indicated that the number of patients seen for neck pain ranged between 19-27% (Nyiendo et al. 1989: 83). A study conducted at the Technikon Natal (South Africa) found that 54.4% of the patients presenting to the Clinic and 57.4% of the patients presenting to private practitioners in South Africa complained of neck pain (Drews 1995: 66).This category included neck pain and associated headaches or arm pain. While 14.8% of private practice patients and 16.7 of clinic patients had only neck pain.

Although the incidence, prevalence and the number of patients seeking help from chiropractors for their neck pain seem to vary from author to author. The number of people suffering from this condition is clearly significant.

2.3 Anatomy and innervation of cervical spine facet joints

The neck is the most mobile part of the spine (Bland 1994: 3). It consists of several joints and is an area that sacrifices stability for mobility and thus is vulnerable to injury. (Magee 1992: 34).

The cervical vertebrae are divided into 2 anatomical parts : (i) The craniovertebral or suboccipital joints between skull (C0) and atlas (C1) and between atlas and axis (C2), and (ii) the zygopophyseal joints from the inferior surface of C2 to the superior surface of T1. (Kapandji 1990: 170 and Moore 1992: 349)

The occipitoatlantal joints (C0-C1) and atlanto-axial joints are atypical joints in that they have no intervertebral discs, no zygopophyseal (facet) joints and show different movement to the rest of the cervical joints. C0-C1 allows for flexion and extension while C1-C2 accounts for 50% of total cervical rotation. (Gatterman 1990: 13, Moore 1992: 348 – 350)

The lower cervical vertebra form a "3 joints complex" with the adjacent vertebra. The first joint is between bodies of the vertebra. They are joined by a fibrocartilagenous disc. This intervertebral disc serves to unite as well as to keep the vertebra apart. (Gatterman 1990: 14). The other 2 joints are the posterior (zygopophyseal or facet) joints. These are paired articulations between the inferior articular process of one vertebra and the superior articular process of the vertebra below. They are true diarthrodial joints, have articular cartilage, a loose capsule lined with synovial membrane, reinforced with ligaments and related muscles. (Gatterman 1990: 14)
These joint complexes or motion segments act together as a unit to produce movement. Flexion-extension, side bending and rotation are products of this synergism or coupling. (Haldeman 1992: 130)

Co-ordination of neck movements and static posture is maintained and co-ordinated through many joint movements and combinations of muscle actions. This combined functioning is predominantly automatic and unconscious i.e. reflex action. (Gatterman 1990: 260)

The deep intersegmental spinal muscles that attach to the articular and spinous processes of the vertebra ensure efficient action of the superficial muscles (main movers) by adjusting small movements of the vertebral column. (Gatterman 1990: 16).

The structures in and around the vertebral joints: muscle, tendon, ligaments, periosteum, disc and facet joints, are extensively innervated by nerves that relay sensory information to the central nervous system. (Bolton 1997).

There are various mechano and nociceptive receptors in the facet joint, surrounding muscle, ligament and intevertebral disc. These are as follows:

Muscle spindles	- probably the most common encapsulated nerve ending in the neck. - found in relatively large numbers compared to muscles in other areas of the body. - tend to be found in the deeper portions of the muscles. (Bolton 1997).
Golgi tendon organ	- found in musculotendinous junction and in fascia dividing muscle into compartments (often in association with muscle spindles).
Pacinian corpuscles	-found in muscle adjacent to tendons and fibrous connective tissue. -most are found in outer layers of fibrous material of the facet joints. (Bolton 1997).

Of particular interest to the manipulative therapist and more specifically this study are the intrinsic receptors of the joint . These were classified by Wyke in 1967 and presented in the concise text by Colloca (1997: 23) in the following table (overleaf).

Table 2.1 Articular receptors

Type	Morphology	Location	Characteristics
I	Thinly encapsulated globular corpuscles	Fibrous capsules of joints in the superficial layers	Static and dynamic mechanoreceptors, lo threshold, slowly adapting
II	Thickly encapsulated conical corpuscles	Fibrous capsule of joints in the deeper synovial layers	Dynamic mechanoreceptors, low threshold, rapidly adapting
III	Thinly encapsulated fusiform corpuscles	Applied to surfaces of joint ligaments (collateral and intrinsic)	Dynamic mechanoreceptors, very high threshold, slowly adapting
IV (a)	Traditional plexus of unmyelinated nerve fibres	Fibrous capsule of joints	Nociceptive mechanoreceptors, very higł threshold, non-adapting
(b)	Free unmyelinated	Joint ligaments (collateral and intrinsic)	Chemosensitive (to abnormal tissue metabolites)

2.4 Facet joint dysfunction

"The term dysfunction implies that at one anatomical level the components of the joint are not functioning normally." (Kirkaldy-Willis 1992: 105)

Dysfunction has been called many names. Subluxation and fixation are commonly used to describe this state of altered functioning. Haldeman (1992: 627) says a subluxation is an aberrant relationship between adjacent articular structures that may have functional or pathological sequelae, causing an alteration in the biomechanics and/or neurophysiological reflections of these articular structures. Fixation according to Haldeman (1992: 623) is a state whereby an articulation has become temporarily immobilised in a position that it may normally occupy during any phase of physiological movement.

From this definition it would seem that the joint fixation, or loss of motion, is one part of the subluxation or dysfunctional joint.
The other symptoms and signs, adjusted from Kirkaldy-Willis' (1992: 109) model for low back to reflect that of the neck, are: Symptoms: neck pain (often local, sometimes referred), painful movement. Signs: Local tenderness, muscle contracted (spasm), extension painful, normal neurological exam and, as mentioned above, hypomobility.

This facet joint dysfunction is known diagnostically as a facet syndrome (Kirkaldy-Willis 1992: 122, Gatterman and Panzer 1990: 161, 205) and can usually be confirmed with a Kemp's (extension, rotation and axial compression) Test which compresses the irritable facet joint.

2.5 Causes of dysfunction

2.5.1 Direct and indirect trauma

According to Shafer and Faye (1987: 5) dysfunction is often caused by a definite but minor trauma and is often classified as a sprain or strain.
Dishman (1988) maintains that pain arising from a synovial joint or intervertebral disc will evoke a splinting reflex from the surrounding muscle. Pain from muscle pathology will also cause local muscle spasm and produce loss of movement in that joint.

2.5.2 Mechanical causes

The locking or fixation of a facet joint is often presumed to be from mechanical derangement like intra-articular jamming, shortening, adhesions and incongruency of the joint surfaces. (Mootz 1995: 178-180).

2.5.2.1 Intra-articular jamming

May be due to meniscoids, synovial folds or hypertrophic villi becoming entrapped within the joint. This interferes with movement, causes pain, muscle spasm (through aberrant receptor feedback) and inflammation (chemical irritation). (Gatterman 1990: 45,46, Haldeman 1990: 206).
Panzer (1995: 419) agrees with meniscoid entrapment but offers formation of intra and extra-capsular adhesions, abnormal capsule tension and osseous mechanical locking as alternative causes.

2.5.2.2 Shortening and scarring

Gatterman (1990: 45) mentions ligament shortening (from prolonged muscular hypertonicity) and articular adhesions (fibrosis) as possible mechanisms of keeping a joint fixed. This is more likely to be in long-standing cases.
Bove (1997) puts forward the theory that scar tissue between the nerve and nerve bed is the cause of pain and decreased movement. Damage to the delicate intrinsic nerve (nervi nevorum), through stretching, causes adhesions and nerve sensitization.

2.5.2.3 Congruency

Greenman (1989: 61) proposes that the hypomobility is due to a lack of congruency between the joint surfaces which leads to incorrect tracking. This is echoed by Gatterman (1990: 46, 47) when she suggests that facet tropism or asymmetry of the facet joints decreases the mechanical efficiency of the joint.

2.5.3 Reflex changes

Korr (1975) sees the aberrant muscle spindle activity as the cause of intersegmental muscle spasm and resultant joint fixation. His theory states that if the vertebral attachments of the short spinal muscles are brought together by unguarded movement and silence of annulospiral activity. The lack of input to the central nervous system results in turning up of the gamma (γ) motor neuron "gain" increasing the intensity of the muscle spasm. The vertebral attachments cannot resume their normal position and the spasm is perpetuated.
The stimulation of Golgi tendon organs and joint mechanoreceptors is hypothesised to be involved in the reduction of spasm and the restoration of joint movement.

As can be seen from the above, the causes of joint dysfunction can be singular or multifactorial. Several of the above mechanisms may occur together in a single case or could predispose one to be affected by another.

2.6 Effects of adjustment

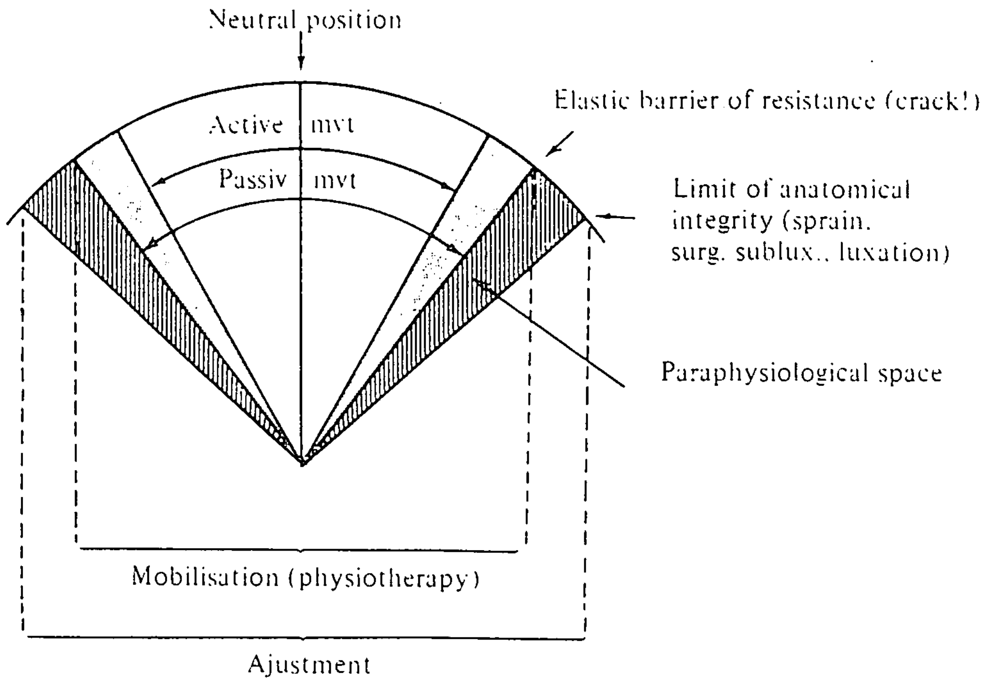
Manipulation has two uses, firstly to relieve pain resulting from joint dysfunction and secondly to restore the range of motion to a joint whose function is impaired (Mennel 1990, Panzer 1995: 424).
This is thought to be brought about by mechanical changes within the joint by introducing paraphysiological movement (Sandoz 1976) and / or reflexogenic effects from the stimulation of certain pathways (Wyke 1973, Korr 1975).

2.6.1 Mechanical effects

Manual adjustments are delivered in such a way as to gap the or separate the joint surfaces. Often occurring in this process is the phenomenon known as joint cavitation. (Sandoz 1976). This is the "cracking" sound often heard with a joint manipulation and is also known as the "audible release". (Brodeur 1995)
Instrumental thrusts rarely cause this cavitation sound. (Osterbauer and Fuhr 1990).

Sandoz's model of mobilization, adjustment and cavitation is easily understood when looking at the following diagram.

Figure 2.1 Schematic representation of movement in mobilisation and manipulation of a normal diarthrodial joint. (From Sandoz 1976)



When a joint undergoes manipulation it first passes through the physiological (active and passive) range of movement. It then must cross the elastic barrier to pass into the paraphysiological space. It is at the this point that the cavitaton sound is heard, a sudden give is felt and the range of motion is slightly increased beyond the usual limits . The manipulation should end here as to go any futher would cause tissue damage. (Sandoz 1976)

This model provides us with a simple explanation for understanding how crossing into the paraphysiological space, can induce extra range of motion.

Sandoz (1976) does mention the extra force component that separates manipulation from mobilisation but neglects to mention the rate of this force application, or speed of the thrust across the elastic barrier. So from this model just crossing the elastic barrier is seen as the important part of the manipulation and not how quickly or slowly this is done. Which has been more recently shown to be of influence in the success of a manipulation (Hertzog et al. 1995).

Brodeur (1995) in his review of the literature on joint cracking, modifies and expands Sandoz's model. He summarises the main points as follows:

1) The volume of the joint remains constant for normal joint loads.

2) If the stress on the capsule exceeds a certain threshold, the capsule snaps back from the synovial fluid, increasing the volume of the joint capsule (which also decreases the pressure) and causing cavitation to take place as the internal joint pressure drops.

3) The sudden increase in volume drops the tension on the capsule, allowing the joint space to rapidly distend (enlarge).

4) The rapid distension is checked by a sudden jerk to a stop as the ligament and periarticular tissue reach their anatomical limits.

5) The time interval between the sudden increase in joint volume from the snap-back cavitation process and the sudden jerk on the periarticular ligament and tendons is shorter than the time required for muscle stretch reflexes to protect the joint from sudden separation.

6) Hence, the jerk on the ligaments and the other periarticular structures causes the firing of high threshold mechanoreceptors. It is hypothesised that this causes reflex relaxation of muscles as well as reflex actions that inhibit pain.

The clinical significance of the cavitation sound is still uncertain. Opponents of its effects like Grieve (1989: 525) say it does little more than impress the patient. Hertzog et al. (1995) when comparing slow and fast manipulations to the thoracic spine indicate that it

was not the sound but the speed of the manipulation, that evoked the electromyographical (EMG) activation, that influenced the outcome.
Cassidy, Kirkaldy-Willis et al. (1992) and Casidy, Quon et al. (1992) are proponents and support the popular belief that a cavitation sound is the sign of a successful adjustment. They actually use the audible release to define manipulation and to differentiate between mobilisation and manipulation. Hertzog (1994) also notes that many chiropractors will repeat an adjustment immediately if no cavitation is heard. For many practitioners it is an integral part of the quantative assessment of the manipulative treatment.

Besides the immediate increase in the range of motion by crossing the elastic barrier (Sandoz 1976, Cassidy, Lopez et al. 1992, Cassidy, Quon et al. 1992) it would seem logical that during the process of joint separation that the mechanical factor causing the blockage or fixation (as discussed in 2.5) may be removed.

2.6.2 Reflexogenic effects

2.6.2.1 Pain

The following sub-section serves to explain the basic principles involved in pain and pain control, as pertinent to manipulation. An in depth discussion on the multifactorial nature of pain and pain modulation is beyond the scope of this dissertation.

Mechanoreceptors, because of their different natures, respond to different kinds of loads. Types I and III are slow reacting and are therefore good at sensing static loads whereas type II receptors are better at sensing dynamic loads at the beginning and end of joint movement. Mechanoreceptor input travels to the spinal cord through the dorsal roots of the spinal nerves. (Colloca 1997: 39, 42)
These nerve fibres along with others have been categorised as types A and C. A being fast-conducting (5-15 msec) myelinated and subdivided into α, β, γ and δ, while C fibres

are slow (1 msec), small and unmyelinated. Aδ fibres carry the first sharp pain while the C fibres are thought to be responsible for delayed secondary aching pain. Both types arrive at the tract of Lissauer to terminate on neurons in the dorsal horn of the cord grey matter. Interneurons connect the incoming axons to second order neurons which ascend to the higher centres via various pathways. (Colloca 1997: 39)

There is an intimate relationship between the nociceptors and mechanoreceptors. The intensity of the nociceptive stimulus is not solely dependant on the intensity of the mechanical or chemical stimulation, it is continuously modulated through both peripheral and central mechanisms that can inhibit or excite the initial stimulus at the interneural connections. (Colloca 1997: 42)

In 1965 Melzack and Wall proposed a "Gate Control Mechanism" within the substansia gelatinosa of the dorsal horn. Impulses travelling in the larger myelinated mechanoreceptor fibres takes precedence over the small-diameter nociceptive fibres and act to inhibit the transmission of nociceptive activity.

Thus a decrease in mechanoreceptor input, through fixation/ dysfunction, could lead to an increase in pain. Likewise, an adjustment could stimulate the static and dynamic low threshold mechanoreceptors (more specifically Type I and II receptors) in and around the joint, to cause presynaptic inhibition of the pain stimuli from the nociceptors (type IV receptors). (Colloca 1997: 42)

Although the theory has undergone many alterations to date, the basic principle that pain can be blocked by proprioreceptive input at the vertebral level, is still well accepted. (Curl 1994: 292)

2.6.2.2 Muscle spasm

The following reflex mechanisms and structures in and around the joint have been linked to muscle spasm and the reduction thereof: sympathetic nervous system, muscle spindles, Golgi tendon organs, fascilitated motor neuron pools and articular receptors. (Gatterman 1990: 44 , Bergmann 1995: 110-111)

Nociceptive reflexes from an irritated area can through complex mechanisms affect the sympathetic nervous system which increases the muscular tone of this area. Thus by interrupting or decreasing the nociceptive input to the central nervous system, through the above mechanism (2.6.2.1), the normal muscle tone could be reset. (Colloca 1997: 42).

When articular surfaces are separated during an adjustment, the hypertonic intersegmental muscle is suddenly stretched, initiating muscle spindle mediated reflexes that relieve the hypertonicity as discussed in 2.5.3. (Korr 1975).

Golgi tendon organs act as brakes and limit excessive joint movement by initiating reflex inhibition of motor activity in the muscles operating the joint (Gatterman 1990: 44). High velocity thrusts are thought to be able to stimulate Golgi tendon organs around the joint, causing reflex inhibition of motor activity thus breaking into the muscle spasm cycle. (Korr 1975, Sandoz 1981).
Stretching of the joint capsule and thus stimulating mechanoreceptors is said to reflexly inhibit fascilitated motor neuron pools that are responsible for the increased muscle tone and spasm that are found with joint dysfunction. In much the same way as it does to the nociceptive stimuli. (Cassidy, Kirkaldy-Willis et al. 1992: 288, Colloca 1997: 47).

2.6.3 Comparative effects of manual and instrumental thrusts

The differences between these treatment applications seems to be from the differences in mechanical properties (force and speed) as well as the lack or occurrence of the cavitation sound.

In vivo studies by Nathan and Keller (1994) where pins were inserted into two adjacent lumbar spinous processes of three human subjects, an intervertebral motion device

attached to the pins revealed, after impulses applied with an AAI, 72 N of force applied by the AAI caused 1.62 mm intervertebral displacement.
Smith et al.'s (1989) study on an anaesthetised dog, using accelerometers attached to the bone, showed measurable intervetebral motions (± 1 mm translation and 0.5° rotation) in response to mechanical thrusts from the AAI. The same authors had the force produced by the AAI in unpublished studies at about 53 N.
From the above studies it can be seen that instrumental thrusts only cause slight intervertebral motions (± 1 mm of translation occurs and ± 0,5° rotation) enough force seems to be produced to activate mechanoreceptors (10N). (Osterbauer and Fuhr 1990).

Kawachuk and Herzog (1993) when comparing 5 different cervical spine manipulations to symptomatic patients (at an average of 18 manipulations per group) found, using a thin flexible pressure pad placed between the doctor's contact and the patient, the mean peak force of the lateral break was 102,2 N over 86,7 msec, rotary 40,5 N over 79,1 msec and Activator 40,9 N over 31,8 msec. From these results it can be deduced that the manual lateral break technique was considerably greater in force than the rotary and Activator manipulations. It must however be noted that only the perpendicular force was measured thus during the rotary technique only part of the treatment force was measured. (Herzog et al. 1993).
Also of interest to note is that the time period for the Activator thrusts were ± 2.5 times shorter than the manual techniques. This points to the possibility that the instrumental thrusts were faster.
The speed of the manipulative thrust is preported to be a critical factor in the success of a manipulation. In fact, Kirk et al. (1991:29) in the "States Manual of Spinal, Pelvic and Extravertebral Technic" say that one of the "Basic rules of Adjusting" is that the quickness of the delivery of the impulse thrust is essential.
This is backed up by the research done by Herzog et al. (1995) that indicated that when comparing slow and fast manipulations to the thoracic spine that it was the speed of the manipulation and not the cavitational sound that seemed to influence the outcome of a

measured EMG response.

From studies Duell (1984) estimates the activator thrust at 20-30 times faster than a medium meric thrust. Slosberg (1988) cites Wood and Adams (1984) in their research at Palmer College where the activator was estimated to be 100-200 times faster than manual Thompson type of thrust. It also has been shown to be 5-10 times shorter than the stretch reflex (20-24 msec). (Slosberg 1988, Lamb et al. 1991: 167).

Brodeur (1995) when reviewing the cavitation (2.6.1) states that the cavitation mechanism provides an easy means of producing the necessary forces on the ligaments, to initiate the desired reflexes. He then goes onto mention that drop mechanisms, Activator adjusting "guns" and other tools might also provide means to produce the same result because of their high velocity, that could stimulate the same mechanoreceptors as the cavitational adjustment. Thus the effects of an adjustment may not be from the cavitational process itself but merely that the forces that are produced during the process or from the process, may be similar to those produced from higher speed interventions such as from instrumental thrusts.

It does seem logical that a manual thrust is capable of producing both the mechanical and reflexogenic effects as stated in 2.6.1 and 2.6.2. However, instrumental thrusts would not seem to supply enough joint movement (Smith et al. 1989, Nathan and Keller 1994) to cause the mechanical effects. The benefits from instrumental thrusts would seem to be from the stimulation of static and dynamic receptors causing reflex inhibition of pain and muscle activity alone (Duell 1984, Brodeur 1995).

2.7 Manual thrust studies

2.7.1 Range of motion

Increase in range of motion has been used as an assessment tool when comparing the effectiveness of different treatments and treatment protocols in cervical spine dysfunction (Youdas et al. 1991). In the following studies of manual techniques it will be presented that manual manipulation would seem to cause an increase in cervical range of motion, at least over the short term.

A pilot (non-controlled) study by Cassidy, Quon et al. (1992) where 50 patients with unilateral neck pain received a single cervical manipulation indicated that cervical manipulation might cause an increase in cervical rotation and decrease in pain.

When comparing different treatments in a randomized controlled trial without a long-term follow-up, it was found that a single manipulation (52 patients) was as effective as mobilization (48 patients) in increasing range of motion in mechanical neck pain (Cassidy, Lopez et al. 1992).

Howe et al. (1983) in a randomized control trial of manipulation to the cervical spine (52 patients) produced a significant increase in measured rotation that was maintained for three weeks and an immediate improvement in lateral flexion that was not maintained. Indicating that cervical spine manipulation has short and possibly long term effects on cervical ranges of motion especially in rotation.

Nansel et al. (1990) after manipulating the lower cervical spines of 32 pain free subjects and reassessing their lateral flexion passive end-range asymmetry at 30 minutes, 4 hours, 24 hours and 48 hours found dramatic short term improvements (30 min and 4 hr). However 12 out of the 16 who had had previous trauma to their necks regained their asymmetries by 48 hours, while 14 out of the 16 who had had no previous neck trauma maintained their improved symmetry. (i. e. Their adjustments held longer.) These results seem to agree with that of Howe (1983) in that lateral flexion improvements after manipulation are only of short duration.

Nansel et al. (1992) when comparing the effectiveness of upper and lower cervical adjustments in reducing passive rotational and lateral-flexion asymmetries in 101 asymptomatic subjects, found that upper cervical adjustments were more effective in reducing rotational asymmetries whereas lower cervical adjustments were more effective in reducing lateral flexion asymmetries. The goniometric measurements were taken before and 30 minutes after the manipulations. These results reafirm the immediate effects of the manual manipulation in increasing cervical ranges of motion.

When assessing cervical intersegmental mobility pre and post manipulation in 58 case studies and comparing them with normative X-ray data. Yeomans (1992) finds that mobility post manipulation is significantly greater than before the treatment, suggesting that manipulation of a hypomobile joint enhances its mobility. This study is of interest in that it uses two systems of X-ray measurement rather than a goniometer and intersegmental mobility is measured not general cervical mobility. Criticisms of the study are that the control group was from normative data, the patients were not selected randomly and patients were treated for different time periods varying from 3 weeks to 6 months. These criticisms aside, the results would seem to fit in with the trend of other research in the same field.

This trend, seen from these studies, is that manipulation of the cervical spine seems to have a short term effect in increasing the cervical range of motion. Long term effects, greater than 1 month, are not known.

The findings from the above studies would seem to agree with the mechanical effects of adjustments while not refuting other possible mechanisms. It remains to be seen, however, if mechanical thrusts that do not cross the elastic barrier, can equal or improve on these results.

2.7.2 Pain

A double-blind controlled study on chronic, non-specific neck pain (1 month or more) on 39 patients by Sloop et al. (1982) compared manipulation and diazepam to diazepam alone. They found no consistent favourable response between the two groups. Concluding that the value of a single manipulation was not established and that further exploration was needed. Type II error, because of the small sample size, could have contributed to this study's failure to show a statistically significant result.

Terret et al. (1984) induced cutaneous pain through electrical stimulation in 50 previously pain free subjects. The control group received joint springing to the thoracic spine while the experimental group received a manipulation to the thoracic spine. On assessing their local cutaneous pain tolerance ten minutes after the treatment the manipulation group showed a 140% difference from the control group.

When considering the results from this study it must still be ascertained whether induced cutaneous pain (acute) in the thoracic spine can be correlated with chronic neck pain.

Although this study was performed on the thoracic spine and involves cutaneous pain it can be presumed that the mechanisms at work here would cause similar pain decreasing effects in other areas of the spine.

Howe et al.'s (1983) study shows immediate significant improvement in symptoms after cervical manipulation and azapropazone for neck pain and stiffness compared to those who received azapropazone alone. The findings after 1 and 3 weeks were, however, not significant. The subjective (pain) component of this study was ascertained by asking the patient whether the symptom were absent, the same, better or worse. A limitation of the study is that only 6 of the 52 patients had chronic (4 weeks or more) pain, making the group heterogenous.

Vernon et al. (1990) used a pressure pain threshold to evaluate the effect of manipulation on chronic neck pain. Nine patients were assessed, before and 5 minutes after, either an oscillatory mobilization or a rotational manipulation to the cervical spine. The manipulation group's thresholds increased by on average 45% while the control group showed no improvement.

Although the results from this study are encouraging for manipulation, the small sample size makes the results far from conclusive.

Both Terret (1984) and Vernon (1990) use pain tolerance/ threshold instead of questionnaires in an attempt to measure pain improvement after manipulation. The techniques used were different (skin pain versus pressure pain) yet both results favoured the manipulation group. The vast difference between the improvement scores could possibly be related to the different pain receptors responsible for sensing electrically induced cutaneous pain and pain from pressure, and the varying effect manipulation may have on these.

When comparing different treatments in a randomized controlled trial without a long-term follow-up, it was found that a single manipulation (52 patients) was 1,5 times more effective than mobilization (48 patients) in decreasing mechanical neck pain using the NRS

101 as the outcome measure. (Cassidy, Lopez et al. 1992).

Terret et al. (1984), Vernon et al. (1990) and Cassidy, Lopez et al. (1992) all compare manipulation to mobilization techniques which do not cross the elastic barrier, much like instrumental thrust. So it could perhaps be extrapolated that mobilization and instrumental thrusts might be similar in their effect in treating cervical spine dysfunction.

Mobilizations do not however, contain a thrust and therefore would not have the same velocity as instrumental thrusts. If it is the speed of delivery that is crucial to the intervention, as argued in 2.6.3, then the instrumental thrusts would be expected to perform better when treating the same condition.

Further impetus for the use of manipulation to the spine comes from a randomized clinical trial (Koes et al. 1993) using 256 patients with nonspecific back and neck complaints of at least 6 weeks duration. They concluded after 3 months of treatment, a 12 month follow-up and subsequent 90 subgroup analyses that manual therapy (manipulation and mobilization) showed better results in terms of decreasing the severity, increasing the physical functioning (both measured on a ten-point scale) and global perceived effect (measured on a six-point scale) than did physiotherapy (electrotherapy, exercise and massage) in chronic cases (1 year or longer) and in patients younger than 40 years old.

This study (Koes et al. 1993) received the highest quality scores by the RAND group's study on the appropriateness of manipulation and mobilization of the cervical spine (Coulter et al. 1996: 19). They scored all the randomised controlled trials pertaining to the subject on: homogeneity; comparability; follow-up of study population; the descriptions of the interventions given; the type of outcome measures used and how they were assessed; and the data presentation and analysis. They do however advise caution as to the results being somewhat misleading because only a small subset of the patients had neck pain. This author wishes to point out that the manual therapy intervention used, included both manipulation and mobilization. The positive results should therefore not be attributed to manipulation alone.

Results from a study by Rogers (1997) on 20 chronic neck pain patients show that after six sessions of manipulation to the cervical and upper thoracic regions during a 3-4 week period decreased the pain levels by 44%. Compared to the control group, that did two unsupervised sessions of cervicothoracic stretches daily, which only had a 9% reduction in pain levels. Although only a small sample was used this study would seem to be supporting the trend of the small but growing body of evidence, that manipulation of the cervical spine is helpful in reducing neck pain.

2.7.3 Muscle tone and proprioception

This short sub section will attempt to show that cervical spine manipulation has some input into the nervous system and has some effect on the regulatory mechanisms of proprioception and muscle tone.

The other variable measured in above study (Rogers 1997) was proprioception. Where blindfolded patient's ability to reproduce a neutral head position was tested. The manipulation group again scored better than the stretch group with a 41% improvement over only 12% improvement of the stretch group. (Rogers 1997). The criticisms of small sample size still stands yet this pilot study points to the possibility that manipulation of the cervical spine might positively influence the proprioreceptive functioning of the cervical spine.

In the study conducted by Nansel et al. (1993) to determine the effect of lower and upper cervical adjustments on lumbar muscle tone in 68 asymptomatic subjects. The authors using C2 and C7 bilateral adjustments and tissue compliance meters on either side of the lumbar spinous processes determined that upper cervical adjustments did not produce significant change in compliance whereas lower cervical adjustments induced significant decrease in lumbar muscular tone. They presumed the effect to be from tonic neck reflexes involving intersegmental pathways. This study although not directly linked to cervical dysfunction indicates that manual thrust manipulations to the cervical spine influences the tone of musculature elsewhere in the body. Pointing to the concept that manipulation has input that into the nervous system to affect reflexes that may be pertinent to spinal health.

The studies mentioned in this section (2.7.3) and the previous one on pain (2.7.2) seem to indicate that manipulation can bring about changes in certain neurological mechanisms, presumably via facilitation of certain reflexes, adding impetus to the neurological or reflex theories on the effects of manipulation. The manipulative techniques used in these studies were all manual and it remains to be seen if mechanical devices like the AAI can reproduce similar results.

2.8 Instrumental thrust techniques

The Mercy Center Conference Classification for Moving Stylus Instruments is "promising" (appears to be appropriate for the given indication in the specific patient population) to "established" (accepted by the practicing chiropractic community for a given indication in a specific patient population.) The evidence was of class 1 (from controlled studies in refereed journals), 2 (from significant results of uncontrolled studies in refereed journals) and 3 (provided by opinion of experts, anecdote and/or by convention). (Haldeman et al. 1993).

The Activator Adjusting Instrument (AAI) has been tested in various studies to determine its force, velocity, acceleration and displacement (Duell 1984, Fuhr and Smith 1986, Smith et al. 1989, Herzog et al. 1993, Kawchuk and Herzog 1993, Keller and Lehneman 1994, Nathan and Keller 1994) but no controlled clinical trials on the cervical spine have been conducted to date (Bergman 1993).

Gemmel and Jackobson (1995) found no difference in the ability of Activator instrumental and Meric manual, impulse-recoil type adjustments in reducing low back pain in their, single treatment, randomized controlled trial. The lumbar segments which tested positive to joint challenge were adjusted using the randomly selected technique (16 Meric and 14 Activator). Patients filled the visual analogue pain scale (VAS) in immediately before and within five minutes after the single treatment. The major limitations of this study are that the sample size was small, only a single treatment was administered and no long-term effects were measured. It is however the only study found by this author to date, comparing instrumental and manual techniques in decreasing spinal pain.

Although the adjustments were performed in the lumbar spine, it is of interest to note that both manual and instrumental thrusts significantly decreased the patients' pain on average by +/- 22 points on the VAS with only five subjects (3 Meric and 2 Activator) reporting no immediate reduction in pain.

2.9 Safety and comfort issues

2.9.1 Manual

Due to the nature of manual manipulation, complications, however rare (1: 40 000 for mild complications and 1: 400 000 to 1: >1 000 000 for serious complications), are noted (Coulter et al. 1996: xiv). Manual manipulation of the upper cervical spine can cause vertebrobasilar artery accidents, which can be fatal. Other problems seen, include: transient vertigo; lightheadedness; nausea; dizziness or loss of consciousness. (Haldeman 1992: 554, 572). Complications of lower cervical spine manipulation are most likely to occur when rotary techniques are used. These can result in herniated discs that cause nerve root entrapment or spinal cord compression. (Haldeman 1992: 572).

Rivett and Milburn (1997) found in their study on complications arising from spinal manipulation in New Zealand that over half (62%) the adverse responses came from manipulation to the cervical spine. The majority of these were CVAs. They propose that manipulative health professionals are at risk of causing serious complications from spinal manipulative therapy.

Haldeman (1997), in his latest literature review reports that by far the greatest number of CVAs occurring post-manipulation are due to dissection of the vertebral or basilar arteries. He goes on to say that attempts to document risk factors for this problem, have not been successful. These dissections are most common in the 20- 50 age group and females may be slightly more at risk. The only patients who seem to be at risk are those who present with a recent history of severe, unilateral pain in the head or neck which is totally different from any pain they have experienced before.

Also of noteworthy interest, is that the traditional screening procedure (Wallenberg's, Houle's, George's tests) of turning the neck and holding it in a particular direction, to close one of the vertebral arteries, has not been shown to be effective. (Haldeman 1997)

A recent study conducted in Sweden to assess the side effects of spinal manipulation by chiropractors on 625 patients with 1858 recorded visits. Found that benign short-lasting (less than 48 hours) reactions were common after spinal manipulation. The most likely type of reaction to occur was: discomfort in the area of treatment (two thirds of all reactions). 10% of all reactions were: fatigue, pain outside area of treatment or headache. (Leboeuf-Yde et al. 1997). The results obtained were similar to that of the Norwegian study conducted by Senstad at al. (1997). These results indicate a level of discomfort after manual manipulation.

It would be interesting to see what sort of results a similar study involving instrumental thrusts would produce.

2.9.2 Instrumental

Taking the above (2.9.1) into account, instrumental thrusts are generally accepted to be clinically safer and less traumatic than manual thrusts. The reasons being that instrumental thrusts are low-force and are delivered in a neutral prone position, so there is no torque or stretching of ligament or joint capsule. This decreases the risk of cerebrovascular accident and also the possibility of producing segmental instability (Kleynhans 1980: 364,369, Byefield 1991, Fuhr 1995).

It is Slosberg's (1988) opinion that the manner in which the impulses are delivered (i.e. no torque) may also eliminate the elements of fear, discomfort and resistance that accompany a manual adjustment.

These safety and comfort concerns are echoed in the popular opinion that instrumental thrusts should be used in the treatment of post-traumatic conditions, paediatric, osteoporotic, pregnant, apprehensive and fearful patients. (Osterbauer and Fuhr 1990, Byefield 1991, Osterbauer et al. 1992).

2.10 Specificity versus Art

The Activator instrument would seem to deliver a more controlled force to a specific contact point. (Fuhr and Smith 1986, Byefield 1991) than a manual thrust. This idea may lead many manipulative practitioners to criticise instrumental manipulation as removing the "art" from practice. However it could be argued conversely that standardization and increase in specificity of the thrust would prove more beneficial in general.

2.11 Conclusion

In summary the literature indicates that neck pain is a common complaint and that both manual and instrumental adjustments have some benefits in the treatment of facet joint dysfunction, but evidence, especially for instrumental techniques, is lacking. Manual techniques seem to have the advantage over instrumental thrusts in that they have the added benefit of the mechanical effects of paraphysiological movement. While on the other hand instrumental adjustments seem to be safer. The issues regarding safety are logically justified, for this reason this dissertation is aimed at the relative effectiveness of the two approaches.

The major contribution of this study will therefore be to address the apparent gaps in the literature and provide clinical evaluation of these protocols.

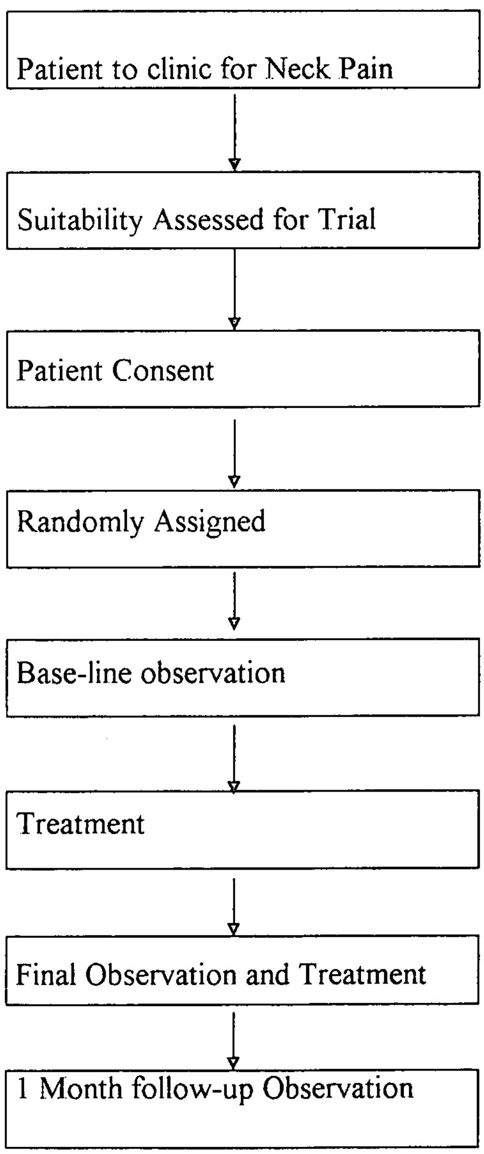
CHAPTER THREE

3.O MATERIALS AND METHODS

3.1 Introduction

This chapter covers how the study was conducted. This includes the study design, the subjects (patients) used, the interventions (treatments) they received as well as data collected from them and the statistical procedures this data was subjected to.

Figure 3.1 Flow chart of experimental chronology



3.2 Study Design

This study was designed to be a randomised comparative pilot study.

3.2.1 Object of the Study

The object of the study was to identify the effectiveness of each treatment group in terms of the objective and subjective measurements. The study attempted to identify the more effective method of treatment, which could aid practitioners in their treatment of the cervical spine dysfunction.

3.2.2 Selection of subjects

Advertisements were placed on noticeboards, local radio stations and in local newspapers inviting free participation in a clinical trial for people with neck pain.
Those volunteering for the study were questioned by the Technikon Natal Chiropractic Day Clinic staff for the recognised symptoms (neck pain, pain on movement) and the signs (painful extension, local tenderness, muscle contracted, hypomobility and normal neurological exam) of the cervical spine in the dysfunctional phase (Kirkaldy-Willis 1992: 109). It was assumed that the Kirkaldy-Willis model for low back dysfunction could be transposed to reflect that of the cervical spine.
The patients also had to be literate and between the ages of 15 and 65 to be eligible.

Those initially accepted had a standard case history (Addendum 1) taken and full physical (Addendum 2) and regional cervical spine (Addendum 3) examinations were performed.

Patients with neurological deficit, history of fracture or surgery in the cervical region and systemic disorders affecting the cervical spine were excluded from the study.

Radiographs, where deemed necessary, were taken to exclude patients with contraindications to manipulation or other complicating pathology.

Only patients who suffered from cervical spine dysfunction and fell into the diagnostic category of cervical facet syndrome were included in the study.

Those patients with active or latent myofascial trigger points were not excluded from the study.

3.2.3 Allocation of subjects

Once the patients had signed the informed consent form (Addendum 4) and had agreed to refrain from any other form of treatment for their neck pain over the duration of the study. They were then randomly allocated to either the instrumental (experimental) or manual (control) group.

This was accomplished by placing 30 possibilities into an envelope, 15 in each group. The patient then drew a card out from the envelope. This determined to which group they were assigned.

3.3 The data

The data in this study consisted of primary and secondary data.

3.3.1 The primary data

The patient's perception of their disability (CMCC Neck Disability Index)
The patient's perception of their pain level (Numerical Pain Rating Scale – 101)
The patient's perception of the sensory dimension of their pain (McGill Short-Form Pain Questionnaire)
The patient's cervical spine ranges of motion (CROM Goniometer)

3.3.2 The secondary data

This consisted of the literature review. Current documentation of Spinal Manipulative Therapy (SMT) and the treatment of neck pain were consulted.

3.4 Methods of measurement

Subjective measurements

3.4.1 CMCC Neck Disability Index (Addendum 5) (Vernon and Mior 1991)

This questionnaire indicates how the everyday life of the patient is affected by their neck pain. The questionnaire consists of 10 questions. Each question scores a maximum of 5 points and a minimum of 0. The total score is out of 50 and is reflected as percentage disability. Those who did not drive and therefore had to skip one question where marked out of 45.

Vernon and Mior's (1991) assessment of the Neck Disability Index indicated that it had a high level of reliability and internal consistency. The questionnaire also appeared to be sensitive to changes in disability during the course of treatment and to the severity of the complaint.
They also found it to be applicable to a wide age range. It seemed not to be affected by gender and had an acceptable level of validity.

3.4.2 Numerical Pain Rating Scale (101 Scale) (Addendum 6) (Jensen et al. 1986)

This questionnaire assesses the patients' perception of the intensity of the pain. The patient indicates by means of a percentage, the intensity of the pain experienced prior to a treatment. When it is at its (i) worst and (ii) least. The average of these two figures indicates the average pain experienced by the patient.

In a study comparing six methods of measuring clinical pain intensity, Jensen et al. (1986) found that the NRS 101 to be the "superior measure". It has advantages over the other methods in that it is simple to administer and score, can be used in written or verbal form and does not seem to be associated with age.

3.4.3 McGill Short-Form Pain Questionnaire (Addendum 7) (Melzack 1987)

This questionnaire is designed to assess the sensory dimension of the patient's pain. The short form consists of fifteen words each describing a type of pain. Each description is ranked on an intensity scale: 0= none, 1= mild, 2= moderate, 3= severe. The total score is reflected as a percentage of the maximum, 45. (Melzack and Katz 1992: 162).

The McGill Short Form correlates very highly with the sensory, affective and total indices of the McGill Long Form questionnaire and is used to eliminate patient fatigue through filling out many forms for research purposes. (Melzack and Katz 1992: 163).

The McGill Short Form is one of the most widely used tests for the evaluation of pain and is sensitive to clinical therapies (Melzack 1987).

Objective measurements

3.4.4 **Cervical Spine Range of Motion** (Addendum 8)

A CROM goniometer produced by Performance Attainment Associates (St Paul, MN) was used to measure the cervical ranges of motion in flexion, extension, bilateral rotation and bilateral lateral flexion. The ranges of motion were measured in degrees according to the protocol laid out in the manufacturers procedure manual.

Studies by Capuano- Pucci et al. (1991) and Reault et al. (1992) indicated that the CROM goniometer has good to excellent intra and inter tester reliability in measuring cervical ranges of motion.

The CROM goniometer was also shown to be highly reliable when compared to other range of motion measuring techniques, i.e. universal goniometer and visual estimation. (Youdas et al. 1991).

3.5 The location of the data

The primary data was obtained from the three questionnaires and CROM goniometer readings (as detailed in 3.4)

The data was collected before the first treatment, before the last treatment and at a one month follow-up consultation.

The secondary data were sourced from current journals, books and the Internet.

3.6 Interventions

The patients were treated with their randomly selected technique. The patients received treatment until symptom free or up to a maximum of eight treatments over a period of about four weeks with two to three treatments per week.
A follow-up consultation for reassessment took place after one month.

3.6.1 Control group – Manual Thrust

The control group received standard, manual thrust, chiropractic adjustments to the cervical spine.
The levels of dysfunction were determined by using Kemp's test, motion palpation and local tenderness.
With all the manual techniques the joint slack was taken out to the elastic barrier and a high velocity low amplitude thrust was delivered in the direction of the fixation.

The choice of technique was guided by motion palpation findings (Shafer and Faye 1989:37). An audible cavitation was not required to indicate a successful adjustment. (Suter et al. 1994).

The techniques employed were diversified rotary and lateral break techniques according to the "Compendium of Chiropractic Technique" (Szaraz 1990: 46,50,57,60,77) and are all summarised below :

Cervical rotary – Thumb extension

This technique is indicated for rotary lesions from C1 to C4. The patient is supine with the headpiece above horizontal. The indifferent hand cups the occiput while the thumb pad of the contact hand is placed against the posterior arch of the atlas or the articular process of the involved vertebra. The fingers are spread wide and placed across the patient's cheek.

Traction is applied with the indifferent hand while the contact hand rotates the head and neck to take out the joint slack. The thrust is a short amplitude, high velocity pronator impulse with rotary action of the forearm of the contact hand.

Cervical rotary – Index contact

Indicated for rotary fixations from C1-C7. The doctor is on the side of the lesion and takes a firm index contact on the articular pillar of the involved vertebra. The indifferent hand cups the patient's ear with hooked fingers against the rim of the occiput to provide rotation and cephalad traction. The segment as well as the head and cervical spine until segment reaches restriction. A quick, short amplitude pectoral thrust is then delivered in a rotary direction. Slight ulnar deviation, during thrust, provides rotary movement.

Sitting cervical

Used for rotary fixations from C2-C6. The patient sits on a chair while the doctor takes his stance on the opposite side of the lesion. Contact is taken with the palmar aspect of the middle finger by reaching over in front of the patient. The contact is made over the posterior aspect of the TVP of the involved vertebra. The contact finger is reinforced with the adjacent fingers while the thenar aspect of the hand supports the patient's chin. The indifferent hand takes a web contact against the rim of the occiput, to provide cephalad traction. The patient drops the head into the contact hand. A single thrust is given under traction in a rotary fashion.

Lateral break

Indicated for lateral fixations from C1-C6. The patient is supine with the head piece level. The doctor is at the head of the patient, slightly toward the side of the lesion. Once the lesion has been identified the neck is deviated away from the lesion to separate the TVPs. An index contact is taken with the wrist straight. The indifferent hand cups the occiput and provides cephalad traction. Joint slack is taken up toward the lesion and a sudden short amplitude, pectoral, thrust is given straight across with no cervical rotation.

Thumb move

This technique is used for rotational dysfunctions of C6-T3. The patient lies prone with the headpiece below horizontal. The doctor takes a fencer stance on the ipsilateral side of the patient. A firm thumb contact is made on the spinous lamina junction of the involved vertebra. The contact forearm is parallel to the floor. The indifferent hand takes contact on the contralateral occiput and temporal bone with a web contact. The patient's face is rotated away from the lesion and cephalad traction is applied. The spinous process is used as a lever and the impulse, pectoral thrust is applied "straight across". (contralateral and pisiform contacts can also be taken)

3.6.2 Experimental group – Instrumental Thrust

The patients in this group were treated with an instrumental thrust delivered by means of an Activator Adjusting Implement (AAI). The knob was set at its maximum amplitude (i.e. maximal spring tension). This was maintained for all patients to ensure that the thrust delivered to each patient was of a consistent force. (Herzog et al. 1993)The dysfunctional segments were identified as with the control group by Kemp's test, motion palpation and local tenderness. For the purpose of this study the Activator Technique of leg length analysis was not used.

Patients were treated prone with the headpiece slightly lowered. Once the dysfunctional segment was located the rubber tip of the AAI was placed over the dysfunctional joint or on the lateral aspect of the vertebra involved. Contacts were firm enough to prevent slipping of the rubber tip but not load the spring. The spring was then loaded using the instruments trigger mechanism and the impulse delivered in the direction of the fixation.

3.7 Statistical Analysis

The statistical package Statgraghics Plus Version 6, supplied by Manugistics Incorporated, was used for data entry and analysis.

3.7.1 Control - intra-group comparison

The subjective data from the questionnaires (represented as percentages) and the objective data, degrees for each plane of movement, were analysed using Wilcoxin's signed rank test to determine whether there was improvement between the (i) initial and the final, (ii) the initial and the one month follow-up, and (iii) the final and the one month follow-up. These two tailed tests were conducted at the $\alpha = 0.05$ level.

3.7.2 Experimental – intra-group comparison

The subjective data from the questionnaires (represented as percentages) and the objective data, degrees for each plane of movement, were analysed using Wicoxin's signed rank test to determine whether there was improvement between the i) initial and the final, ii) the initial and the one month follow-up, and ii) the final and the one month follow-up. These two tailed test were conducted at the $\alpha = 0.05$ level.

3.7.3 Inter-group comparison (control vs experimental)

The Mann-Whitney Unpaired test was used to compare the control and experimental groups. The two groups were treated independently of one another (i.e. Unpaired) in a two tailed format. The purpose was to determine whether there is any significant difference between the two groups at the $\alpha = 0.05$ level of significance.

3.7.4 Summary statistics: mean, median, mode, standard deviation and standard error were presented in the tables. These showed the central location and the variability of each data set.

3.7.5 Power analysis results of each test were given below the relevant table. These were then used in the discussion to determine the power of each test and the chance of Type II error.

3.7.6 Bar charts were used to present major findings and to act as a visual summary. The bar charts also serve to summarise results from the Mann-Whitney and Wilcoxin's signed rank tests. They were used to show trends within and between the groups.

CHAPTER FOUR

4.0 THE RESULTS

4.1 Introduction

This study consisted of a sample of 30 patients: 15 in group A (receiving instrumental thrusts with an AAI) and 15 in group B (receiving manual thrust manipulations). Four volunteers were rejected as they had complicating problems of: myofascial trigger points, fibromayalgia, neurological signs and thoracic facet syndrome.

This chapter will represent the data and attempt to analyse the data in tabular form in order to accept or reject the hypotheses.

4.2 The Hypotheses

The null hypothesis is the same for both treatment groups and is defined as follows:

Ho: There would be no statistical difference in the subjective and objective findings on analysis of the intra group data, showing that this treatment protocol was ineffective.

The alternative hypothesis is again the same for both treatment groups and is defined as follows:

Ha: There would be no statistical difference in the subjective and objective findings on analysis of the intra group data, showing that this treatment protocol was effective.

In order to intergrate the data from the two group, a third null hypothesis and alternative hypothesis are required.
Defined below as:

Ho: There would be no statistical difference in the subjective and objective findings on analysis of the inter-group data, showing that the two treatment groups were equally effective.

Ha: There would be a statistical difference in the subjective and objective findings on analysis of the inter-group data, showing that the two treatment groups were not equally effective.

Key for Abbreviations in Tables

Group A : Instrumental thrust group

Group B : Manual thrust group

S.D. : Standard deviation

S.E. : Standard error of mean

Bold numbers : significant

4.3 Demographic data

Table 4.1 : Age distribution of patients

Age	Group A	Group B	Total % of Patients
20 - 29	3	2	16.7 %
30 - 39	3	5	26.7 %
40 - 49	5	4	30.0 %
50 - 59	4	4	26.7 %

Table 4.2 : Gender distribution

Gender	Group A	Group B	Total
Male	5	6	11
Female	10	9	19

Table 4.3 : Distrubution of pain duration, prior to Treatment

Months/ years of pain	Group A	Group B	Total % of Patients
1-2 months	2	3	16.7 %
3-5 months	1	1	6.7 %
6-11 months	0	1	3.3 %
12-23 months	0	2	6.7 %
2-3 years	7	4	36.7 %
> 3 years	5	4	30 %

4.4 The analysed data

The data was analysed at the $\alpha = 0.05$ level

The decision rule for a two-tailed test states:

Reject the null hypothesis (Ho) if, $p \leq \alpha \div 2$.

Accepted the null hypothesis (Ho) if, $p > \alpha \div 2$.

Now, $\alpha = 0.05$

therefore, $\alpha \div 2 = 0.025$

Therefor the p-value would have to be below or equal to 0.025 to reject the null hypothesis and

conclude that there is a significant improvement at the $\alpha = 5\%$ level.

4.4.1 The non-parametric Mann-Whitney Unpaired tests

Table 4.4 Statistical results of the goniometric measurements comparing the initial cervical ranges of motion.

	GROUP A Initial Treatment					**GROUP B** Initial Treatment			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	53.2	56.0	7.9	2.0	0.100	60.2	62.0	20.2	5.2
Extension	60.3	58.0	14.2	3.7	0.648	53.4	56.0	19.7	5.1
(R)Rotation	57.3	60.0	13.8	3.6	0.802	58.0	60.0	11.6	3.0
(L)Rotation	60.5	60.0	9.9	2.6	0.630	57.6	60.0	10.6	2.7
(R)Lat Flex.	38.5	40.0	7.0	1.8	0.382	41.6	46.0	11.8	3.1
(L)Lat Flex.	40.0	40.0	11.2	2.9	0.467	42.7	46.0	12.8	3.3

Power	
Flexion	0.207
Extension	0.097
(R) Rotation	0.052
(L) Rotation	0.111
(R) Lat Flex	0.126
(L) Lat Flex	0.088

Table 4.5 The stastitical results of the goniometric measurements comparing final treatment cervical ranges of motion

	GROUP A Final Treatment					GROUP B Final Treatment			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	60.3	58.0	14.2	3.7	0.308	65.1	68.0	15.0	3.9
Extension	65.5	66.0	7.4	1.9	0.454	63.6	60.0	11.5	3.0
(R)Rotation	65.4	64.0	7.9	2.0	0.465	63.5	62.0	7.2	1.9
(L)Rotation	65.5	66.0	12.0	3.1	0.967	65.9	64.0	10.2	2.6
(R)Lat Flex.	47.1	46.0	8.9	2.3	0.983	46.8	46.0	8.9	2.3
(L)Lat Flex.	49.5	50.0	7.5	1.9	0.787	48.2	44.0	9.9	2.6

Power	
Flexion	0.134
Extension	0.078
(R) Rotation	0.098
(L) Rotation	0.051
(R) Lat Flex	0.051
(L) Lat Flex	0.066

Table 4.6 The statistical results of the goniometric (cervical ranges of motion) measurements at the 1Month follow-up consultation

	GROUP A 1Month follow-up Consultation					**GROUP B** 1Month follow-up Consultation			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	58.9	58.0	13.8	3.6	0.177	64.9	64.0	14.2	3.7
Extension	62.1	60.0	10.2	2.6	0.934	62.8	62.0	11.4	2.9
(R)Rotation	66.2	64.0	13.6	3.5	0.707	63.6	64.0	5.8	1.5
(L)Rotation	65.9	65.0	11.5	3.0	0.818	66.3	70.0	10.9	2.8
(R)Lat Flex.	45.6	44.0	11.0	2.8	0.677	44.3	42.0	9.5	2.4
(L)Lat Flex.	47.9	46.0	7.0	1.8	0.404	45.9	44.0	9.3	2.4

Power	
Flexion	0.196
Extension	0.053
(R) Rotation	0.093
(L) Rotation	0.090
(R) Lat Flex	0.062
(L) Lat Flex	0.094

From tables 4.4 - 4.6 it can be seen that there was no statistically significant difference between the ranges of motion of group A and group B at the initial, final and 1month follow-up consultations. The null hypothesis is therefore accepted indicating that both groups were equally effective. Standard deviation revealed a relative familiarity around the mean for both treatment groups over all treatment periods.

Table 4.7 The statistical results of the subjective findings comparing groups A and B at the initial treatment

	GROUP A Initial Treatment					GROUP B Initial Treatment			
Questionnaire	Mean	Median	S.D.	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	31.8	36.0	14.1	3.4	0.262	26.8	26	13.3	3.4
NRS 101	52.5	50	12.6	3.3	0.095	48	42.5	18.7	4.8
McGILL	35.1	33.3	18.1	4.7	0.724	32.6	33.3	16.5	4.2

Power	
CMCC	0.154
NRS 101	0.368
McGILL	0.065

Table 4.8 The statistical results of the subjective findings comparing groups A and B at the final treatment

	GROUP A Final Treatment					GROUP B Final Treatment			
Questionnaire	Mean	Median	S.D.	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	13.5	10.0	11.0	2.83	0.630	11.0	9.0	9.8	2.6
NRS 101	23.5	20.0	18.2	4.7	0.505	18.7	25.0	14.1	3.6
McGILL	11.5	8.9	10.3	2.6	0.464	10.5	6.7	12.0	3.1

Power	
CMCC	0.093
NRS 101	0.116
McGILL	0.056

Table 4.9 The statistical results of the subjective findings comparing groups A and B at the 1monthfollow-up consultation

	GROUP A 1Month follow-up Consultation					GROUP B 1Month follow-up Consultation			
Questionnaire	Mean	Median	S.D	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	12.00	14.0	7.8	2.0	0.251	9.7	12.0	8.41	2.2
NRS 101	18.6	22.5	14.3	3.7	0.428	16.2	20.0	13.4	3.5
McGILL	8.6	8.9	6.7	1.7	0.615	8.1	6.7	8.8	2.3

Power	
CMCC	0.111
NRS 101	0.072
McGILL	0.056

From tables 4.7 - 4.9 it can be seen that there was no statistically significant difference between the subjective, pain and disability, data of group A and group B at the initial, final and 1month follow-up consultations.The null hypothesis is therefore accepted indicating that both groups were equally effective. Standard deviation revealed a relative familiarity around the mean for both treatment groups over all treatment periods.

4.4.2 The non-parametric Wilcoxin signed rank test

Table 4.10 Statistical results of the goniometric measurements comparing the first and final treatments in Group A

	GROUP A								
	First Treatment					Final Treatment			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	53.2	56.0	7.9	2.0	0.182	60.3	58.0	14.2	3.7
Extension	60.3	58.0	14.2	3.7	0.121	65.5	66.0	7.4	1.9
(R)Rotation	57.3	60.0	13.8	3.6	**0.016**	65.4	64.0	7.9	2.0
(L)Rotation	60.5	60.0	9.9	2.6	**0.006**	65.5	66.0	12.0	3.1
(R)Lat Flex.	38.5	40.0	7.0	1.8	**0.003**	47.1	46.0	8.9	2.3
(L)Lat Flex.	40.0	40.0	11.2	2.9	**0.003**	49.5	50.0	7.5	1.9

Power	
Flexion	0.354
Extension	0.235
(R) Rotation	0.463
(L) Rotation	0.216
(R) Lat Flex	0.809
(L) Lat Flex	0.746

According to the above table there was a significant improvement within group A from the first to final treatment for rotation and lateral flexion. While flexion and extension showed no significant improvement for the same period. The null hypothesis is therefore rejected for rotation and lateral flexion.

Table 4:11 Statistical results of the goniometric measurements comparing the first and final treatments in Group B

	GROUP B								
	First Treatment					Final Treatment			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	60.2	62.0	20.2	5.2	0.683	65.1	68.0	15.0	3.9
Extension	53.4	56.0	19.7	5.1	0.121	63.6	60.0	11.5	3.0
(R)Rotation	58.0	60.0	11.6	3.0	0.061	63.5	62.0	7.2	1.9
(L)Rotation	57.6	60.0	10.6	2.7	**0.016**	65.9	64.0	10.2	2.6
(R)Lat Flex.	41.6	46.0	11.8	3.1	0.039	46.8	46.0	8.9	2.3
(L)Lat Flex.	42.7	46.0	12.8	3.3	0.096	48.2	44.0	9.9	2.6

Power	
Flexion	0.107
Extension	0.370
(R) Rotation	0.310
(L) Rotation	0.554
(R) Lat Flex	0.249
(L) Lat Flex	0.235

From the above table only a significant improvement, within group B, for left rotation was noted. Flexion, extension, right rotation, left and right lateral flexion were not significant for the period between the first and final treatments.The null hypothesis is therefore rejected for only left rotation.

Table 4:12 Statistical results of the goniometric measurements comparing the first treatment and the 1month follow-up consultation in Group A

	GROUP A								
	First Treatment					1Month Follow-up			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	53.2	56.0	7.9	2.0	0.579	58.9	58.0	13.8	3.6
Extension	60.3	58.0	14.2	3.7	1.000	62.1	60.0	10.2	2.6
(R)Rotation	57.3	60.0	13.8	3.6	**0.016**	66.2	64.0	13.6	3.5
(L)Rotation	60.5	60.0	9.9	2.6	0.967	65.9	65.0	11.5	3.0
(R)Lat Flex.	38.5	40.0	7.0	1.8	**0.010**	45.6	44.0	11.0	2.8
(L)Lat Flex.	40.0	40.0	11.2	2.9	0.039	47.9	46.0	7.0	1.8

Power	
Flexion	0.253
Extension	0.065
(R) Rotation	0.395
(L) Rotation	0.255
(R) Lat Flex	0.518
(L) Lat Flex	0.599

From the above table only a significant improvement, within group A between first treatment and 1month follow-up consultation, for right rotation and right lateral flexion were noted. Flexion, extension, left rotation and left lateral flexion were not significant.The null hypothesis is therefore rejected for only right rotation and right lateral flexion.

Table 4:13 Statistical results of the goniometric measurements comparing the first treatment and the 1month follow-up consultation in Group B

	GROUP B								
	First Treatment					1Month Follow-up			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	60.2	62.0	20.2	5.2	0.096	64.9	64.0	14.2	3.7
Extension	53.4	56.0	19.7	5.1	0.302	62.8	62.0	11.4	2.9
(R)Rotation	58.0	60.0	11.6	3.0	0.039	63.6	64.0	5.8	1.5
(L)Rotation	57.6	60.0	10.6	2.7	**0.003**	66.3	70.0	10.9	2.8
(R)Lat Flex.	41.6	46.0	11.8	3.1	0.181	44.3	42.0	9.5	2.4
(L)Lat Flex.	42.7	46.0	12.8	3.3	0.267	45.9	44.0	9.3	2.4

Power	
Flexion	0.104
Extension	0322
(R) Rotation	0.345
(L) Rotation	0.566
(R) Lat Flex	0.098
(L) Lat Flex	0.112

From the above table only a significant improvement, within group B, for left rotation was noted. Flexion and extension left and right lateral flexion and right rotation were not significant. The null hypothesis is therefore only rejected for left rotation.

Table 4:14 Statistical results of the goniometric measurements comparing the final treatment and the 1month follow-up consultation in Group A

	GROUP A								
	Final Treatment					1Month Follow-up			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	60.3	58.0	14.2	3.7	0.267	58.9	58.0	13.8	3.6
Extension	65.5	66.0	7.4	1.9	0.934	62.1	60.0	10.2	2.6
(R)Rotation	65.4	64.0	7.9	2.0	1.000	66.2	64.0	13.6	3.5
(L)Rotation	65.5	66.0	12.0	3.1	0.773	65.9	65.0	11.5	3.0
(R)Lat Flex.	47.1	46.0	8.9	2.3	1.000	45.6	44.0	11.0	2.8
(L)Lat Flex.	49.5	50.0	7.5	1.9	1.000	47.9	46.0	7.0	1.8

Power	
Flexion	0.057
Extension	0.163
(R) Rotation	0.054
(L) Rotation	0.051
(R) Lat Flex	0.066
(L) Lat Flex	0.086

There was no significant improvement from the final treatment to the 1month follow-up consultation in group B for any of the ranges of motion. The null hypothesis is therefore accepted for this time frame.

Table 4:15 Statistical results of the goniometric measurements comparing the final treatment and the 1month follow-up consultation in Group B

	GROUP B								
	Final Treatment					1Month Follow-up			
Goniometer	Mean	Median	S.D.	S.E.	P-Value	Mean	Median	S.D.	S.E.
Flexion	65.1	68.0	15.0	3.9	0.579	64.9	64.0	14.2	3.7
Extension	63.6	60.0	11.5	3.0	1.000	62.8	62.0	11.4	2.9
(R)Rotation	63.5	62.0	7.2	1.9	1.000	63.6	64.0	5.8	1.5
(L)Rotation	65.9	64.0	10.2	2.6	1.000	66.3	70.0	10.9	2.8
(R)Lat Flex.	46.8	46.0	8.9	2.3	0.114	44.3	42.0	9.5	2.4
(L)Lat Flex.	48.2	44.0	9.9	2.6	0.061	45.9	44.0	9.3	2.4

Power	
Flexion	0.050
Extension	0.054
(R) Rotation	0.050
(L) Rotation	0.051
(R) Lat Flex	0.106
(L) Lat Flex	0.093

There was no significant improvement from the final treatment to the 1month follow-up consultation in group B for any of the ranges of motion. The null hypothesis is therefore accepted for this time frame.

Table 4.16 The statistical results of the subjective findings comparing the first and final treatments in group A

	GROUP A								
	First Treatment					Final Treatment			
Questionnaire	Mean	Median	S.D.	S.E.	P-Values	Mean	Median	S.D	S.E.
CMCC	31.8	36.0	14.1	3.4	**0.0005**	13.5	10.0	11.0	2.83
NRS 101	52.5	50	12.6	3.3	**0.0019**	23.5	20.0	18.2	4.7
McGILL	35.1	33.3	18.1	4.7	**0.0003**	11.5	8.9	10.3	2.6

Power	
CMCC	0.967
NRS 101	0.997
McGILL	0.989

According to the above table there was significant improvement within group A, between first and final treatments, for all three questionnaires.The null hypothesis is therefore rejected.

Table 4.17 The statistical results of the subjective findings comparing the first and final treatments in group B

	GROUP B								
	First Treatment					Final Treatment			
Questionnaire	Mean	Median	S.D	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	26.8	26.0	13.3	3.4	**0.0009**	11.0	9.0	9.8	2.6
NRS 101	48	42.5	18.7	4.8	**0.0003**	18.7	25.0	14.1	3.6
McGILL	32.6	33.3	16.5	4.2	**0.0003**	10.5	6.7	12.0	3.1

Power	
CMCC	0.954
NRS 101	0.995
McGILL	0.979

According to the above table there was significant improvement within group B, between first and final treatments, for all three questionnaires. The null hypothesis is therefore rejected.

Table 4.18 The statistical results of the subjective findings comparing the first and 1month follow-up consultation in group A

	GROUP A								
	First Treatment					1Month folow-up			
Questionnaire	Mean	Median	S.D	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	31.8	36.0	14.1	3.4	**0.0005**	12.0	14.0	7.8	2.0
NRS 101	52.5	50	12.6	3.3	**0.0003**	18.6	22.5	14.3	3.7
McGILL	35.1	33.3	18.1	4.7	**0.0003**	8.6	8.9	6.7	1.7

Power	
CMCC	0.960
NRS 101	0.999
McGILL	0.998

According to the above table there was significant improvement within group A, between first treatment and 1month follow-up consultation, for all three questionnaires. The null hypothesis is therefore rejected.

Table 4.19 The statistical results of the subjective findings comparing the first and follow-up consultation in group B

	GROUP B								
	First Treatment					1Month follow-up			
Questionnaire	Mean	Median	S.D	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	26.8	26	13.3	3.4	**0.0098**	9.7	12.0	8.41	2.2
NRS 101	48	42.5	18.7	4.8	**0.0005**	16.2	20.0	13.4	3.5
McGILL	32.6	33.3	16.5	4.2	**0.0033**	8.1	6.7	8.8	2.3

Power	
CMCC	0.979
NRS 101	0.999
McGILL	0.997

According to the above table there was significant improvement within group A, between the first treatment and 1month follow-up consultation, for all three questionnaires.The null hypothesis is therefore rejected.

Table 4.20 The statistical results of the subjective findings comparing the final treatment and the 1month follow-up consultation in group A

	GROUP A								
	Final Treatment					1Month follow-up			
Questionnaire	Mean	Median	S.D	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	13.5	10.0	11.0	2.83	0.7728	12.0	14.0	7.8	2.0
NRS 101	23.5	20.0	18.2	4.7	0.5791	18.6	22.5	14.3	3.7
McGILL	11.5	8.9	10.3	2.6	0.5465	8.6	8.9	6.7	1.7

Power	
CMCC	0.068
NRS 101	0.118
McGILL	0.135

According to the above table there was no significant improvement within group A, between the final treatment and 1month follow-up consultation, for all three questionnaires. The null hypothesis is therefore accepted.

Table 4.21 The statistical results of the subjective findings comparing the final treatment and the 1month follow-up consultation in group B

	GROUP B								
	Final Treatment					1Month follow-up			
Questionnaire	Mean	Median	S.D	S.E.	P-Values	Mean	Median	S.D.	S.E.
CMCC	11.0	9.0	9.8	2.6	0.3428	9.7	12.0	8.41	2.2
NRS 101	18.7	25.0	14.1	3.6	0.1489	16.2	20.0	13.4	3.5
McGILL	10.5	6.7	12.0	3.1	1.0000	8.1	6.7	8.8	2.3

Power	
CMCC	0.065
NRS 101	0.074
McGILL	0.089

According to the above table there was no significant improvement within group B, between the final treatment and the 1 month follow-up consultation, for all three questionnaires. The null hypothesis is therefore accepted.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

This chapter will discuss the results of the subjective and objective data in sections set out below and will focus on the author's interpretations of these results.

1) Intra-treatment comparison: The assessment of the intra-treatment results from the first treatment to the final treatment represents the effectiveness of the treatment protocol in the treatment of cervical dysfunction. The comparison of the final treatment to the one month follow-up consultation indicates whether or not the treatment's effectiveness was maintained.

The first treatment to the one month follow-up consultation serves to indicate the long term effectiveness and to whether the problem has returned or not.

2) Inter-treatment comparison: The evaluation of the first treatment measurements, shows any variance in the subjective and objective findings between the two groups in terms of their original signs and symptoms. The comparison of the final treatments confirms which treatment is more effective. Appraisal of the one month follow-up treatment measurements represent which treatment method has maintained its effect more effectively.

The author has chosen to use bar graph presentation to illustrate the trends that occurred over the course of the study. The median was chosen over the mean as representative figure. As the mean is easily distorted, by extreme data values, in a study with a small sample size such as this. (Crichton 1993: 17)

The author will also attempt to highlight the difficulties and limitations within this study and statistics in general. This will be an attempt to convince the examiner of the author's understanding of statistical concepts and their usage, as well as supplying the reader with a more comprehensive insight into the nature of the results.

5.2 Intra-group comparisons

5.2.1 The objective data

The statistical data for the cervical ranges of motion can be found in tables 4.10 - 4.15. Comparison of the first to final treatments disclosed a significant increase of left and right rotation, and left and right lateral flexion in the Instrumental thrust group (A). The same group when comparing first treatment to one month follow-up showed only right rotation and right lateral flexion significant improvements, while the final to one month follow-up showed no significant improvement or decline.

From examining the instrumental group (A) it can be proposed that the Activator thrusts had a significant influence in increasing the rotational and lateral flexion components of the cervical spine ranges of motion. The effect seems to be carried through to the one month follow-up period. Although the data suggesting this, is not as convincing as that of the initial effect.

Looking at the Manual group (B) data there are fewer significant improvements with only left rotation showing a consistent significant value from initial to both final and one month follow-up.

However tempting it may be, it is incorrect, to view the almost significant p-values in group B for right rotation, right and left lateral flexion as that! The proximity of the p-value to the significance value is not the issue. The fact remains that at the 95% confidence interval those ranges of motion were not statistically significant.

If a confidence limit had been set, then a discussion on p-values and there distances from one another would have been relevant. This was not the case in this study.

The status quo seemed to be maintained from final treatment to the one month follow-up with no significant changes as in group A.

When we look at the relevant power of each range of motion in both groups. We can see that the power of the tests are overall very weak. Except for the significant lateral flexion components in group A between first and final treatments. This shows that the chance of missing possible statistical significant results, is high. If the sample size had in fact been larger the null hypothesis might have been accepted fewer times. Showing that there might have been an improvement between treatment intervals.

The flip-side of this is that the rotational and lateral flexion results with low power, that were significant, might have been erroneous. However, when looking at the general trends reflected in the bar charts of the median values for the groups (Figures 5.1-5.6). It can be intimated that this conclusion is less likely.

5.2.2 The subjective data

The statistical data itself can be found in tables 4.16 - 4.21.

Within the instrumental group (A) and manual group (B) the first to final and first to follow-up time periods, showed significant improvements for all three of the questionnaires. This indicates that both the treatment protocols were successful in significantly reducing pain and disability that occurs with cervical spine dysfunction. The effect was consistent over the short and long term (1 month).

These same time intervals (first to final and first to follow-up) had strong power, supporting the validity of the results in both groups. The final to follow-up interval had very low power. Thus increasing the chance of incorrectly accepting the null hypothesis.

The trends as observed in viewing the median values, laid out in Figures 5.7 – 5.9, support the assumptions made above. In that they show a decrease in the subjective components between the first and final and first and follow-up, while the final to follow-up shows more or less similar median values.

5.3 Inter-group comparisons

5.3.1 The objective data

The statistical data for the cervical ranges of motion can be found in tables 4.4 - 4.6.

Comparison of the goniometrical measurements presented no statistical differences between the two groups. Analysis of the standard deviation revealed in the data showed a relative familiarity around the mean therefore both groups may display a similar predictability and reliability over their respective treatment periods.

The power for all three assessment periods is weak. This means that even if there had been a difference between the groups, that because of the small sample size, it might have gone undetected.

Other than the anomalous baseline values for right lateral flexion (Figure 5.5), the median values of the groups (Figures 5.1 – 5.6) seem to support the trend that the two groups had similar responses to their respective treatments.

5.3.2 The subjective data

The statistical data itself can be found in tables 4.7 - 4.9.

Comparison of the data from the CMCC, NRS 101 and McGill questionnaires presented no statistical differences between the two groups. Analysis of the standard deviation revealed in the data showed a relative familiarity around the mean therefore both groups may display a similar predictability and reliability over their respective treatment periods.

The power for all three assessment periods is weak. This means that even if there had been a difference between the groups, that because of the small sample size, it might have gone undetected.

The median values of the groups (Figures 5.7 – 5.9) seem to support the trend that the two groups had similar responses to their respective treatments.

5.4 Problems with statistics and limitations of this study

5.4.1 Significance

A common debate is that of the relationship between statistical and clinical significance. Ideally statistics are used to determine clinical significance and thus the intervention's effectiveness. Unfortunately, a test that has been employed and its results used in statistical analysis, may or may not measure the clinical phenomenon. i.e. The very thing it measures or claims to measure may or may not have any clinical impact. It is for this reason that we must be very careful in assuming that statistical and clinical significance are related. The author hopes that in this study the objective cervical range of motion measurements and the subjective questionnaires utilised, in fact represent the changes in a dysfunctional cervical facet joint undergoing manual and mechanical thrusts. As mentioned in chapter 3 the studies by Vernon and Mior (1991), Jensen et al.(1986), Melzack (1987), Capuano-Pucci et al. (1991) and Reault et al. (1992) assess various aspects pertaining to reliability and validity of the tests used. Their relevance to the clinical entity of cervical dysfunction is always open to debate. It has been assumed by this author, after reviewing the current literature, that these measures having been used to assess the same and similar conditions by other researchers and appearing to measure the phenomena that occur during cervical dysfunctional states, are in fact some of the most accessible and reliable tools available for this type of study.

In summary a relevant quote from Crichton (1993:14) "By stating a treatment difference we consider to be of clinical importance we ensure that *statistically significant* equates to *clinically important*."

Vernon and Mior's (1991) assessment of the Neck Disability Index indicated that it had a high level of reliability and internal consistency.

In a study comparing six methods of measuring clinical pain intensity, Jensen et al. (1986) found that the NRS 101 to be the "superior measure".

The McGill Short Form is one of the most widely used tests for the evaluation of pain and is sensitive to clinical therapies (Melzack 1987).

Studies by Capuano- Pucci et al. (1991) and Reault et al. (1992) indicated that the CROM goniometer has good to excellent intra and inter tester reliability in measuring cervical ranges of motion.

The CROM goniometer was also shown to be highly reliable when compared to other range of motion measuring techniques, i.e. universal goniometer and visual estimation. (Youdas et al. 1991).

5.4.2 Limitations

Before a discussion on the specific limitations of this study can proceed a general look at clinical trials has to be taken. Randomised controlled trials, where the control is either a standard treatment or a placebo group, are the simplest and most commonly used study designs in the health care clinical setting. (Crichton 1993). The need here is to show that one treatment causes a larger response than another. Statistical analysis is the tool we use to attempt to show this difference. It is however, limited. Coulter (1991:130), in his analysis of the controlled clinical trial, uses these strong words, "...the controlled clinical trial is a wrongheaded attempt by man to subjugate nature." The gist of his argument is that clinical trials are unable to cope with the heterogeneity of the subject matter. In this case, a dysfunctional or disease state in man.

This is true, but how else are we supposed to come to reasonable, hopefully life improving conclusions. However flawed this process is, it is the best we have at the moment.

We must constantly keep in mind that our assumptions are just that, and that trials and statistics are not the answers themselves but may help us to reach the "truth" or further our understanding of the problems we attempt to tackle.

Without getting too philosophical let us look at how we can improve the chance of this and other studies in being more relevant.

Homogeneity: In this study the author had the patient randomly allocate themselves to either treatment group. This was an attempt to safeguard against selection bias. Ideally matched pairs should be used, where each person is matched with someone of the same or similar age, sex, race and history. In this study's clinical setting and time restraint, it was not possible to achieve this. Looking at the demographic data in 4.3 it can be seen that the make up of the two groups were fairly similar with respect to age, sex and pain duration prior to treatment. It can be loosely assumed that the two groups would respond in a similar manner to the same treatment protocol.

Likewise the sample is thought to be generalizable i.e. representative of the greater population suffering from the same chronic neck pain.

Blinding: Pocock (1993: 32) states that randomised control trials performed double blind are the gold standard for studies aiming to prove that a therapy is effective. Patient blinding in this study was attempted but probably not achieved due to the study design not excluding patients who had previous received manual chiropractic manipulations (six in the instrumental group and five in the manual group). Thus some of the patients were aware that they were not receiving a standard manual manipulation and this might have skewed the results in either direction.

Practitioner blinding in this study was not feasible as all the treatments were given by the author. This weakens the study as the practitioner can consciously or subconscious affect the outcome measure through bias in favour of a treatment or a patient.

Blinded evaluation is preferred in this type of study. It would have added weight to the study as it would have excluded observer bias. Unfortunately this was not practical for this particular study.

Thus concluding that the weight of this study is deminished by the lack of both single and double blinding.

P-values and Type errors: P-values are a way of reporting the results of statistical tests, but they do not define the practical importance of the study. (Bailar and Mosteller 1992: 181). A p-value is a probability and is used to assess the degree of dissimilarity of two or more groups of measurements. (Bailar and Mosteller 1992: 183)
This study limited the possibility of falsely rejecting the null hypothesis (saying there is a difference between the two treatments when there isn't to 0.05 (α), but because this is a two tailed test we use $\alpha \div 2$ (0.025). That means there is 1 in 40 chance that this study would result in a false positive. So the chance of committing this Type I error is only 2.5%.
A limitation of this study is the possibility that type II error was committed. What may have occurred here is that a clinically important difference was not detected because of the relatively small sample size. The smaller the study the greater the risk of running a Type II error. This error is not rejecting the null hypothesis when it is in fact false i.e. a false negative.
Failure to attain a level of statistical significance (≤ 0.025) does not necessarily mean that the two treatments being compared are identical, especially with small a sample.(Bailar III and Mosteller 1992:369). So with this possibility in mind the intergroup comparisons of the ranges of motion and subjective data although seen in this study as not statistically significant could possibly be erroneous because of Type II error.

Power: The probability of Type II error is known as β. The power of a statistical test is 1 minus β ($1-\beta$). This is the probability of detecting the difference between the groups. (Bailar III and Mosteller 1992: 359, 387). Their is a close connection between sample size and the power of the statistical test. (Bailar III and Mosteller 1992: 195). The smaller the study the greater the risk of Type II error and thus a weaker power will probably be reflected. Ideally the power value should be as close to 1 as possible. (Crichton 1993: 13). Thus if a test, for example, had a low power of say 0.17 that would mean that the probability of detecting a result could be purely chance 17 times out of 100. (Coulter 1991: 45). So, with a small sample the chance of an incidental result increase.

5.5 Comparison with other studies and existing knowledge

To compare one study to another is not an easy task and is sometimes implausible, as each is often so different in design and the outcome measures used often vary greatly. It is for this reason that the data presented in Table 5.1 must not be viewed as a critique of the studies listed, but merely a summarisation of possible similarities and differences amongst the studies noted. It should not be viewed in isolation from the content presented in chapter 2, or the research articles themselves.

What can be gleaned from Table 5.1 is that both the instrumental and manual thrusts in this study agreed with the general consensus that cervical manipulation has an effect in reducing pain and increasing range of motion in the cervical spine, over the short term. Long term effects (greater that 1 month) of cervical manipulation are not known as they have not been adequately assessed. It is only this study, that of Sloop et al. (1982) and Koes et al. (1993) that have even attempted to measure long term effectiveness of cervical manipulation in reducing pain and increasing cervical range of motion.

Key to Table 5.1

— - not tested for

✓ - affirmative

x - non affirmative

lat. flx - lateral flexion

rotatn - rotation

↑ - increase

↓ - decrease

ROM - range of motion

Table 5.1 Comparison of studies involving cervical spine manipulation

Study	Short Term ↑ ROM	Long Term ↑ ROM	Short Term ↓ Pain	Long Term ↓ Pain
Sloop et al. 1982	—	—	✓ - tendency	✓ - tendency
Howe et al. 1983	lat. flx ✓ rotatn ✓	rotatn ✓ (3wks)	✓	x - (3 wks)
Nansel et al. 1990	lat. flx ✓	—	—	—
Vernon et al. 1990	—	—	✓	—
Cassidy, Quon et al. 1992	✓	—	—	—
Cassidy, Lopez et al. 1992	✓	—	✓	—
Nansel et al. 1992	lat. flx ✓ rotatn ✓	—	—	—
Yeomans et al. 1992	✓	—	—	—
Koes et al. 1993	—	—	✓	✓ (12 mnths)
Rogers 1997	—	—	✓	—
This study - Instrumental	lat. flx ✓ rotatn ✓	lat.flx ✓ (4wks) rotatn ✓ (4wks)	✓	✓ (4wks)
This study - Manual	rotatn ✓	rotatn ✓ (4wks)	✓	✓ (4wks)

5.6 Possible effects on existing knowledge and practices

Although the results of this study do not prove anything, they do add to the body of knowledge that indicate that cervical manipulation has, at least, short term effects on decreasing neck pain and increasing cervical range of motion when treating cervical spine dysfunction.

This study also points to the possible long term effects of manipulation on the symptoms and signs that accompany cervical spine dysfunction.

What could be of great interest is that the results from this pilot study would seem to intimate that instrumental thrusts could have similar effects to that of manual thrust manipulations. If, this is shown, in further studies, to be the case, then the future role of manual thrusts within manipulative care might be due for review. Especially in the light that instrumental thrusts use less force, do not put the joint under tortional stress and are perceived to be safer. (Byefield 1991).

Figure 5.1

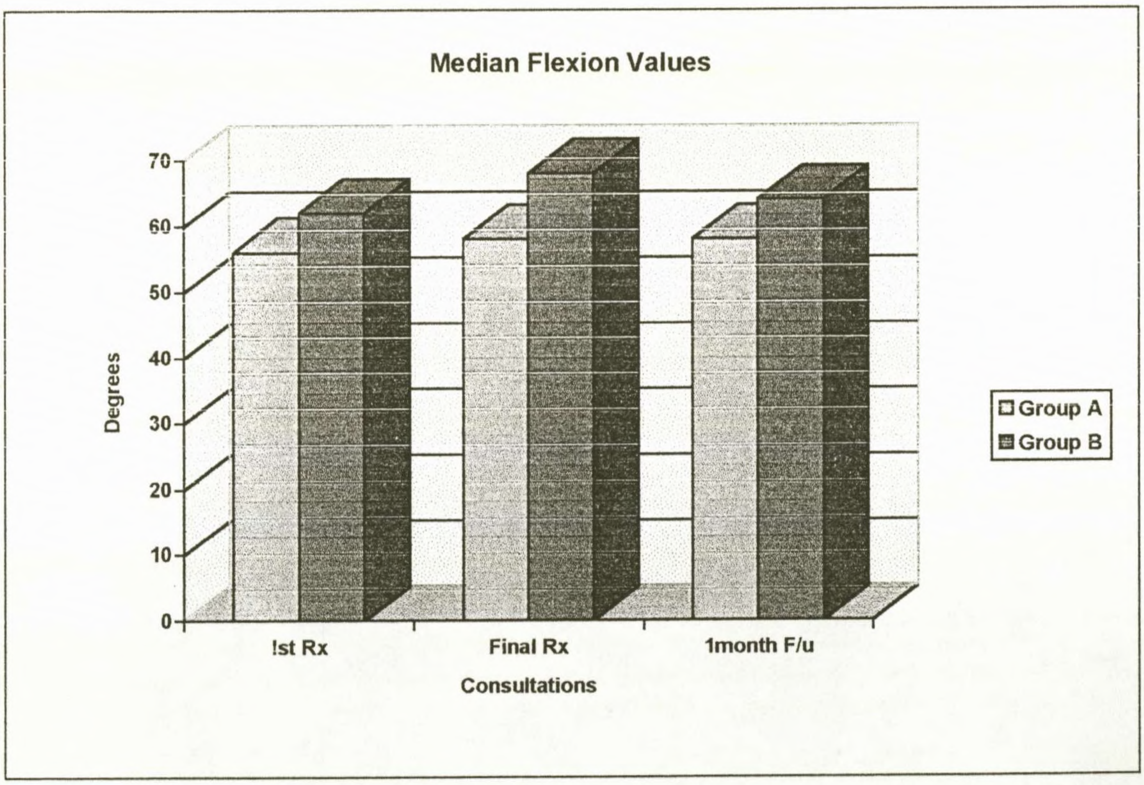

Median Flexion Values
70
60
50
40
30
20
10
0
Degrees
!st Rx
Final Rx
1month F/u
Consultations
Group A
Group B

Figure 5.2

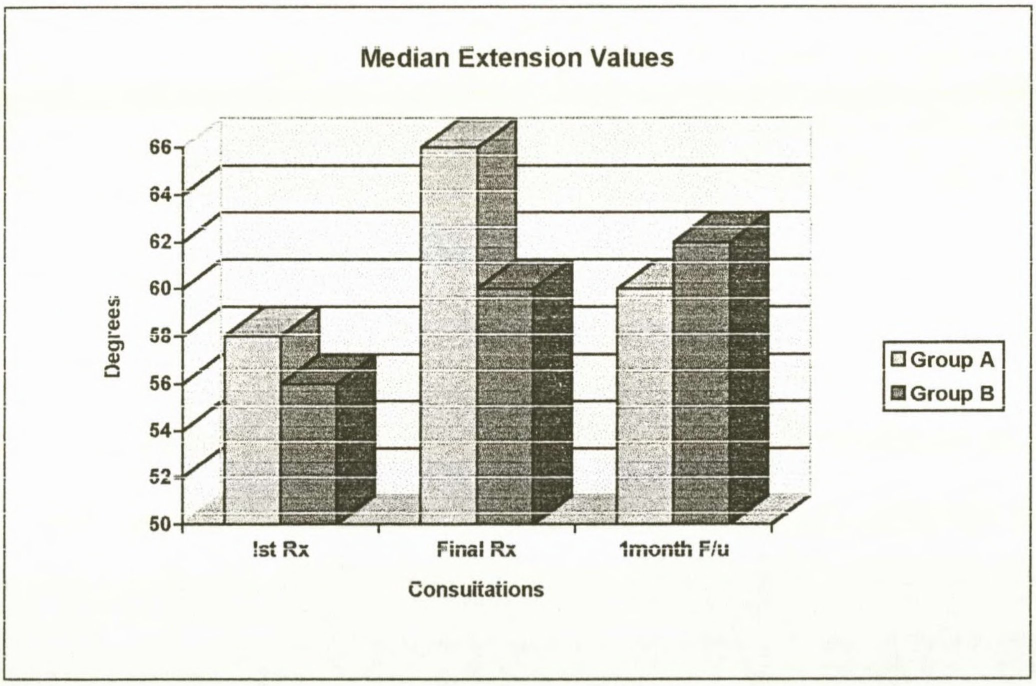

Median Extension Values
66
64
62
60
58
56
54
52
50
Degrees
Ist Rx
Final Rx
1month F/u
Consultations
Group A
Group B

Figure 5.3

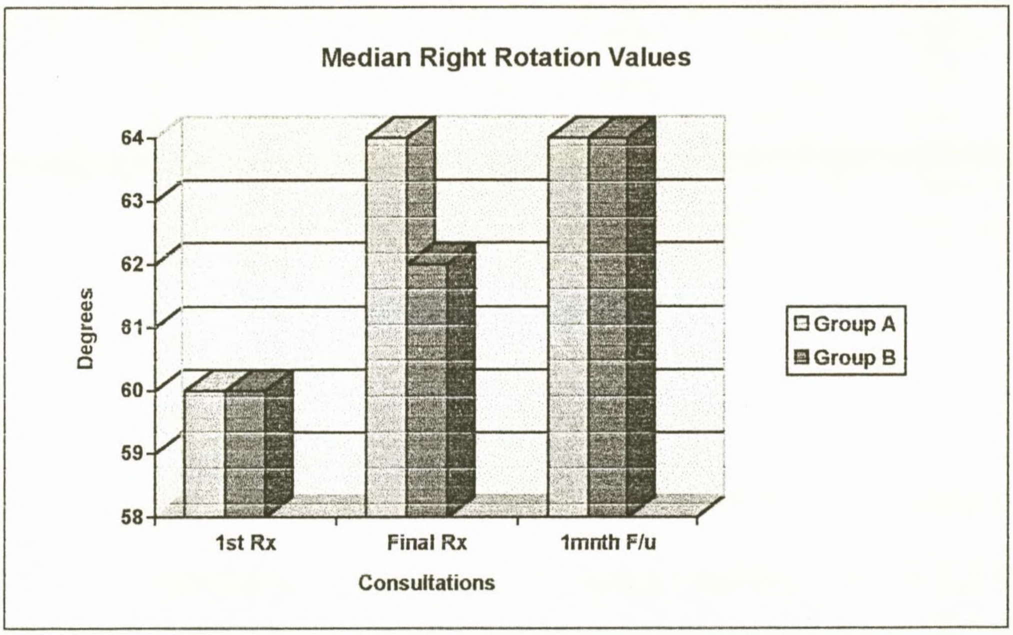

Median Right Rotation Values
64
63
62
61
60
59
58
Degrees
1st Rx
Final Rx
1mnth F/u
Consultations
Group A
Group B

Figure 5.4

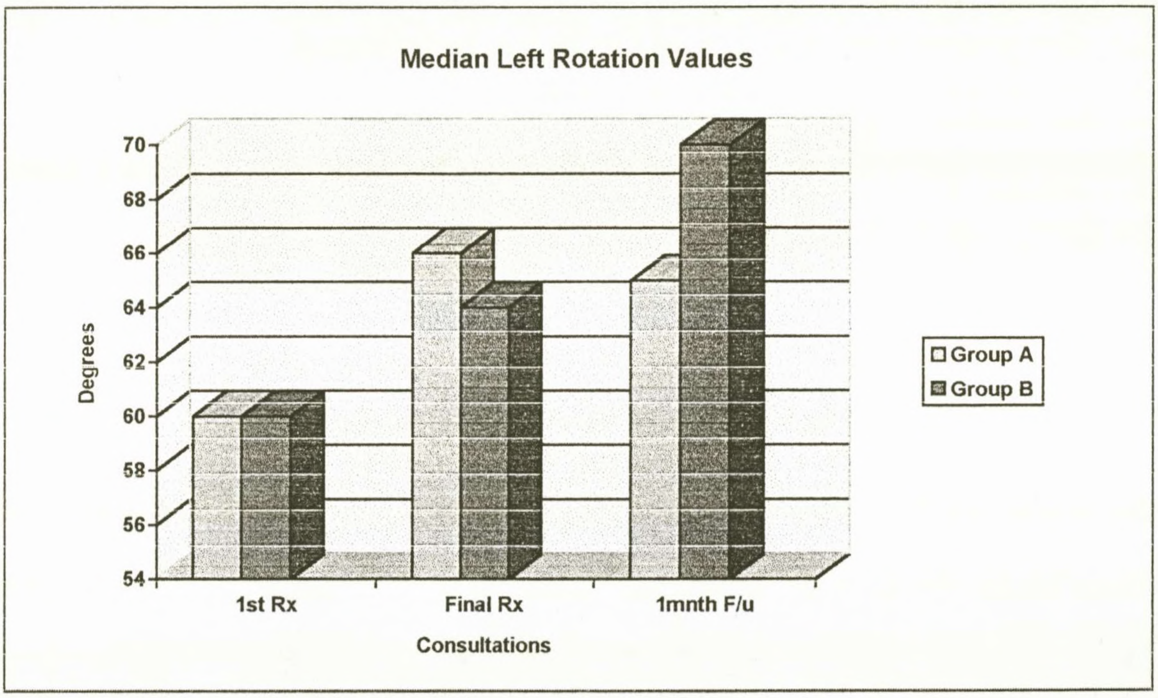

Median Left Rotation Values
70
68
66
64
62
60
58
56
54
Degrees
1st Rx
Final Rx
1mnth F/u
Consultations
Group A
Group B

Figure 5.5

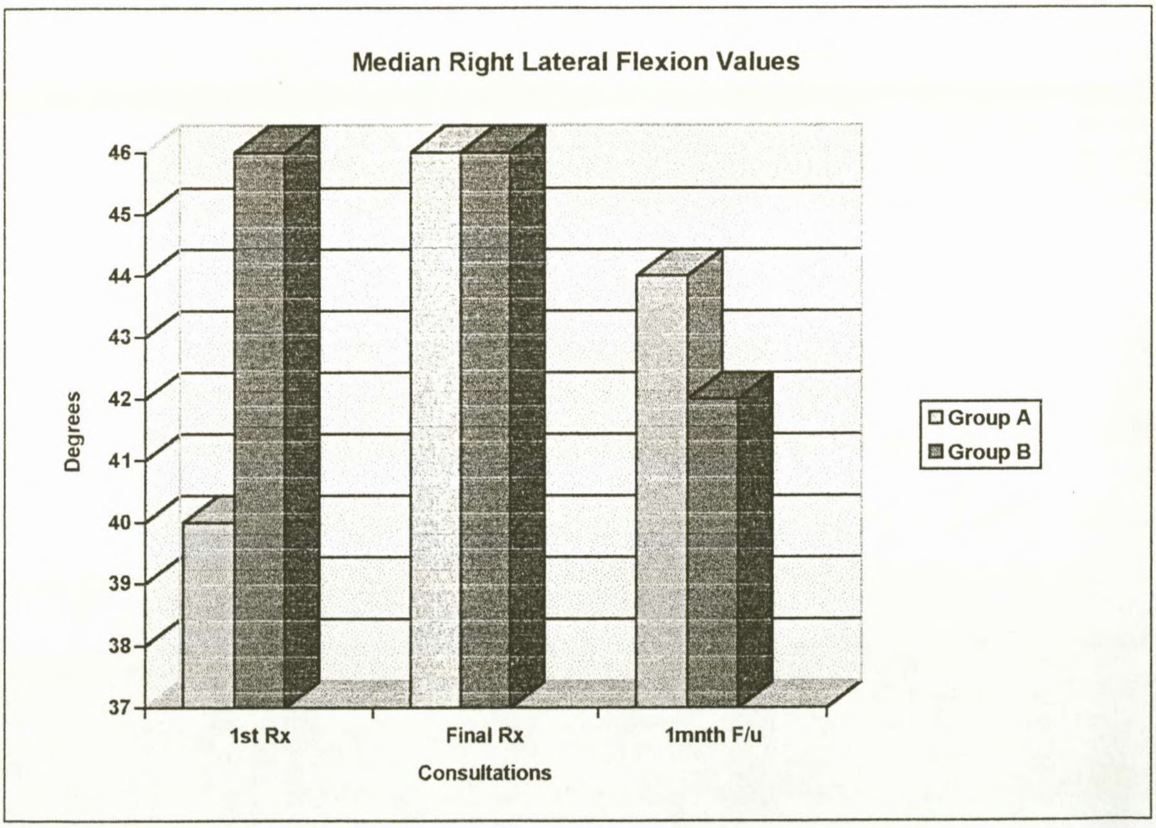

Median Right Lateral Flexion Values
Degrees
46
45
44
43
42
41
40
39
38
37
1st Rx
Final Rx
1mnth F/u
Consultations
Group A
Group B

Figure 5.6

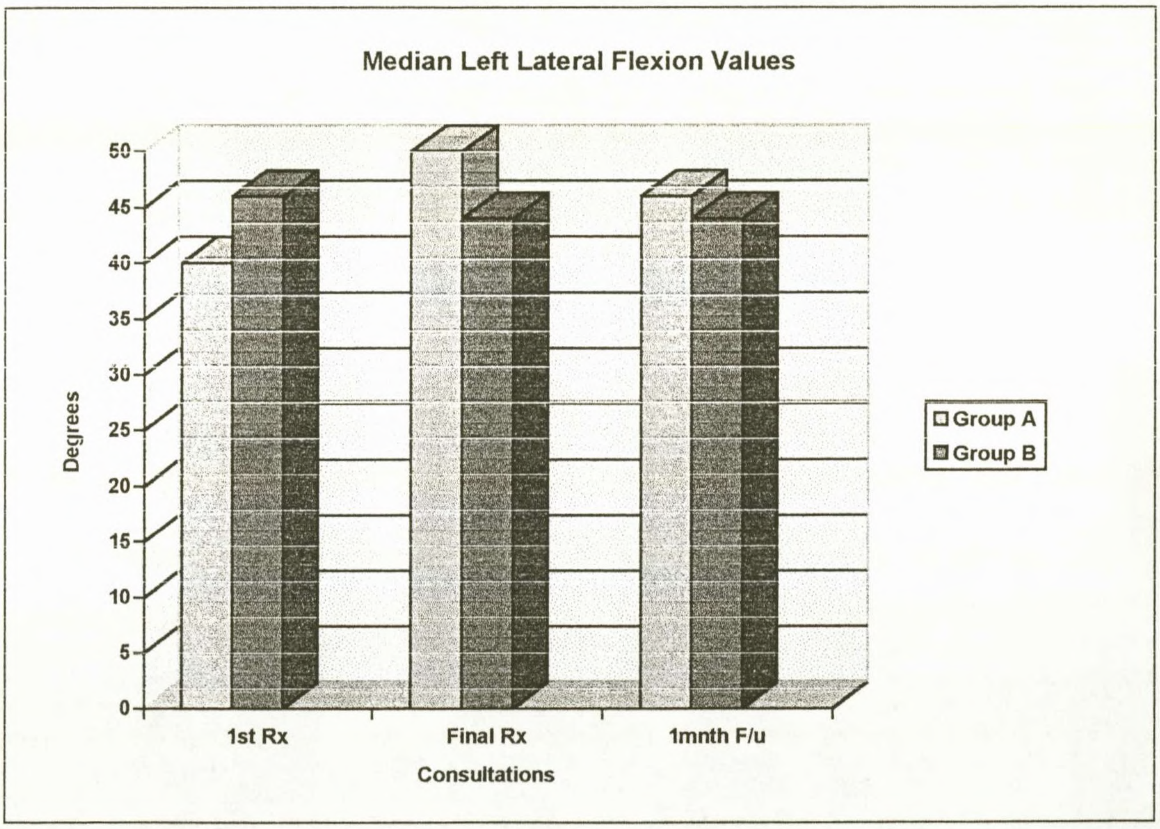
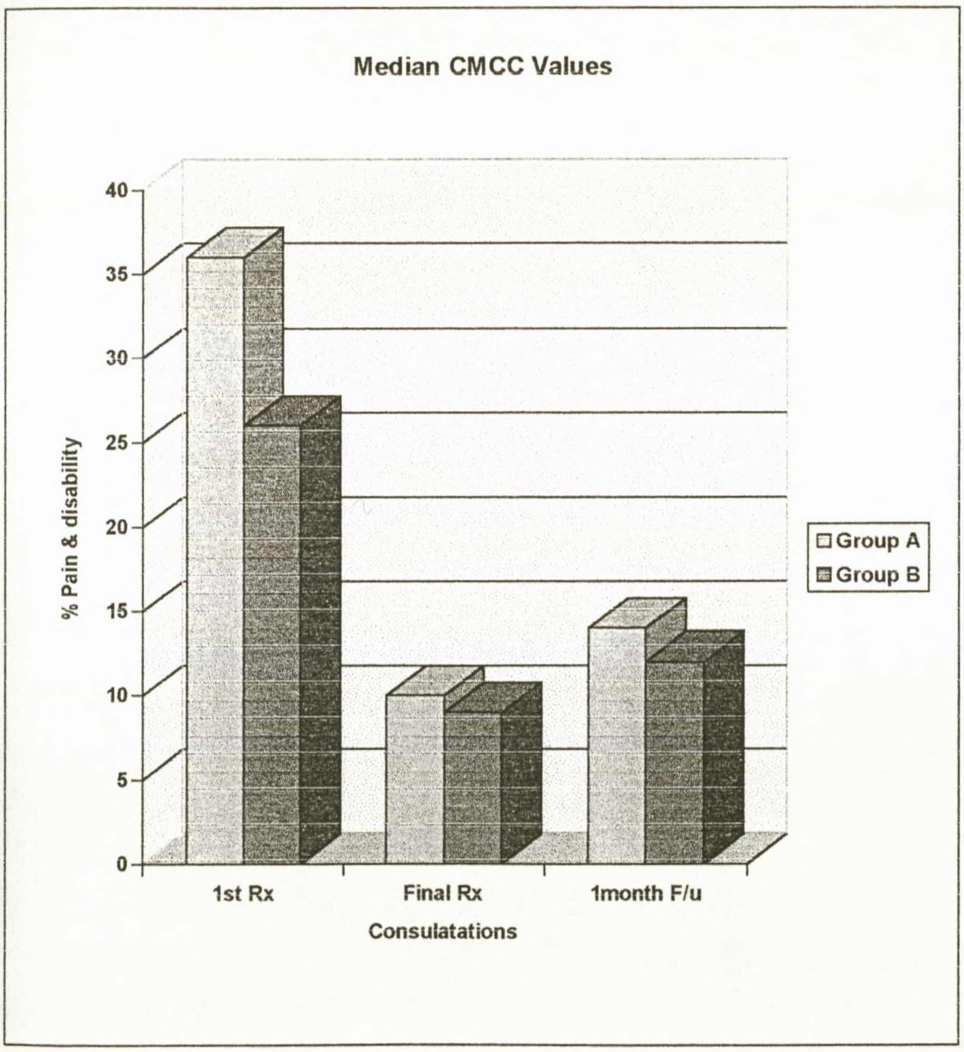

Median Left Lateral Flexion Values
Degrees
0
5
10
15
20
25
30
35
40
45
50
1st Rx
Final Rx
1mnth F/u
Consultations
Group A
Group B

Figure 5.7



Median CMCC Values
40
35
30
25
20
15
10
5
0
% Pain & disability
1st Rx
Final Rx
1month F/u
Consulatations
Group A
Group B

Figure 5.8

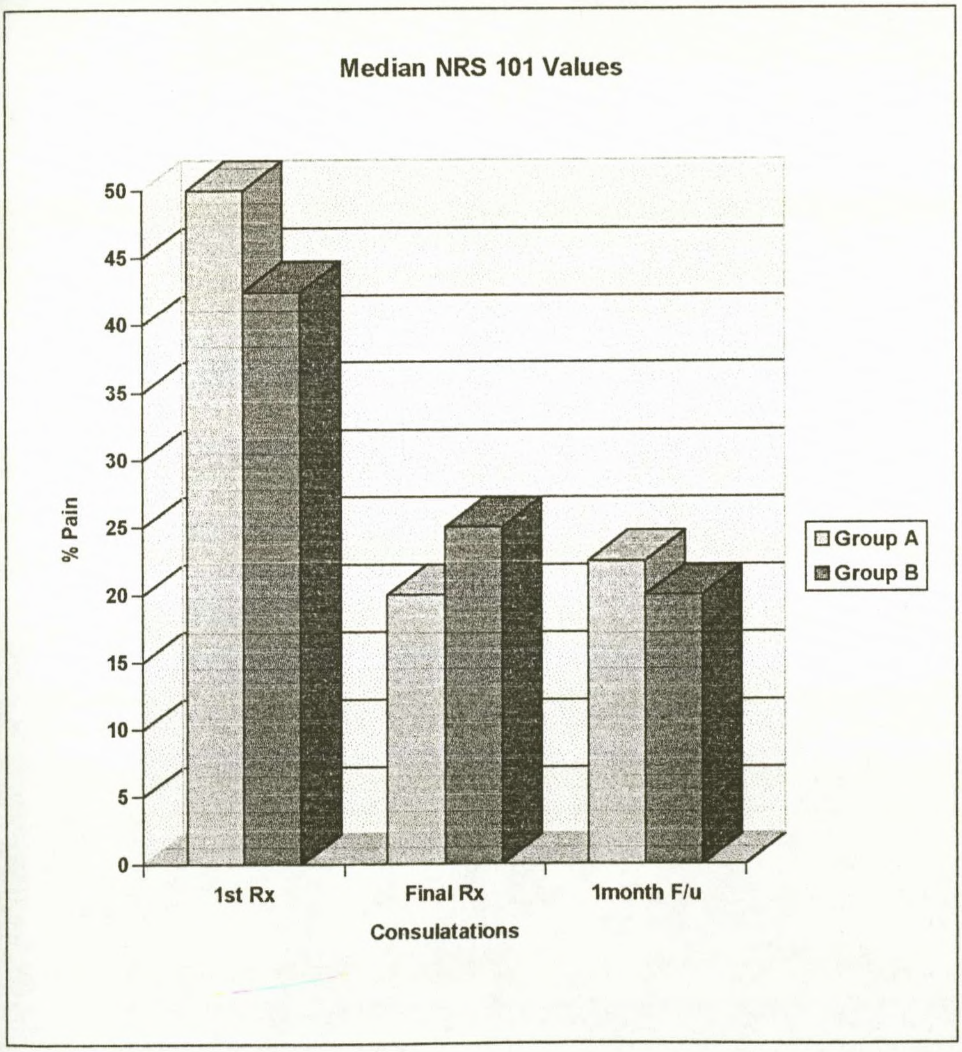
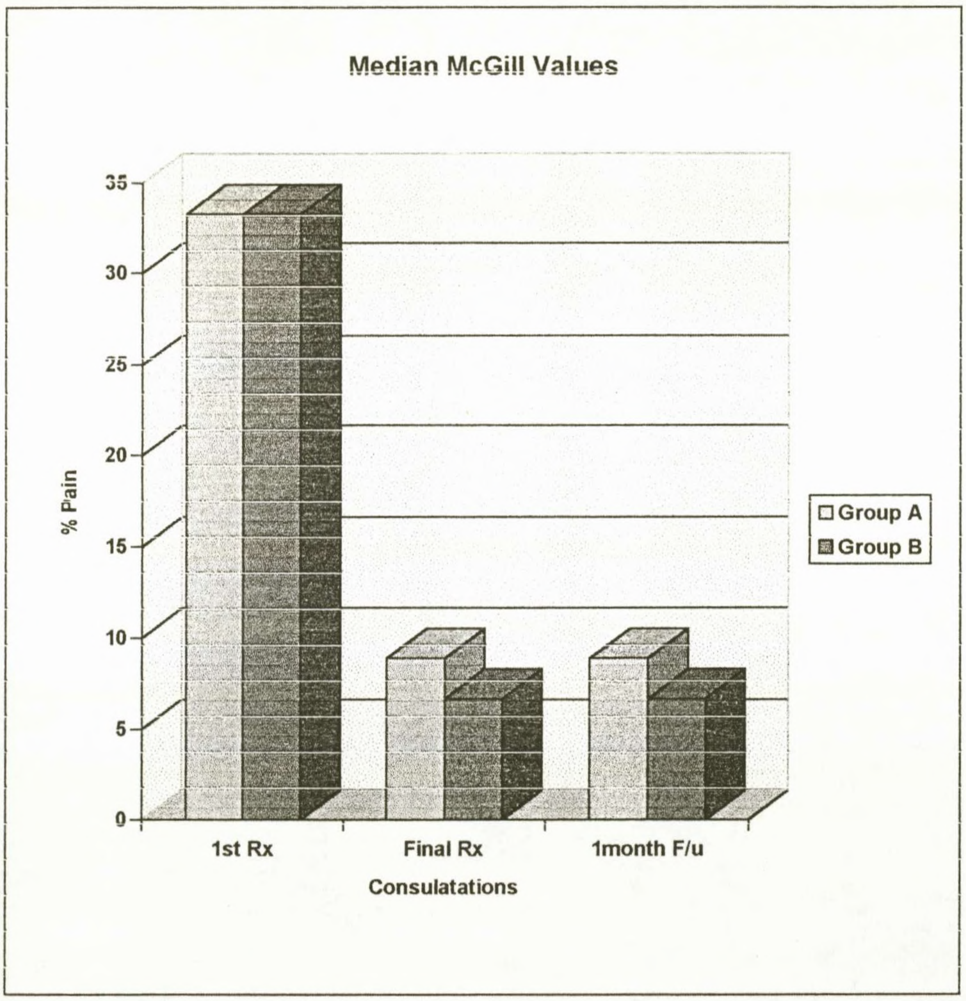

Median NRS 101 Values
% Pain
50
45
40
35
30
25
20
15
10
5
0
1st Rx
Final Rx
1month F/u
Consulatations
Group A
Group B

Figure 5.9


Median McGill Values
% Pain
0
5
10
15
20
25
30
35
1st Rx
Final Rx
1month F/u
Consulatations
Group A
Group B

CHAPTER SIX

6.0 RECOMMENDATIONS AND CONCLUSIONS

6.1 Recommendations

With hindsight, unlimited time and funds this author would recommend a study that could fully investigate the effectiveness, and possibly efficacy, of these two treatment protocols in treating the dysfunctional cervical spine. The chief areas to focus on, to improve on this study, are described below.

Sample size :
Firstly, a larger sample size would have to be selected. Sample sizes of at least 30 per group would enable the tester to have more statistical tests at his disposal like paired and unpaired t-tests.
The [illegible] should be pre-determined (as done with α) to have the chance of Type II error limited to a set level.

Homogeneity :
The inclusion and exclusion criteria would be stricter to ensure a more homogenous population with respect to age, sex, race and history of complaint. Using matched pairs would greatly enhance the strength of the study.

Area specificity :
The upper and lower cervical spine are different with respects to anatomy and biomechanics. Therefore any future study should take this into account and only one of these areas be selected for treatment.

Placebo group :

A placebo group should be incorporated into the study. This author suggests the activator set at "no thrust" position.

Blinding :

More effective blinding should be used. Only people who have not previous received manipulative care should be accepted so that they would be blinded to the treatment they would be receiving. The examiner collecting the data and collating it should be blinded as to which treatment the patient is receiving. This would decrease the chance of observer bias.

Accuracy :

The goniometric readings could be more accurate and would also be less likely to be subject to human error if more advanced technology was used.

6.2 Conclusions

This study consisted of 30 patients who were recognised to have of the symptoms and signs of the cervical spine in the dysfunctional phase.

The patients were randomly placed into two groups of 15. Group A received instrumental thrusts delivered by means of an Activator Adjusting Instrument (AAI) while Group B received standard diversified rotary and lateral break manipulations to the dysfunctional cervical segments, as identified during the orthopaedic cervical regional examination.

The patients received treatment until symptom free or up to a maximum of eight treatments over a period of about four weeks with two to three treatments per week. A follow-up consultation for reassessment took place after one month.

The statistical analysis revealed statistically significant changes after treatment, within both groups for all the subjective measures (perceived pain and disability).
Group A (instrumental) showed statistically significant changes for the objectively measured components of lateral flexion and rotation. While Group B (manual) showed only statistically significant changes in rotation.
The effects on the subjective and objective measures seemed to be maintained at the one month follow-up.

When statistical analysis was used to compare the two groups no statistical significant results were noted.
This would lead to the assumption that both treatment groups responded equally favourably in terms of the subjective findings and objective measures.
Therefore the results from this study suggest that instrumental and manual thrust manipulations are equally effective in their ability to treat the dysfunctional cervical spine.

ADDENDUM 1

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: TN Other
Current: TN Other

X-ray Studies:
Previous: TN Other
Current: TN Other

Clinical path. lab.:
Previous: TN Other
Current: TN Other

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 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. Family history:
   Immediate family:
   - Age
   - Health
   - Cause of death
   - DM
   - Heart disease
   - TB
   - HBP
   - Stroke
   - Kidney disease
   - CA
   - Arthritis
   - Anaemia
   - Headaches
   - Thyroid disease
   - Epilepsy
   - Mental illness
   - Alcoholism
   - Drug addiction
   - Other

8. Psychosocial history:

   Home situation

   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.

ADDENDUM 2

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. <u>RESPIRATORY EXAMINATION</u>

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. <u>ABDOMINAL EXAMINATION</u>

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. <u>SPINAL EXAMINATION:</u>(See Regional examination)

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

9. <u>BREAST EXAMINATION:</u>

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:

ADDENDUM 3

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

Patient: ______________________________ File: ____________

Date: ______________ Intern/Resident: ______________________________

Clinician: ____________________________ Sign: ________________

OBSERVATION:

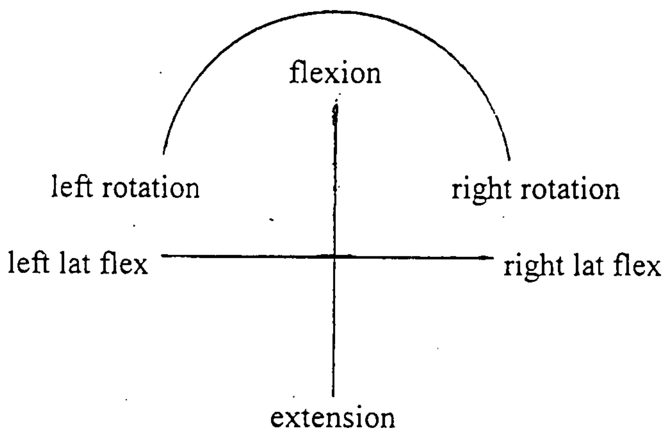
Posture
Swellings
Scars
Discolouration
Hair Line
Bony & Soft Tissue Contours

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:

ADDENDUM 4

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)

ADDENDUM 5

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.

ADDENDUM 6

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.

____

ADDENDUM 7

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) ______

ADDENDUM 8

CROM Procedure Manual

Procedure for Measuring Neck Motion with the CROM

CROM (Cervical Range of Motion Instrument) is a product of:

Performance Attainment Associates
3600 Labore Road, Suite 6
St. Paul, MN 55110-4144

Introduction

Pain and loss of motion in the cervical region are common problems that increase with age. Over 40 million adult Americans suffer from some form of osteoarthritis or degenerative joint disease, and 50 to 85 percent of these people will experience debilitating back or neck pain of a temporary or chronic nature.

Accurate measurement of cervical motion during the course of a therapeutic regime can provide objective data on the benefits of the selected treatment. However, currently available measurement devices are time consuming, cumbersome, poorly standardized and poorly accepted by practitioners. In response to this lack of a acceptable means of measurement, existing devices were evaluated and the following design criteria established:

- easily applied
- measures all planes of motion
- comfortable
- time efficient
- easily adjusted
- quickly read
- standardized landmarks and positioning
- standardized protocol
- reproducibility
- simple design
- reasonable cost

Based on these criteria, the CROM instrument, accessories and protocol were developed. The CROM accurately and quickly measures the range of sagittal, coronal and horizontal movements that can be performed by the head and neck.

To perform and document accurate cervical measurements you will need the following items:

- CROM Instrument, including the rotation arm and the forward head arm
- magnetic yoke
- vertebra locator
- tape measure
- recording sheets
- procedure manual

The CROM Instrument is aligned on the nose bridge and ears and is fastened to the head by a velcro strap (see figure 1).

Three dial angle meters are used to take most of the measurements. The **sagittal plane meter** and the **lateral flexion meter** are gravity meters. The **rotation meter** is magnetic and responds quickly to the shoulder-mounted **magnetic yoke,** accurately measuring cervical rotation. Because the rotation meter is controlled by the magnetic yoke, shoulder substitution is eliminated.

Figure 1: CROM with rotation arm and magnetic yoke

Two frequently observed problems seen in patients with cervical dysfunction are forward head (cranio-thoracic postures) and rounded shoulders (scapular protraction). Forward head is the anterior glide of the cervical spine and head with cervical hyperextension. The CROM Instrument, with the **forward head arm** and the **vertebra locator**, accurately measures forward head (see figure 2).

Rounded shoulder is the anterior movement of the scapula (shoulder and upper extremity) on the thorax. Rounded shoulder measurements are taken with the **tape measure**.

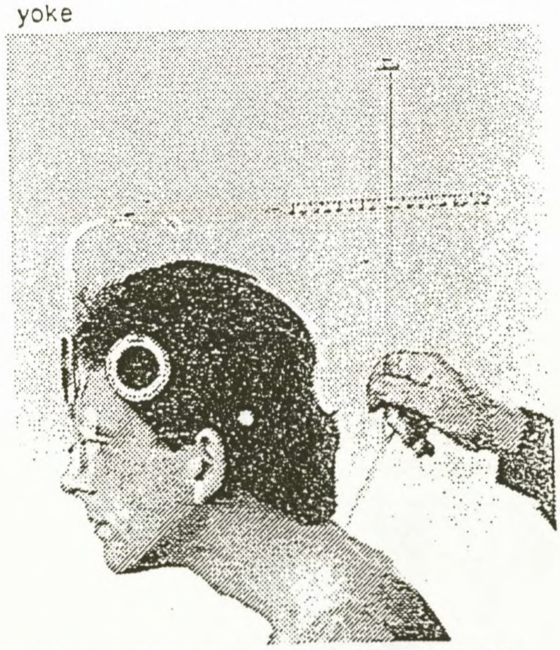


Figure 2: CROM with forward head arm and vertebra locator

Suboccipital Flexion and Extension

Instruct the subject to position the **CROM Instrument** as if putting on a pair of glasses. Fasten the velcro strap in line with the bows. You will not need the magnetic yoke, rotation arm, forward head arm or vertebra locator for these measurements. Instruct the subject to stand facing away from an outside corner of a wall or edge of a open door frame. The subject's sacrum, thoracic spine and occiput must be in contact with the corner of the wall or door edge (see figure 3). Instruct the subject to maintain constant pressure to prevent substitution movements. Since the sagittal plane meter normally reads zero when the ear bows are parallel to the horizontal plane, this reading (zero or otherwise) indicates the subject's resting suboccipital posture; record it on the recording sheet*.

Figure 3: Resting posture

Instruct the subject to flex the suboccipital area as much as possible while maintaining equal pressure at the skull, thorax and sacrum (see figure 4). Record this measurement.

Figure 4: Flexion

Instruct the subject to extend the suboccipital area as much as possible without allowing the skull, thorax and sacrum to leave the contact surface (see figure 5). Record this measurement.

Figure 5: Extension

*A sample recording sheet is provided in the back of this manual. Tablets of the recording sheet may be ordered from your dealer as PAA Form 101.

Cervical Flexion and Extension

Instruct the subject to sit erect in a straight-back chair with the sacrum against the back of the chair, the thoracic spine away from the back of the chair, arms hanging at sides and feet flat on the floor. Next, instruct the subject to position the CROM instrument as if putting on a pair of glasses. Fasten the velcro straps snuggly in line with the bows. You will not need the magnetic yoke, rotation arm, forward head arm or vertebra locator for these measurements.

To assure full flexion in this multi-joint area, first instruct the subject to "nod your head to make a double chin" (suboccipital flexion). Then encourage the subject to flex further until full cervical flexion is obtained (see figure 6). To take the reading on the sagittal plane meter, read through the meter's beveled edge; from this angle the pointer will be magnified to the dial edge. Record this measurement in the appropriate space on the recording sheet.

Figure 6: Cervical flexion

To measure cervical extension, first instruct the subject to "nod your head back" (suboccipital extension). Then have the subject extend further until full extension is achieved (see figure 7). Record this measurement also.

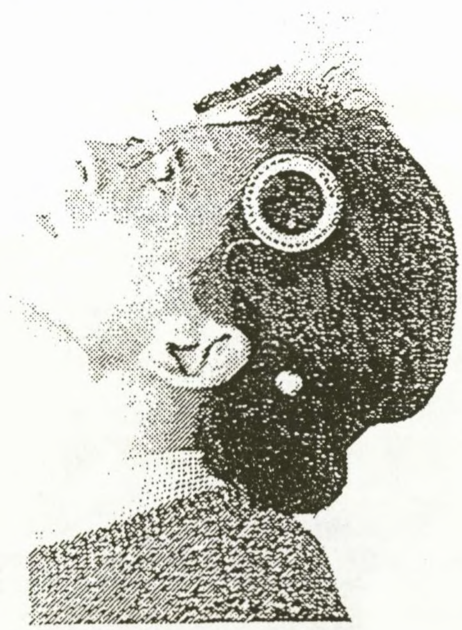


Figure 7: Cervical extension

Lateral Flexion

Instruct the subject to sit erect in a straight-back chair with the sacrum against the back of the chair, the thoracic spine away from the back of the chair, arms hanging at sides and feet flat on the floor. Note: to eliminate rotation during lateral flexion the subject should focus on a point on a wall straight ahead. The sagittal plane meter will read zero if the subject is looking straight ahead. The lateral flexion meter will also read zero if the head is not laterally flexed. If the lateral flexion meter does not read zero, record the reading as lateral flexion at rest. You will not need the magnetic yoke, rotation arm, forward head arm nor vertebra locator for these measurements.

Instruct the subject to flex the head laterally to the left, keeping the shoulders level and without rotating the head (see figure 8). Monitor for shoulder elevation by lightly placing your hand on the right shoulder, and correct manually any head motion outside the coronal plane. Note and record the measurement from the lateral flexion meter.

Figure 8: Left lateral flexion

Now instruct the subject to flex the head laterally to the right, again keeping the shoulders level without rotating the head (see figure 9). As before, monitor for left shoulder elevation and correct head motion.

Figure 9: Right lateral flexion

Rotation

You will need to use the CROM instrument plus the magnetic yoke and rotation arm for these measurements. To obtain an accurate rotation measurement, first determine which direction is north.*

Next, place the magetic yoke on the subject's shoulders with the arrow pointing north (see figure 10). Instruct the subject to sit erect in a straight-back chair with the sacrum against the back of the chair, the thoracic spine away from the back of the chair, arms hanging at sides and feet flat on the floor. The lateral flexion and sagittal plane meters must read zero for the rotation meter to be level; if necessary, assist the subject into the correct position. As the subject faces straight ahead, grasp the rotation meter between your thumb and index finger and turn the meter until one of the pointers is at zero.

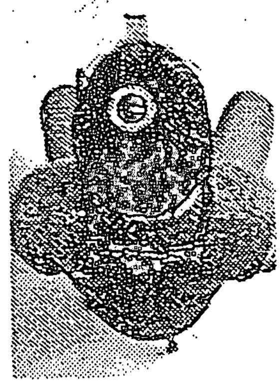


Figure 10: Magnetic yoke pointing north

Instruct the subject to focus on a horizontal line on the wall so the head is not tipped during rotation. Have the subject turn the head as far to the left as possible (see figure 11), and to ensure that no shoulder rotation occurs, lightly stabilize the right shoulder with your hand. (Note: if the head and shoulders are rotated together the pointer will not move because the magnetic yoke positioned on the shoulders eliminates shoulder substitution.) Record this measurement in the appropriate place on the recording sheet.

Figure 11: Left rotation

While you lightly stabilize the left shoulder, instruct the subject to turn the head as far as possible to the right (see figure 12). Record this measurement also.

Figure 12: Right rotation

*You can find magnetic (map) north by noting the direction of the red needle on the rotation meter when it is at least four feet from the magnetic yoke.

Forward Head

Instruct the subject to sit erect in a straight-back chair with the sacrum against the back of the chair, the thoracic spine away from the back of the chair, arms hanging at side and feet flat on the floor. You will need to use the CROM instrument plus the forward head arm and the vertebra locator for this measurement, but not the magnetic yoke nor the rotation arm.

Attach the forward head arm on the CROM in place of the rotation arm (see figure 13). Stand to the subject's left side so you can read the sagittal plane meter. To assure that the forward head arm is horizontal, assist the subject to position the head with the sagittal plane meter reading zero. While the subject maintains this position, locate the seventh cervical vertebra and place the foot (bottom tip) of the vertebra locator on the spinous process. Position the locator so the bubble is centered within the vertical lines on the vial. The forward head arm is calibrated in centimeters for the horizontal distance from the nose bridge to the locator contact point with the seventh vertebra.

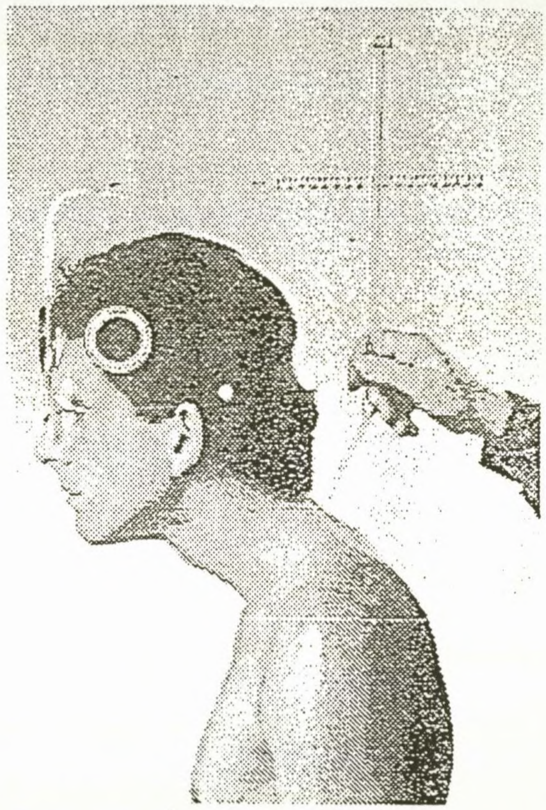


Figure 13: CROM with forward head arm and vertebra locator

Now, instruct the subject to slide the head as far back as possible, while keeping the chin level. Note the measurement at the junction of the forward head arm and the vertebra locator and record it as retraction.

Next, instruct the subject to relax and record this measurement as the resting posture.

Then, instruct the subject to protract or protrude the head forward as much as possible, while keeping the chin level. Record this measurement as protraction.

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