THE PREVALENCE OF CERVICAL SPINE DYSFUNCTION IN TENSION-TYPE HEADACHE SUBJECTS COMPARED TO NONHEADACHE SUBJECTS.

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I declare that this dissertation represents my own work

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DEDICATION

I would like to dedicate this work to my parents, Carol and Peter.

Thank you for all your continued love and support.

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ABSTRACT

The aim of this investigation was to establish the prevalence of cervical spine dysfunction in tension-type headache subjects, as opposed to nonheadache subjects, in terms of specific objective clinical criteria.

The researcher postulated that in order to alleviate a tension-type headache, adequate attention should be given to the treatment of any cervical spine dysfunction(s). Consequently it was hypothesised that there would, firstly, be a difference in the prevalence of cervical spine dysfunction in tension-type headache as opposed to nonheadache subjects, in terms of objective clinical findings, and secondly, a difference in the objective findings on analysis of the intra-group data after treatment, would confirm that these components of cervical spine dysfunction, in tension-type headache patients, could be corrected using manipulation.

Fourty subjects were diagnosed as having tension-type headaches and fourty nonheadache subjects were assessed to see if they fell into the nonheadache group. From the headache group, twenty subjects were randomly recruited to a treatment group. The subjects ages were selected from the general population and were aged between 18 and 44. The treatment group received chiropractic adjustment(s) after light soft tissue therapy for 6 treatments over a period of 3 weeks.

The research project was carried out where measurements of the cervical spine function included using the CROM goniometer, the algometer, motion palpation, dynamic flexion/extension intersegmental x-ray analysis and cervical spine sagital curve alignment assessment. These were performed at the initial consultation and after the sixth treatment for the treatment group. Following this, the data was then analysed statistically using a 95% confidence level. Intra-group comparisons were done using the Wilcoxon's signed rank test. Inter-group comparisons were done using the Two-sample unpaired t-test.

Inter-group comparisons indicated that the headache group had a statistically significant ($p<0.05$) higher prevalence of cervical spine dysfunction as opposed to the nonheadache group. The findings included hypomobile motion palpation findings (in 97.5% of headache subjects as opposed to 60% of the nonheadache), confirmed by decreased active inter-segmental motion x-ray findings (especially at the C1-C2 and C2-C3 levels), statistically significant loss of normal cervical spine lordosis and a high prevalence of tender points (especially in the mid- and upper cervical region). Comparison of the cervical range of motion measurements presented no statistically significant difference, except for extension and left lateral flexion.

Intra-group results of the treatment group indicated that the treatment group had a statistically significant improvement in terms of motion palpation findings, tender point findings, CROM, radiographic findings of intersegmental mobility and measurements of the lordotic angle.

From these results, it would seem that the role of the cervical spine in tension-type headache needs more careful consideration, with regard to assessment and management.

It is suggested that further studies with a larger sample size are needed to clearly establish the prevalence of cervical spine dysfunction in tension-type headache subjects.

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DEFINITION OF TERMS

Fixation

The state whereby articulation has become temporarily immobilized in a position that it may normally occupy during any phase of physiological movement

(Haldeman 1992: 623.)

Manipulation

A passive therapeutic maneuver in which specifically directed manual forces are applied to vertebral and extra-vertebral articulations of the body, with the object of restoring mobility to restricted areas

(Gatterman 1990: 410.)

Motion Palpation

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

(Alley 1983.)

Vertebral Subluxation

A motion segment in which alignment, movement integrity, and/or physiologic function are altered although contact between the joint surfaces remains intact

(Gatterman 1995.)

Objective Clinical Findings

Refers to procedures utilised by the practitioner that objectively assess the patient's condition

(Own definition.)

Cervical Spine

The cervical spine consists of all the vertebrae making up the bony skeleton from the occiput to the seventh cervical vertebrae including the intervertebral discs, nerve roots and accompanying soft tissue

(Own definition)

Cervical spine dysfunction

Impaired or altered function of related components of the cervical spine, including skeletal, arthrodial and myofascial structures, resulting in the following aspects of cervicogenic dysfunction:

1. Inter-segmental Hypomobility
2. Tender points in the soft tissue
3. Reduced regional ranges of motion
4. Radiographic findings of:
    a) Static misalignment
    b) Dynamic intersegmental abnormality

(Vernon and Steiman 1992.)

CHAPTER 1

1.0 INTRODUCTION

Tension-type headache is a highly prevalent condition (Schwartz et al. 1998). In a population-based study of 13,343 subjects, from the Baltimore Community and using the International Headache Society diagnostic criteria, it was revealed that the prevalence of episodic tension-type headache was 38.3% (5108 subjects) and 2.2% (297 subjects) for chronic tension-type headache (Schwartz et al. 1998). Tension-type headache consistently shows female predominance (Abramson et al. 1980; Schwartz et al. 1998). In a community survey in Jerusalem, the prevalence of tension-type headache was 21% in males and 30% in females (Abramson et al. 1980), while Schwartz et al. (1998) found a male:female prevalence ratio of 1:1,16.

Schwartz et al. (1998), interviewed 5405 tension-headache subjects about their headaches and found that 9922 annual estimated actual workdays were lost because of headache. Of these days lost, 43% were due to tension-type headache. Schwartz et al. (1998) also noted that there were 23287 reduced effective labour workdays (annually) because of headache and that 64% of these were due to tension-type headache.

According to the International Headache Society criteria (Headache Classification Committee 1988), the intensity of pain in tension-type headache is typically mild to moderate. In a study by Rasmussen et al. (1992) of 488 subjects diagnosed with tension-type headache, from a random sample of 1000 subjects, it was found that the pain, in 99% of the cases, was described as mild to moderate.

Rasmussen et al. (1992) also noted that the subjects who had an increased frequency of tension-type headache, complained of headaches being more severe. He found that 76% of 488 subjects, with tension-type headache of more than 30 days per year, reported moderate or severe intensity compared to 50% of those with less frequent headaches.

Patients with tension-type headaches may also complain of other symptoms. In a series of 402 patients with tension-type headache, associated symptoms included tiredness (81%), poor sleep (53%) and light headedness (51%) (Chun 1985.)

Various theories on the aetiology of tension-type headache have been proposed: Psychogenic factors (Murphy and Lehrer 1990), vascular factors (Langemark et al. 1989), neurological factors (Vernon and Steiman 1992) and humoral factors (Jensen and Hindberg 1994). Lichstein et al. (1991) hypothesized that the contraction of the frontalis muscles may be responsible for tension-type headache. Riley (1983) reported that postural abnormalities, such as flexed posture, causing increase in the occipitalis muscle tension, are responsible tension-type headache. Nagasawa et al. (1993) carried out a roentgenographic study on 372 patients with tension-type headache and 225 normal control subjects. He found that a great majority of the patients were found to have a straightened cervical spine. This condition may exert a slight anteflexion of the cervical spine which may cause a passive loading of the occipital muscles. This passive loading may play a pathophysiologic role in predisposing a patient to tension-type headache.

Edmeads (1988) conducted a detailed review of the literature concerning the relationship between headaches and structural disorders of the cervical spine. He did, however, conclude that the relationship between tension-type headache and cervical spine dysfunction remains unclear.

Vernon and Steiman (1992), found a high prevalence of cervical spine dysfunction in tension-type and migraine headache sufferers.

A case-control study still needs to be conducted to compare the prevalence of cervical spine dysfunction in tension-type headache as opposed to non-headache subjects.

The International Headache Classification Committee has subdivided tension-type headache into a category with and a category without disorder of pericranial muscles (Headache Classification Committee 1990). No mention is made here to cervical spine dysfunction(s).

Based on a review article by Vernon (1991) of all studies of manipulation for the treatment of headache, he concluded that there is appropriate evidence that supports the use of manipulation as a valid treatment for headache.

Boline et al. (1995) compared, in a randomized comparative trial of 150 tension-type headache subjects (no placebo or control group), a headache drug, amitriptyline, to spinal manipulation and found the latter to have a more sustained therapeutic benefit, that was statistically significant, as well as, less side effects. Although poorly understood, this possibly questions the fact that the benefit obtained by chiropractic manipulation may have been more durable and may have corrected some of the underlying causative (but still poorly understood) mechanisms for the kind of headaches suffered by these subjects.

It is with this in mind that this study will attempt to:

i) determine the prevalence of cervical spine dysfunction in tension-type headache as opposed to non-headache subjects;

ii) provide a possible rationale for chiropractic management of tension-type headache;

iii) identify clinical examination findings of the cervical spine which may relate to tension-type headache.

CHAPTER 2

2.0 REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

Tension-type headache is considered to be common (Schwartz et al. 1998) and has been shown to cause the patient mild to moderate pain (Rasmussen et al. 1992), with resulting incapacity (Schwartz et al. 1998). This literature review presents an outline of the known aetiologies, pathophysiology and clinical characteristics of tension-type headache, in order to understand tension-type headache and determine if there is a relationship with the cervical spine.

A review of current research on pain mechanisms in tension-type headache is also presented, together with literature on findings of cervicogenic dysfunction in tension-type headache. Finally, an overview of the results of clinical studies of spinal manipulation for tension-type headache is included.

Continued critical review of the literature will also expose what is not known and still needs investigation, with regard to cervical spine dysfunction in tension-type headache. Thus providing rationale for this study.

2.1.1 Classification of tension-type headache

The Headache Classification Committee of the International Headache Society, has divided the classification of tension-type headache into episodic and chronic tension-type headache (Headache Classification Committee 1988.)

The symptomatology of episodic and chronic tension-type headache is largely the same, although the general clinical picture does vary (Olesen 1988: 437.)

Part of the diagnostic criteria used to separate the two types of tension-type headache include frequency and duration. In addition, the International Headache Society has allocated a category of tension-type headache with and a category without pericranial muscle disorders (Olesen 1988: 437.)

The two types are more clearly outlined as:

1. Episodic tension-type headache requires a minimum of 15 previous episodes with less than 15 days per month frequency (less than 180 days per year), and may last from 30 minutes to seven days. It may or may not be associated with disorders of the pericranial muscles as determined by manual palpation, pressure algometer and electromyographic recordings(Olesen 1988: 437.)

2. Chronic tension-type headache has an attack frequency of 15 or more attacks per month over a period of at least six months and, as with episodic tension-type, headache may or may not be associated with pericranial muscle disorders (Olesen 1988: 437.)

2.1.2 PREVALENCE:

Tension-type headache has been found to be the most common headache treated by health practitioners, making up approximately 80% of all headache complaints (Dalessio 1987: 172.)

The prevalence of tension-type headache in a given population seems to remain unclear. For instance, in surveys of the general population in the United States and Western Europe, a considerable variation in the prevalence of tension-type headache has been reported ranging from ~30% to ~80%. Differences in definitions and methodology may be largely responsible for this variation (Rasmussen 1991.)

In a random sample of 13343 people interviewed during a one-year study in order to assess the impact of headaches on work time and work effectiveness, tension-types headache emerged as the major culprit (Schwartz et al. 1998). It was revealed that the prevalence of episodic tension-type headache was 38.3% (5108 subjects) and 2.2% (297 subjects) for chronic tension-type headache (Schwartz et al. 1998).

A recent one year prevalence study by Ulrich et al. (1996) of 4000 people from a general Dutch population, showed that tension-type headache made up 76% of headache sufferers.

2.1.3 SEX DISTRIBUTION:

The sex distribution of episodic tension-type headache is controversial. Some studies show female predominance and others equal occurrence in the two sexes (Abramson et al. 1980; Nikiforow 1981). Chronic tension-type headache, however, consistently shows a female predominance (Abramson et al. 1980). Lance (1982: 102) states that approximately 75% of chronic tension-type headache patients are females.

Ulrich et al. (1996) found the male/female ratio to be 1:1,23 in tension-type headache. A correlation with frequency of headache was not made in this study. A recent epidemiological study by Schartz et al.(1998) found the male/female ratio to be 1:1,16.

2.1.4 AGE:

The prevalence of chronic tension-type headache seems to increase with age, whereas episodic tension-type headache decreases with increasing age (Abramson et al. 1980). Thus, the mean age for subjects with chronic tension-type headache is higher than for subjects with episodic tension-type headache.

Schwartz et al. (1998) found that the prevalence of episodic tension-type headache peaked in the 30 to 39-year-old age group in both males (42.3%) and females (46.9%).

Dalessio (1987: 172) has suggested that tension-type headache is more commonly found in adults, which is about the time that individuals experience a stress increase in life.

2.1.5 CLINICAL SIGNS AND SYMPTOMS:

According to the International Headache Society (Headache Classification Committee 1988), the clinical features of tension-type headache are defined as follows:

A. At least 10 previous headache episodes fulfilling criteria B-D listed below.

B. Headache lasting from 30 minutes to seven days

C. At least two of the following characteristics:

1. Pressing/tightening (non-pulsatile) quality
2. Mild or moderate intensity (may inhibit, but does not prohibit activities)
3. Bilateral location
4. No aggravation by walking stairs or similar routine physical activity

D. Both of the following:

1. No nausea or vomiting (anorexia may occur)

2. Photophobia and phonophobia are absent, or one but not the other is present.

Kunkel (1991) states that the headache may be unilateral and can be localised to specific areas such as the occipital and frontal area. Spira (1992), states that tension-type headache diagnosis should present no difficulty to the clinician if the diagnostic criteria are strictly adhered to.

The features of a tension-type headache, according to Spira (1992), are:

1. Symmetry.
2. Bifrontal, bioccipital and nuchal distribution.
3. Mild to moderate severity.
4. Stable intensity profile.
5. Accentuated as the day progresses
6. Frequency is often high and, at times, daily.
7. Absence of migrainous features, such as lateralization, photophobia, nausea, vomiting or debilitating severity.

According to Diamond and Dalessio (1992: 124), 77% of patients with tension-type headache have a family history of headache.

2.1.6 Pathomechanics of tension-type headache

Various theories on the aetiology of tension-type headache have been proposed (Laroix and Corbett 1990). These theories will be briefly discussed below, together with their relevant proposed mechanisms. This will serve as an outline to the current knowledge. An in-depth discussion will be entered into, regarding cervical spine dysfunction as this involves the main scope of this paper.

2.1.6.1 VASCULAR FACTORS:

Neck muscle contraction which is often associated with tension-type headache may lead to intramuscular arterial constriction, resulting in muscle ischaemia, contraction and pain (Raskin, 1988: 217.)

As evidence of vasomotor instability, Drummond and Lance (1981) found the temporal artery pulse amplitudes to be statistically significantly lower in 27 patients with tension-type headache than in 19 control subjects. In a study by Langemark et al. (1989) on temporal blood muscle flow in chronic tension-type headache, it was hypothesized that this type of headache was of ischaemic origin, based on early reports of alleviation by vasodilators and lack of effect or worsening by vasoconstrictors.

The finding by Wallasch (1992) that there is no change, as measured by the Transcranial Doppler Technique, in flow rate of the basal cerebral arterial blood in patients with chronic tension-type headache compared to healthy controls, is in contrast with his earlier finding (Wallasch 1992) of reduced flow rates in patients with episodic tension-type headache.

Headache is a common complaint in patients with vertebrobasilar insufficiency (Grindal and Toole 1975.)

Vascular headaches of vertebrogenic origin can occur through several mechanisms:

Osteophytes on the facet joints and uncovertebral joints can encroach upon the vertebral artery, vertebral nerve and sympathetic plexus. Joint fixation or hypermobility can lead to irritation of both the sympathetic plexus and superior ganglion (Zagami 1994.) Vernon (1988) postulates that disturbed somatoautonomic reflexes can be responsible for disordered cerebrovascular tone. In contrast, he found no positive findings of vertebrobasilar insufficiency in his study on the prevalence of cervical spine dysfunction in tension-type and migraine headache subjects (Vernon and Steiman 1992.)

To conclude, the role of reduced cervical musculature blood flow in the developement of tension-type headache seems to be worthy of consideration when one considers the resultant muscle ischaemia, contraction and pain (Raskin 1988:217). Conflicting findings of reduced blood flow in episodic tension-type headache patients, while chronic tension-type headache patients have normal levels (Wallasch 1992), suggest that the ischaemic effect may only be of temporary consequence. The role of vertebrobasilar insufficiency, due to cervical spine dysfunction, resulting in tension-type headache, although physiologically possible (Vernon 1988), has not been found to have a high prevalence in tension-type headache patients (Vernon and Steiman 1992).

2.1.6.2 MUSCULAR FACTORS:

The mechanism of this type of headache was believed to be similar to that of chronic muscle contraction in any other part of the body as a result of muscle spasm linked to the central nervous system involving neural pathways and reflex arcs. (Diamond and Dalessio, 1992: 124)

Melzack and Wall (1984: 154) explain that the mechanism involves the following:

a) A polysynaptic reflex of withdrawal usually initiates muscle spasm. Any local pathology (e.g. trauma) will stimulate nerve fibers and the impulse is then transmitted directly to the spinal cord and then to the ventral routes. From here the stimulus is said to pass via efferent nerves to the neuromuscular junction. This results in acute contraction of the muscles and movement from the painful stimulus occurs.

b) Polysynaptic pathways and the lemniscal system are also stimulated. The initial stimulus is conducted via these paths, up the spinal cord to thalamic and central levels. Here the stimulus is interpreted as painful.

c) The brain sends impulses via the reticulospinal system to activate the gamma efferent neurons which contract the muscle spindle.

d) This contracting muscle spindle evokes a monosynaptic stimulus which travels directly to the ventral horn and causes a discharge in the efferent peripheral nerve as well as muscle contraction. This last reflex arc (muscle spindle contraction) is a monosynaptic pathway and subsequently related to the tendon stretch reflex. Ordinarily the contracting muscle inhibits firing of the muscle spindle which terminates this stretch reflex, allowing the muscle to relax. The state of activity of the gamma motor system determines the degree of muscle tone.

If the gamma efferent system continues to fire (due to cortical influence or pathology) the spindle remains taut and the muscle contracts continuously until the contraction itself becomes painful. This results in more spasm and pain, anxiety and a pain cycle is set up.

The theory that head and neck muscular contraction may play a pathogenetic role in some patients with tension-type headache is reflected in the new classification of the International Headache Society (Headache Classification Committee of the International Headache Society 1991) by the proposal of two sub-types of tension-type headache, one which is "associated with disorder of pericranial muscles" and the other sub-type which is "unassociated with disorder of pericranial muscles".

Recordings of pericranial muscular activity in tension-type headache have indicated varied results. An early study done by Langemark and Oleson (1987) on 53 tension-type headache subjects, showed significant muscular tenderness in association with tension-type headache, as opposed to the 42 control subjects. Lichstein et al. (1991) found increased frontal electromyographic activity during the headache state in subjects with migraine and tension-type headache compared to headache-free controls and to the headache-free period, but these differences did not reach statistical significance.

Tenderness and pain thresholds in pericranial muscles were studied in a random sample of 735 adults to evaluate the possible role of pericranial myofascial nociception in headache pathogenesis. Subjects with episodic tension-type headache and females with chronic tension-type headache were more tender than the rest of the population, and males without any experience of headache were less tender than the rest of the male headache population. Statistically speaking, a strong positive correlation was found between tenderness and increased frequency of tension-type headache (males: $P<.0001$; females: $P<.00001$). This study supports the pathogenic importance of muscular factors in tension-type headache. (Jensen et al. 1993)

Kunkel (1991) makes note of the probability that the muscle spasm is as a result of the headache rather than the cause. Edeling (1988: 18) explains that the state of sustained muscle contraction could be induced by a state of anxiety or chronic depression but could also represent a disorder in which these muscles are thrown into a state of sustained spasm to splint a painful condition of the underlying cervical joints.

Other authors feel that this issue cannot be resolved without further investigation (Kidd and Nelson 1993), and that the aetiology of tension-type headache is multifactoral (Lacroix and Corbett 1990).

2.1.6.3 PSYCHOLOGICAL FACTORS:

Lance et al. (1983: 12) maintains that a third of tension-type headache patients have an aspect of depression involved in the cause of their tension-type headache. More recent studies by Murphy and Lehrer (1990) indicate that shoulder and neck tension, as well as emotional provocation, will contribute to tension-type headache. In contrast, Merikangas et al. (1994), investigating the association between psychopathology and headache in a prospective longitudinal epidemiologic study, found that subjects with tension-type headache did not differ from controls in rates of psychopathology or personality abnormalities.

Raskin (1988: 56) reports that anxiety expressed in a physical form results in tension-type headache. He states various studies in which this psychological cause has been a factor in precipitating the tension-type headaches. He concluded that the most common psychological problems in patients with tension-type headache were dependence, sexuality and control of urges. He points out that these studies were done on patients who had long-standing headaches, and that these psychological findings could be a result of living with chronic pain. Personality studies on tension-type headache sufferers have reported hypochondriasis, depression and hysteria as a common trait (Raskin 1988: 56.)

Therefore, the question of whether tension-type headaches cause, or are caused by psychological problems remains unanswered.

Dalessio (1987: 177) notes that approximately 84% of depressed patients evaluated mentioned headache as the only complaint or combined with other clinical features. It is believed that the aetiology of depression is possibly associated with lack of brain monoamine neurotransmitters like serotonin and norepinephrine (Dalessio 1987: 178). Jensen and Hindberg (1994) found a significant ($P<0.02$) decrease in plasma serotonin concentration during episodes of tension-type headache. However, in a later controlled study (Brendtsen et al. 1997), investigating the peripheral serotonin metabolism in 40 patients with chronic tension-type headache, it was found that the peripheral serotonin metabolism was largely normal in the tension-type headache group, as opposed to the 40 control subjects.

To conclude, although it is difficult to ascertain whether psychological factors are a cause or a symptom of tension-type headache, they can be seen as an association. Therefore, by combining treatment of psychological problems with other treatments of for tension-type headache may facilitate the patient's recovery from tension-type headache.

2.1.6.4 FACTORS OF CERVICAL SPINE DYSFUNCTION

The role of the cervical spine in producing headache is controversial. While most authors agree that headache may originate in the structures of the neck, there is dispute over how frequently this occurs. There is also no consensus about how disorders of the cervical spine and related structures can cause headaches, what diseases of the cervical spine produce headaches and how these headaches may be identified (Vernon 1995: 307.)

Edmeads (1988) lists the following three conditions that must be present for the referral of head pain from the neck:

1. There should be pain-sensitive structures within the neck, these include:

    i. parts of the vertebral column proper, including:
    - the apophyseal joints
    - the synovial joints of the occipitoatlanto and atlanto-axial junctions
    - the annulus fibrosis of the intervertebral discs
    - the ligaments of the spinal column
    - the periosteum of the vertebral bodies;

    ii. the cervical muscles and their attachment to bone;

iii. the cervical nerve routes;

iv. the vertebral arteries

(Edmeads 1988)

2. There should be recognisable neurological pathways and mechanisms through which pain can be conveyed from cervical segments to the head:

i. To the back of the head by compression, irritation or inflammation of C2 sensory root.

ii. Orbitofrontal-frontal-vertex pain through the C1 sensory root.

iii. Pain referral to the V1 dermatome via tentorial nerves which, when stimulated, activate the trigeminal nerve.

iv. Stimulation of the upper cervical nerve roots (C2-C4) will effect the trigeminal nerve and thus effect the V1 (opthalmic division of trigeminal) dermatome.

v. Scalp musculature can be effected due to myofascial and aponeurotic connections.

(Edmeads 1988)

3. There should be identifiable pathological processes or physiologic dysfunctions within the neck capable of serving as an adequate stimulus to the pain receptors in the cervical structures:

i. Clearly, there are many disease processes capable of simulating these pain-sensitive structures:

-The apophyseal and other synovial joints may be inflamed or subluxed when involved by arthritic processes, trauma or by infection. Nerve endings in the annulus fibrosis may be stimulated by disc herniation. Spinal ligaments may be stretched or torn by trauma, or inflamed and attenuated by rheumatoid arthritis. The periosteum may be involved by infection, trauma or tumour.

-The cervical muscles may be strained, torn or inflamed through trauma, or may be in a painful spasm as a reflex attempt to splint an underlying lesion of the vertebral column.

-The cervical nerve roots and nerves may be injured by trauma, compressed by neural structures such as with posterior fossa tumours, or inflamed by infectious processes such as herpes zoster.

-The vertebral arteries may produce occipital pain when affected by spontaneous dissection or by atherothrombotic occlusion.

(Edmeads 1988)

ii. Much less clear is the role of dysfunction of the cervical structures in producing headache:

Evidence for the spinal subluxation phenomenon in groups of headache sufferers was explored by Vernon and Steiman (1992) in a descriptive study on cervicogenic dysfunction in 19 tension-type headache and 28 migraine headache patients. A high prevalence of cervical dysfunction was found in both groups. Although not a controlled study, these results give a good indication of cervical dysfunction in sufferers of tension-type headache. Further investigation involving controlled trials needs to be done in order to conclusively demonstrate cervical dysfunction in tension-type headache sufferers.

In the 1992 report, by Vernon and Steiman, the following components of cervicogenic dysfunction were outlined:

1. Inter-segmental Hypomobility
2. Tender points in the soft tissues
3. Reduced regional ranges of cervical motion
4. Radiographic findings of:
    a. Static misalignment
    b. Dynamic inter-segmental abnormality

Others that can be included are:

5. Static malposition of the head and neck (specifically, anterior carriage and low round shoulders

(Vernon and Steiman 1992)

The recent literature supportive of each of these components is now reviewed.

Hypomobility

A common clinical phenomenon is the hypomobility lesion, so-called because it often presents as a restriction in movement in a spinal joint. Such restrictions of movement frequently accompany spinal pain, and imply the presence of a lesion that produces both the pain and the restriction in movement (Bogduk and Marsland 1985.)

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

A characteristic of a joint hypomobility lesion (or fixation) is the loss of joint play and pain in testing the joint (Dishman 1988.)

Static and dynamic palpation is the chiropractors' most essential tool in the diagnosis of dysfunction. Dynamic motion palpation is becoming more widespread throughout the field of chiropractic (Dishman 1988.)

A randomized control study was done by Jull et al. (1988), to show the accuracy of manual diagnosis for cervical zygopophyseal joint pain syndromes (facet syndrome). The study consisted of 20 subjects. The detection of present or absent symptomatic joints was established by means of radiologically-controlled diagnostic blocks. Eleven subjects were assessed by the manipulative therapist, who had no knowledge of the medical diagnosis. The other nine subjects were first assessed by the manipulative therapist and then by means of the diagnostic block. Results show that the manipulative therapist correctly identified all the 15 patients that had symptomatic zygapophyseal joints, and correctly specified the segmental level of the symptomatic joint. Thus manual diagnosis done by a trained manipulative therapist may be seen as reasonably effective means of diagnosising cervical zygapophyseal syndromes and is less expensive than radiologically-controlled diagnostic blocks. However, according to Dishman (1988). inter-examiner reliability of motion palpation is directly related to his or her training or psychomotor skills.

In Vernon and Steiman's report (1992) on cervical spine dysfunction in migraine and tension-type headache subjects, there were no tension-type headache subjects who had no fixations at any of the upper cervical segments, whereas 16% had a fixation at only one level, 54% had fixations at two levels and 30% at all three levels. It must be noted, however, that this was not a controlled study.

Trigger-points

Lesions involving the neck muscles at their attachment to the occiput have frequently been cited as a cause of headache (Vernon 1995: 313.) These lesions, which appear as areas of tenderness, are referred to as trigger points. They can occur in any muscle, including those innervated by the upper three cervical nerves, which include the sternocleidomastoid and trapezius as well as the intrinsic neck muscles attached to the occiput (Bogduk and Marsland 1985). Muscle pathology, such as strain, sprain, or trigger point formation, also produces local muscle spasm that produces secondary loss of movement in cervical spine joints (Mennell 1990).

Active trigger-points are those that cause the patient local and referred pain, whereas latent trigger-points are those that exhibit few clinical signs and symptoms except for weakness and restriction of muscular movement (Travell and Simons 1983: 12). Travell and Simons (1983: 12) also noted that active trigger-points are more likely to be encountered in muscles involving posture, including the neck muscles. Many occupations require incorrect neck posture, e.g. static muscle load and awkward working environment, all of which result in disturbances in the joints and the musculature, (Gatterman 1990: 253). The upper trapezius, posterior cervical and sternocleidomastoid frequently exhibit myofascial tendencies causing headache (Travell and Simon 1983: 166).

Reduced Range of Motion

A finding associated with muscle tenderness is increased muscle stiffness (Vernon 1995: 314.)

Voluntary movement depends on the integrity of joint play specific for each plane of voluntary movement. Muscles that move the joint with joint dysfunction become hypertonic due to irritation and pain, therefore active range of motion is restricted (Dishman 1988.)

The development of regional muscle stiffness and reduced cervical spine range of motion was reported on by Kidd and Nelson (1993). They found in their controlled, blinded study, that when using a simple observer's evaluation of neck range of motion in 74 subjects, 37 with and 37 without headache, the headache sufferers had a statistically significant reduction of two or more ranges of motion.

Cervical Lordosis

Vernon and Steiman (1992) found that 77% of the 19 tension-type headache subjects had a substantial alteration of the sagital curve, on the lateral x-ray, consisting of near-total or total reduction, or, in fact, reversal of the normal lordotic configuration. A minor reduction in the sagital lordosis was recorded for 11.5%. This was, however, not a control study.

Nagasawa et al. (1993) compared 373 tension-type headache subjects with 225 normal controls. They found a statistically significant (P<.001) reduction of the neutral curve for the headache group. They hypothesized that the flexor muscles of the head and neck prevent physiological lordosis of the spine, and their sustained contraction may be a principal cause of a straightened neck. Neck flexors may exert a slight anteflexion of the cervical spine causing passive loading of the suboccipital muscle. If the mechanism of tension-type headache is taken to be the result of muscle spasm linked to the central nervous system involving neural pathways and reflex arcs (Diamond and Dalessio, 1992:124), this passive loading may predispose the subject to tension-type headaches (Nagasawa et al. 1993.)

Watson and Trott (1991) studied the degree of anterior head carriage, which they measured photographically, in 60 subjects, 30 with recurrent cervical headache (a combination of tension-type headache, migraine headache and "cervicogenic" headache) and 30 controls and found a statistically significant reduced mean angle of forward head position (that is, a straightened cervical spine) in headache sufferers.

Dynamic inter-segmental abnormality

Pfaffenrath et al. (1988), using a computer-aided method of analysing segmental cervical motion on flexion-extension radiographs, found a statistically higher incidence of restriction at C0-C1 in 15 cervicogenic headache patients as compared with 18 normal controls.

In Vernon and Steiman's (1992) report on tension-type headache and migraine subjects, segmental movement was rated against the normative data from Dvorak et al. (1988).

A total of 97% of all tension-type headache subjects exhibited on dynamic x-ray studies, at least one significant abnormality of segmental mobility from C0 to C7, while 43% exhibited abnormalities at four or more segments. There was segmental hypomobility at C0-C1 for 90% of the subjects in flexion and 70% of subjects in extension. C1-C2 tended towards a pattern of hypermobility, while C4-5-6 showed hypomobility.

Static malposition of head and neck

Nagasawa et al. (1993) investigated the prevalence of rounded shoulders in 372 tension-type headache patients, as opposed to 225 normal control subjects. "Rounded shoulders" referred to cases where the first thoracic vertebra and upper third or more of the second thoracic vertebra were clearly visualized on the lateral x-ray view. They found a statistically significantly higher frequency of rounded shoulders in tension-type patients (57.5%) versus controls (41.8%). Watson and Trott (1991) found a smaller mean angle of forward head position in headache sufferers, possibly indicating that they had straightened cervical spines.

All these findings taken together create a composite of cervical spine dysfunction, which have also been observed in, according to Sjaastad et al. (1983), "noncervicogenic headache" (e.g., tension-type headache and migraine) (Vernon 1995: 316.)

2.1.7 Pathomechanics of pain in tension-type headache

Vernon, in 1988 first outlined a vertebrogenic model for headache. This model, in brief, concerns the role that vertebrogenic dysfunction could play in the triggering and pathogenesis of tension-type headache. Vertebral dysfunction meant cervical fixations, especially C1, C2 and C3. A fixation is defined as: The state whereby an articulation has become temporarily immobilized in a position that it may normally occupy during any phase of physiological movement (Haldeman 1992 : 623.)

Vernon's (1988) anatomical basis of headache contains four categories:

a)Extra-segmental - the ligamentum nuchae and the long myofascial structures within the cervical region, i.e.

- Trapezius.
- Sternocleidomastoid.
- Levator Scapular.
- Splenius.
- Occipitofrontalis.
- Semispenalis capitus.

b) Inter-segmental - encompasses the joints, i.e.

- Intervertebraljoints
- apophyseal joints,
- uncovertebral joints,
- deeper, short, segmental muscles.

c) Infra-segmental - described by Vernon (1988: 175) as a concentrated disturbance of nerve roots, dorsal ganglia and sympathetic nerve fibres in and around the vertebral foramina.

d) Intra-segmental - is primarily concerned with the influence that sensory input has on the transmission of pain in the central nervous system.

Vernon (1995: 308), revises this model to that of cervicogenic headache. Cervicogenic headache means its origin lies within the cervical spine. Vernon, by association, includes tension-type headaches in the term cervicogenic headache.

Vernon (1995: 308), proposes in the mechanism of tension-type headache of cervical origin, that the trigeminal-cervical-nucleus plays an important role.

The trigemino-cervical nucleus is an amalgamation of the caudal end of the trigeminal nucleus and the rostral ends of the dorsal horns of the three upper cervical spinal nerves. These two structures are anatomically, histologically and functionally the same. Thus, the central nervous system has no way of differentiating whether the source of pain is from the cervical spinal nerves or from the trigeminal system (Nilsson 1994.)

The trigeminal nerve is the largest of the cranial nerves. It is the principle general sensory nerve to the head, more specifically the face and also the motor nerve to the muscles of mastication. (Moore 1992: 822.) It consists of three branches, the ophthalmic, maxillary and the mandibular. All three of the branches extend as far as the upper third of the cervical segment and the ophthalmic branch extends as far as the fourth cervical segment (Theisler 1990: 54.)

Vernon (1995: 309), explains that the trigemino-cervical nucleus by virtue of its intimate relationship with the trigeminal nerve and cervical afferent nerves, is sensitive to nociceptive inputs. These can strengthen or facilitate other normally quiescent sensory input that converges on this area causing excitation and hyperfacilitation to arise here.

This hyperfacilitation of the trigeminal-cervical nucleus may explain the formation of the headache and of deep tissue pain and hyperalgesia of the surrounding cutaneous areas. The hyperalgesia and deep tissue pain can be explained by the hypersensitivity of the dorsal horns of cervical nerves. This can also explain the poor localisation and the pain referral because of the general convergence sensory input into one area, that being the trigeminal-cervical nucleus. All these phenomena are important components of myofascial dysfunction and pain referral likely to be operative in tension-type headache (Vernon 1995: 309.)

The chiropractic subluxation is composed of five parts. They are:

1) neural; 2) kinesiopathological; 3) muscular; 4) cellular; and

5) biomechanical. (Dishman 1988)

Gatterman (1990: 252) discusses the arthrokinetic reflex which involves the intra-articular nociceptors: When intra-articular nociceptors are irritated by mechanical or chemical stimulus produced by joint pain, there begins an arthrogenic muscle spasm with referred pain due to the activation of convergent neurones. This arthrokinetic reflex may also be initiated by joint fixation and hypomobility.

The mechanism of pain, due to bony disrelationship (subluxation), is as follows:

1. A mild to moderate bony disrelationship will cause stretching of muscle tendons and ligaments which activate nervous stimuli in the dorsal roots of a specific spinal nerve (Faucret et al. 1980.)

2. The stimuli then travel via the posterior funiculus up the dorsal columns to the nucleus ventralis posterolateralis of the thalamus (crude awareness of pain) and the somesthetic cortex where the stimulus registers as pain (Tan and Wong 1990: 208.)

3. A subluxation also induces nervous stimuli, which, via the dorsal roots of the spinal nerves at the effected level, transmit impulses through the posterior horns via the association neurones and then upwards through the spinoreticular tracts to the reticular activating system (Faucret et al. 1980.)

4. At this point the impulse is able to affect several different structures e.g. any stimuli that proceeds to the limbic lobe may cause mental and behavioural changes leading to anxiety and headache (Faucret et al. 1980.)

5. Any conduction of impulses to the cerebral cortex will then run through the corticoreticular tracts down the medial and lateral reticulospinal tracts which synapse with the anterior horns and lower motor neurones to cause alteration of muscle tone leading to muscle spasticity and ultimately pain (Faurcet et al. 1980.)

2.1.8 Available treatments and their efficacy

Pharmacotherapy seems to be the main treatment for headaches. This is usually in the form of over-the-counter drugs. A total of 60% of headaches in the United Kingdom, and 91% in Australia, are treated with over-the-counter drugs (Fissihi and Osman 1992.)

Ehrmantraut (1980), describes the medical approach to tension-type headaches as the "analgesic and tranquilliser route". The analgesics raise the pain threshold, and the tranquillisers lower the muscle tension.

Raskin (1988) believes that it is important for the physician to inform the patient that an episodic tension-type headache, at this stage of medical advancement, cannot be permanently cured. He claims that only the frequency and severity of the headaches can be reduced. He feels that psychotherapy is to be considered if the emotional problem per se warrants that approach. The therapy would therefore consist of pharmacotherapy and relaxation techniques.

The injection of procaine into the contracted muscles in tension-type headache sometimes relieves a component of tension-type headache but rarely results in the total removal of head pain (Raskin 1988.)

Cerbo et al. (1991) found that the usage of amitriptyline, and antidepressants, on tension-type headache subjects was effective even though the patients had no anxiety or depression symptoms.

Other methods of therapy used for treating tension-type headache include homeopathy, acupuncture, naturopathy, diet therapy, reflexology and aromatherapy (Edeling 1988:37.)

2.1.9 Headache and spinal manipulation

A manipulation is defined (Leach 1986: 15), as "the forceful passive movement of a joint beyond its active limit of motion", but the term adjustment is considered unique as a term to describe chiropractic manipulation in that it entails use of short-lever, specific, high velocity, controlled forceful thrusts by hand aimed at individual articulations (Gatterman 1995: 12.)

Nilsson et al. (1997) investigated the effect of spinal manipulation in the treatment of cervicogenic headache, in a randomised, controlled, blinded study on 53 cervicogenic headache subjects. The use of analgesics decreased by 36 % in the manipulation group, but was unchanged in the soft tissue group. The number of headache hours per day decreased by 69% in the headache group, compared to 37% in the soft tissue group.

The vertebral zygapophyseal joints and facet syndrome has been described as a common source of spinal pain and dysfunction (Gatterman 1990:399). The application of spinal manipulation has been shown to be the treatment of choice for facet syndrome (Gatterman 1990: 399.)

Gatterman (1995: 106) refers to the following possible mechanical changes that can be noted as a result of manual therapy:

- Produce changes in alignment of the joints.
- Influence any motion dysfunction.
- Effect the dynamics of the spinal curvature.

Jamison (1991) points out that the correction of the subluxation is very beneficial in the treatment of tension-type headache. It is, however, difficult to assert the conclusion that relief of headache by manipulation proves the hypothesis that cervical spine dysfunction causes or is associated with tension-type headache, as there is a lack of controlled studies (Vernon 1995: 309.)

In 1995, Boline et al. reported on the progress of randomised comparative trial of chiropractic manipulation and the antidepressant drug amitryptiline in the treatment of tension-type headache. This trial included 150 subjects (87 woman, 63 men) with an average duration of six years. After the six - week treatment phase, subjects in both treatment groups demonstrated clinically and statistically significant reductions of headache activity. Vernon (1995: 316), proposes that manipulation of dysfunctional cervical joints will decrease the facilitation of afferent nerves to the trigemino-cervical nucleus. This is thought to be brought about via the following mechanism whereby manipulation of a joint causes the sudden stretching of structures in and around the joint (e.g. capsule and ligaments), resulting in rapid firing of joint mechanoreceptors which cause reflex relaxation of the surrounding muscle as well as a pain inhibition (Brodeur 1995). Neither group had statistically greater reductions than the other.

However, at the end of a further six-week no-treatment follow-up phase, subjects treated with chiropractic manipulation had significantly less headache activity than those receiving drug therapy, possibly indicating that the benefit obtained by chiropractic manipulation was more durable and may have influenced some of the structures which relate to the pain of Tension-type headache.

Schafer and Faye (1990: 40) have cited the following as indications for manipulation:

- Increasing spinal mobility.
- Freeing entrapped or stretched nerves.
- Returning intervertebral discs and intervertebral foramina to their normal boundaries.
- Extend shortened tendons and ligaments.
- Break adhesions.

2.2 CONCLUSION

The literature reflects that tension-type headache is the most common and, as far as socioeconomics is concerned, the most important type of headache (Schwartz et al. 1998.)

Even though it is experienced by many people, its aetiology is still contentious and may even be multifactorial (Lacroix and Corbett 1990). This ultimately has an effect on what treatments can be offered to patients. There appears to be a composite of cervical spine dysfunction which may play a role in the aetiology of, or is associated with tension-type headache (Vernon and Steiman 1992). This is in contrast to the perception that tension-type headache is not due to cervicogenic causes (Sjaastad et al. 1983 and Headache Classification Committee 1988). The high potential for upper cervical pain to occur creates sufficient opportunities for cranial pain referral (Vernon 1995:

316). Vernon (1995: 309) writes that uncontrolled studies with regard to chiropractic manipulation when taken together indicate (75% - 90%) of success with reduction of tension-type headache. This may indicate that chiropractic manipulation may have affected some of the underlying causative mechanisms, including the chiropractic subluxation (Boline and Nelson 1992.)

A comprehensive, controlled study, investigating cervical spine dysfunction in tension-type headache sufferers, will determine the validity of the model of vertebrogenic headache, as it relates to tension-type headache.

CHAPTER 3

3.1. INTRODUCTION

The following aspects of procedure were followed in the execution of this dissertation:

- measurements and observations,
- study design and protocol,
- and statistical analysis.

3.2. MEASUREMENTS AND OBSERVATIONS

3.2.1. The data

The data required in this study consists of two types: primary and secondary data.

3.2.1.1. The primary data

The primary data was obtained by way of:

a) A standardized case history, physical and cervical regional examination according to the Technikon Natal Chiropractic Day Clinic format (Appendix A,B and C)

b) Radiographic findings of: i) Static alignment

ii) Abnormal dynamic inter-segmental mobility

c) Range of motion with the cervical goniometer CROM.

d) Inter-segmental mobility by using motion palpation.

e) Pressure pain threshold by using an algometer.

3.2.1.2. The secondary data.

The secondary data, required to document and explain certain problems which occurred when correlating the primary data by means of statistical analysis, was obtained from books, journal articles and periodicals.

3.3 STUDY DESIGN AND PROTOCOL

3.3.1 Object of the study

The purpose of this study was to compare the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects, in terms of specific clinical criteria, in order to determine a possible basis for the chiropractic management of tension-type headaches.

3.3.2 The sample

The sample consisted of 80 subjects in total, aged between 18-40 with two categories:

1) Tension-type headache (Group A) and

2) Non-headache subjects (Group B).

Each group comprised 40 subjects who were recruited on a voluntary basis. Both groups were obtained by advertising in local newspapers and on the Natal Technikon campus notice boards.

3.3.3 Allocation of subjects

Subjects were allocated to group A and B, as they presented to the Technikon Natal Chiropractic Day Clinic, in a non-randomized manner. After signing an informed consent form (Appendix D), the subjects underwent an extensive standardized case history, physical examination and cervical spine regional orthopedic examination.

Group A was further randomly subdivided in two groups:

1) Treatment group (Group A1)

2) No treatment group (Group A2)

Each group (A1 and A2) comprised 20 subjects who were allocated by randomized consecutive sampling. A flip of a coin determined the allocation of the first subject to one group, while the next subject went to the other group. A coin was flipped for all the odd number of subjects as they presented in chronological order.

3.3.4 Inclusion and Exclusion Criteria of subjects

1. The tension-type headache group was diagnosed in accordance with the criteria of the Headache Classification committee of the International headache society (1988)(Appendix E).

2. The symptomatic subjects were assessed for any 'Danger Signs', indicative of life threatening pathologies (Turk and Melzack 1992: 345), such as suspected fractures, congenital malformations or tumors, as well as all patients with inflammatory diseases such as rheumatoid arthritis, osteoarthritis, and ankylosing spondylitis, and infectious systemic conditions such as influenza. These subjects were excluded from the study.

3. Each symptomatic subject was to have suffered from tension-type headaches at least once a month for at least 12 months (Dahlof and Dimenas 1995.)

4. Non-headache subjects, who volunteered for the study, were required to not have suffered from headaches. Allowance was made for subjects who suffered from headaches as result of alcohol or drug withdrawal and headaches which occurred during systemic diseases such as influenza, tick-bite fever and malaria, but which was not currently affecting the subject.

5. Non-headache subjects were also to have not suffered from acute or chronic neck or shoulder pain.

6. Subjects were asked to refrain from taking any analgesics in the 12-hour period before the examination.

7. Subjects with hard neurological signs were excluded from the study.

8. Headache subjects with any indication of vascular insufficiency of the neck or cranial structures were not accepted into the study.

9. If any of treatment group A1 developed headache as result of systemic illness or other conditions unrelated to tension-type headache, they were excluded from the study.

3.3.5 Method of measurement

Both groups underwent the following objective measurements:

a) Radiographic findings of static alignment.

With the subject positioned in the lateral position and with the neck in the neutral position, a size 18x24 film was exposed to 70 kilovolts at 20 miliamperes per second. Afterwards, manual measurements were made of the lordotic angle. This angle was taken from the bisector of C1 vertebra, and a line parallel to the inferior endplate of the C7 vertebral body. Six categories (Vernon and Steiman 1992) of configuration were made from these measurements:

- hyperlordosis (>35)
- normal lordosis (25-34)
- hypolordosis (5-25)
- alordosis(+5 to -5)
- quasi-alordosis (combination of c and d, with alordosis usually extending from C3-C6)

- kyphosis (<-5)

b) Radiographic findings of abnormal dynamic inter-segmental mobility.

Segmental motion analysis, by radiography was performed on the upper cervical spine. All active examinations had the subject positioned in the lateral position, with a fixing pallet fixed at the mid-thoracic spine and another at the sternum (Figure 1.), to avoid flexion-extension of the thoracic spine, while ensuring that the central x-ray beam passed one centimeter behind the angle of the jaw when the cervical spine was in the neutral lateral position. The subject wore a goniometer to ensure that movements were executed strictly in the sagital plane.(Amevo et al. 1992) The subjects were asked to bend their head forward as much as possible (Figure 2.i) and a size 18x24 cm film was exposed to 70 kilovolts at 20 miliamperes per second. In the next step, an active extension was performed and another film taken in this position (Figure 2.ii.).

Passive examinations were then performed, with the subjects in the above mentioned position and with the same support. The examiner induced forward inclination at the C1-occipital level (i.e. passively tilted the chin towards the chest without bending the cervical spine). This was followed by maximal, passive, cervical spine flexion performed by the examiner (Figure 3.i.). Extension was

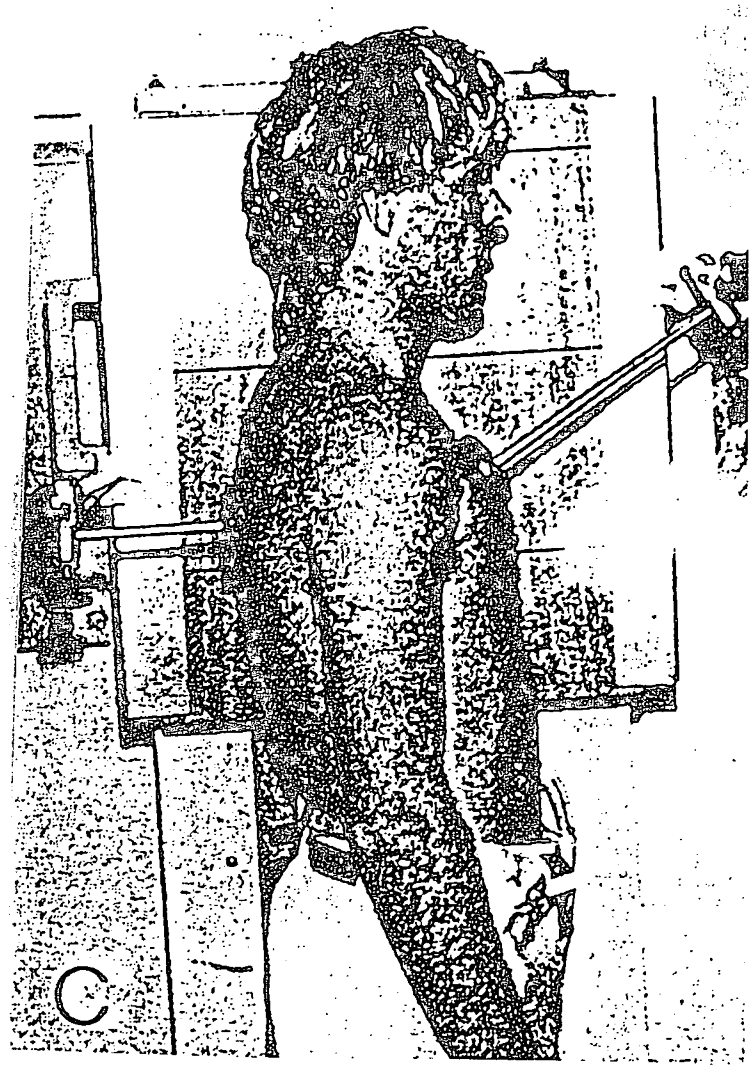


FIGURE 3.1: Subject Positioned in the Lateral position, with a fixing pallet fixed at the mid-thoracic spine and another at the sternum

FIGURE 3.2.i: Active Flexion: Subject asked to bend their head forward as much as possible.

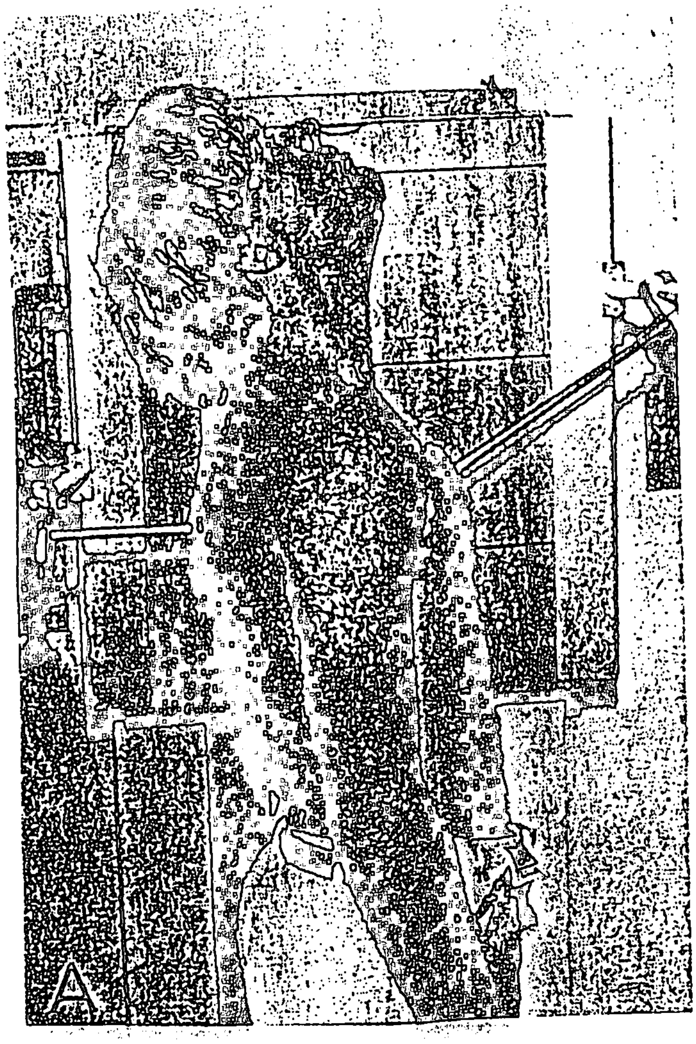


FIGURE 3.2.ii: Active Extension.

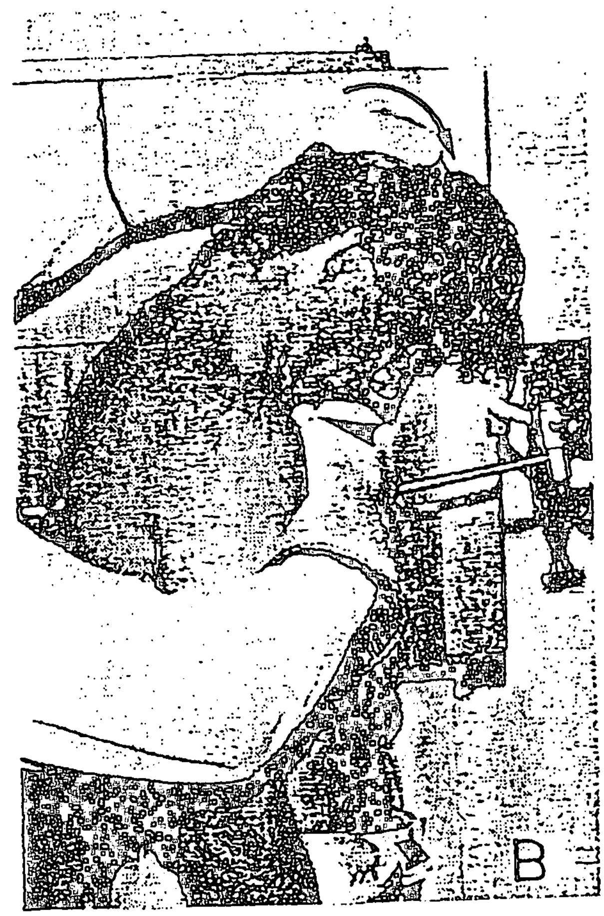


FIGURE 3.3.i: Passive, Cervical spine Flexion performed by the examiner.

FIGURE 3.3.ii: Passive Extension.

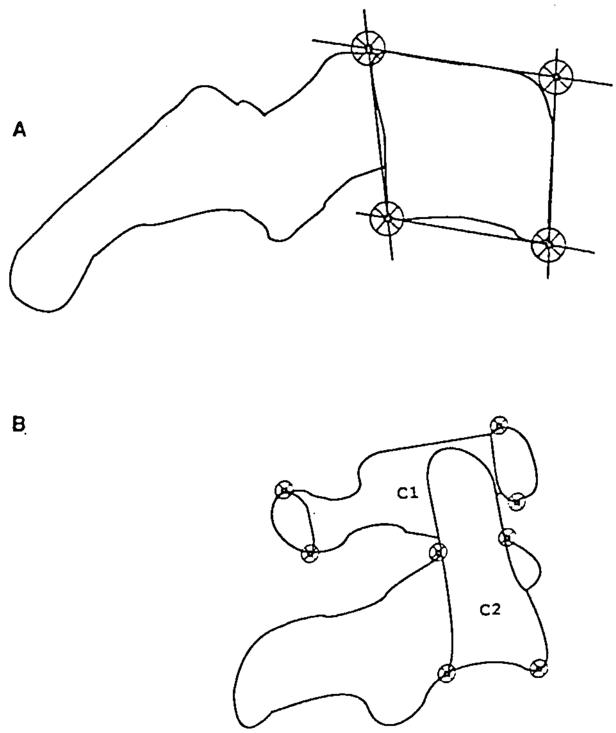


FIGURE 3.4.i: Dvorak et.al.'s (1993) procedure for marking the radiographs.

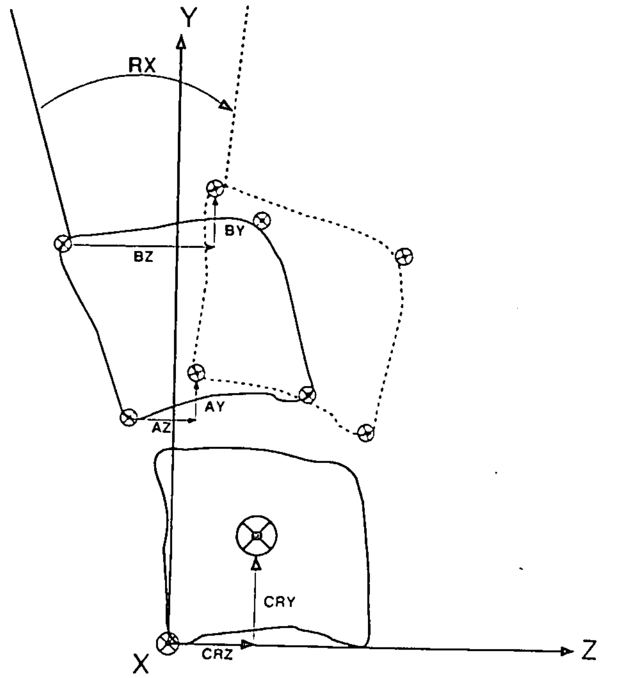


FIGURE 3.4.ii: The Coordinate system and indication of the Segmental angular rotation (RX), in the sagittal plane, which was evaluated in this study

induced by the examiner by protruding the chin forward, followed by maximal, passive extension performed by the examiner (Figure 3.ii.).

The examiner wore a whole lead coat with long sleeves, lead gloves as well as lead glasses. During passive examination, the examiner placed his left hand on the back of the patient's head, the right hand holding the patient's chin. The subject was requested to alert the examiner when discomfort was felt.

Computer digitisation, as used by Pfaffenrath et al. (1988), was used to analyse the radiographic data. The main results were given in a numerical form where the angles of mobility of each facet joint were listed. To determine the segmental motion of a vertebral level using flexion and extension radiographs, two images of the lower level were superimposed. The remaining displacement between the two images of the upper vertebra after superimposition represented its motion relative to the fixed position of the lower vertebra.

According to Dvorak et al. (1993) the procedure for marking the radiographs was as follows: Four lines were drawn tangential to each side of the vertebral body, and the intersections provided the marking points (Figure 4.i.).

The computer used positional information, such as the posterior inferior and posterior superior body corner, read off a graph table situated below the radiographs and entered manually by the examiner, to mathematically calculate the segmental rotation (RX) in the sagittal plane (Figure 4.i.i.).

The following equations were set up, using Panjabi et al. (1982) method, to compute the above parameter:

$$RX = \tan^{1}(Y_3 - Y_1 / X_3 - X_1) - \tan^{-1}(Y_4 - Y_2 / X_4 - X_2) \text{ (Degrees)}$$

Any measurement exceeding two standard deviations from the mean was rated as positive in terms of joint dysfunction. This value was based on a study by Dvorak et al. (1988), comparing functional x-rays of healthy subjects to those of patients who had sustained soft tissue injuries to the cervical spine and were complaining of neck pain. Excessive motion was defined as hypermobility, reduced motion as hypomobility.

The clinical validity of the above mentioned procedure was determined by Dvorak et al. (1993) and was shown to be of value in terms of inter-tester and intra-tester reliability. The same procedure was used by Vernon and Steiman (1992).

c) Range of motion with the cervical goniometer (CROM)(Appendix F).

The CROM, or cervical range of motion instrument manufactured by Performance Attainment Associates, was used to measure neck motion. Ranges of motion utilized were flexion, extension, left lateral flexion, right lateral flexion, left rotation and right rotation. All ranges of motion were measured in degrees.

In a study conducted by Youndas et al. (1991) to determine the reliability of the Cervical Range of Motion Instrument as compared to the use of a goniometer, and visual estimation of range of motion, on 60 patients with cervical dysfunction, it was found that the Cervical Range of Motion Instrument demonstrated a high degree of intra-tester and inter-tester reliability. It was also noted that during the measuring procedure with the Cervical Range of Motion Device no further aggravation of the patient's condition was found (Youndas et al. 1991.)

Capuana-Pucci et al. (1991) stated that the Cervical Range of Motion Instrument showed acceptable inter-tester and intra-tester reliability. They also comment on the ease of application and reliability of the instrument in measuring cervical range of motion.

d) Inter-segmental mobility by using motion palpation.

Motion Palpation for specific detection of motion in the cervical spine was performed on each subject. This was based on the objectives set forth by Schafer and Faye (1990:98), which include:

1.normal and abnormal movement of the vertebral segments.

2.motion restrictions, "jumps", irregular gliding, and smoothness of motion.

3.quality and quantity of bilateral motion.

Three tests of motion in the cervical spine (C1-6) were used: flexion-extension, anterior-posterior rotation and lateral bending (Appendix G). Only significant findings of hypomobility were recorded and a third party (clinician), blinded to whether the subject was a headache patient or not, independently evaluated the patients and then confirmed any fixations. If, in the case of both examiners disagreeing on a fixation, then that finding was recorded, separately, and correlated with the x-ray findings. Motion palpation was performed last to avoid any unintentional restoration of mobility during palpation, as this involved a great deal of neck movement.

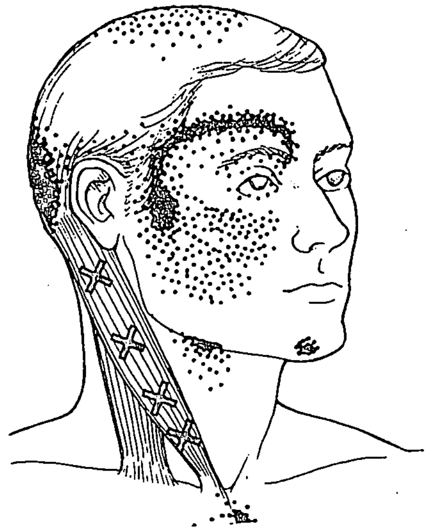
e) By using the Force Dial (Push-Pull Force Gage), a product of Wagner Instruments (P.O.Box 1217, Greenwich, CT 06836, U.S.A), tender points in the muscles of the cervical spine were measured for pressure pain threshold (Appendix H). The readings obtained were measured in kilograms per square centimetre. The higher the readings the less pain felt by the subject.

The examiner identified latent and active trigger points, following Travell and Simons (1983) location guidelines (Figures 5-8), in the following muscles, bilaterally: the sternocleidomastoid muscle (Travell and Simons 1983: 202-204), the trapezius muscle (Travell and Simons 1983: 184-186), the posterior cervical muscles (Travell and Simons 1983: 306-308), and the suboccipital muscles (Travell and Simons 1983: 322-325).

Positive findings (i.e. tender points) were identified by pressure readings lower than 3 kg/ cm^2, or, where the reading taken from a point on one side of the neck, was 1.5 kg/cm^2 less than the corresponding point on the other side (Vernon and Steiman 1992.)

According to Fischer (1986), the pressure algometer has been used in numerous studies, by measuring sensitivity in normal tissue.

The apparatus was fitted with a one square centimetre rubber disc, so that it could be more suitable for measuring tenderness in muscle, ligaments, joint capsules and tendons (Fischer 1986.)



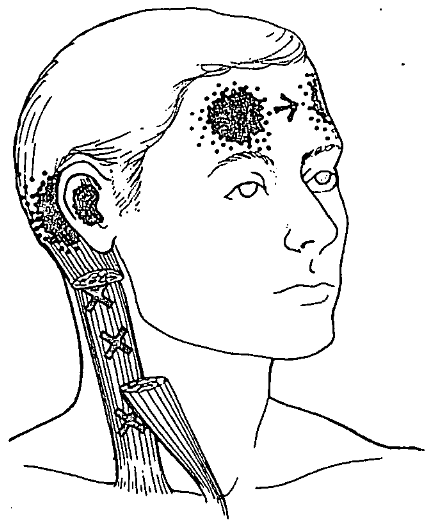
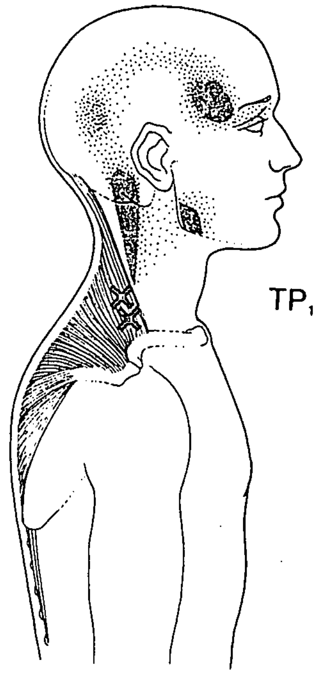


FIGURE 3.5: The Sternocleidomastoid Muscle (Travell and Simons 1983: 202-204)



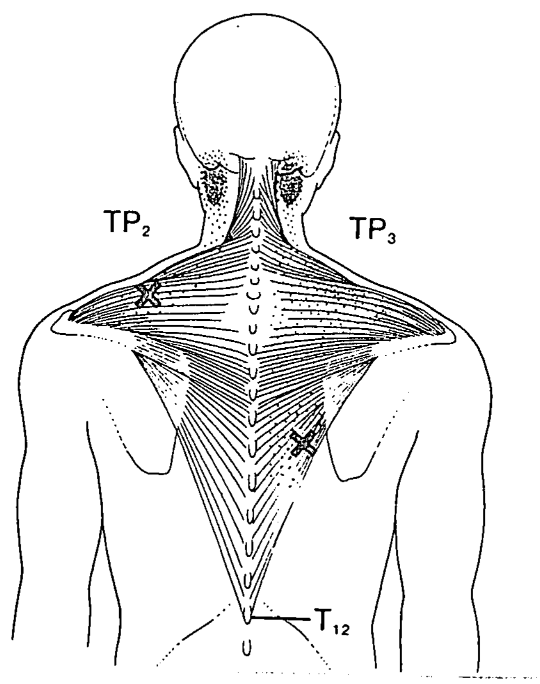


FIGURE 3.6: The Trapezius Muscle (Travell and Simons 1983: 184-186).

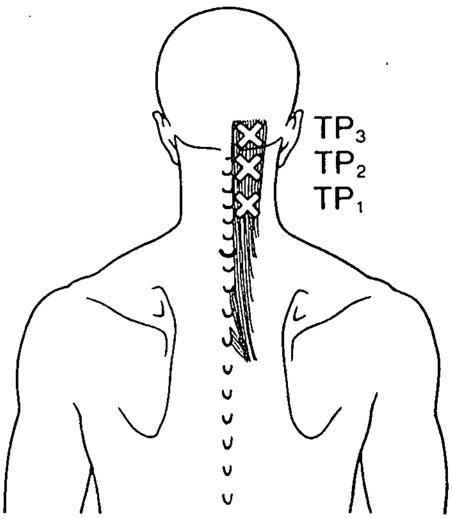


FIGURE 3.7: The Posterior Cervical Muscles (Travell and Simons 1983: 306-308).

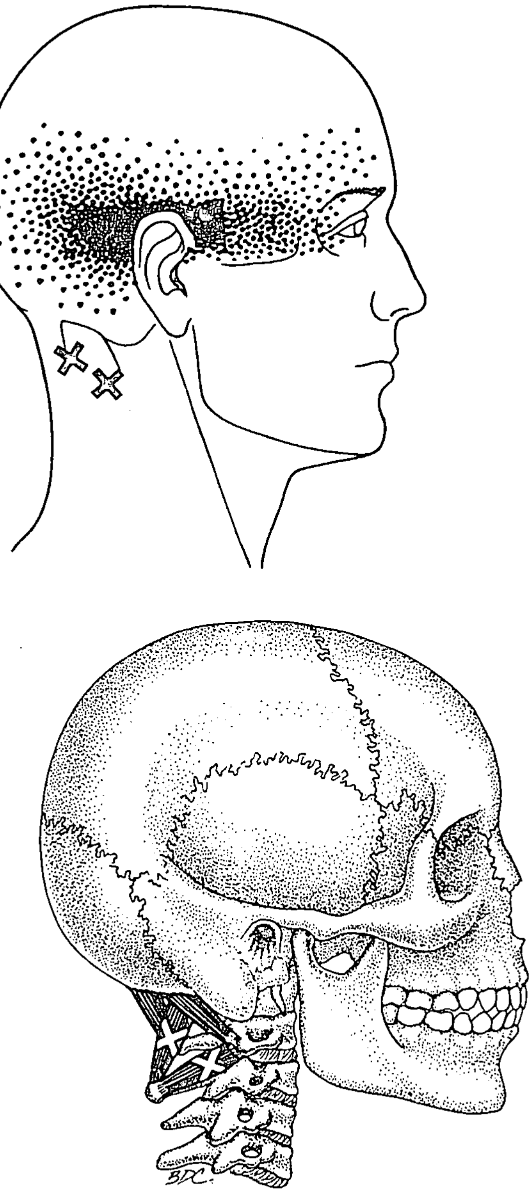


FIGURE 3.8: The Suboccipital Muscles (Travell and Simons 1983: 322-325).

3.3.6 Admissibility of the data

The whole initial assessment for each subject was completed on the same day.

Only the results of those subjects that met the criteria of the study were utilised.

3.3.7 Intervention

The following therapeutic intervention was reported on: Group A1 received a chiropractic adjustment(s) (after two minutes of soft tissue) of the pertinent level(s), with a maximum of six treatments given over a three week period (at a frequency of two treatments a week),or until the patient was asymptomatic. Parkin-Smith (1996) used a similar frequency and duration of treatments in his controlled study on the efficacy of spinal manipulation in the treatment of mechanical neck pain.

The fixated segments, revealed via motion palpation by the author (and confirmed by a clinician), were manipulated by the author using one or more of the following Diversified techniques (as set out in Szaraz (1990)):

i) For rotational occipito-atlantal restrictions; the occiput rotation (mastoid contact) technique (Szaraz 1990: 31.)

ii) Lateral flexion restrictions of the occipito-atlantal junction; the occiput lateral flexion (zygomatic contact) technique (Szaraz 1990: 37.)

iii) Lateral atlanto-axial restrictions; lateral atlas (index contact) technique (Szaraz 1990: 43.)

iv) Rotary atlanto-axial restrictions; rotary atlas (index contact) technique (Szaraz 1990: 45.)

v) Rotary restrictions from atlas to C7; rotary cervical (index contact) technique (Szaraz 1990: 51.)

All detected fixations were manipulated.

At end of the three week period, group A1 subjects were re-assessed for any changes in cervical spine function.

3.3.8 Solving for the sub-problems

3.3.8.1 The first sub-problem

The first sub-problem was to establish the prevalence of cervical spine dysfunction in tension-type headache subjects, as opposed to non-headache subjects, in terms of motion palpation of the cervical spine.

The hypotheses for the Group A and Group B were:

The Null Hypothesis: There was no difference in the motion palpation findings on analysis of the intra-group data, showing that there was no difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

The Alternative Hypothesis: There was a difference in the motion palpation findings on analysis of the intra-group data, showing that there was a difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

3.3.8.2 The second subproblem

The second sub-problem was to establish the prevalence of cervical spine dysfunction in tension-type headache subjects, as opposed to non-headache subjects, in terms of pressure pain threshold (algometer readings) in muscles which attach to the cervical spine.

The hypotheses for the Group A and Group B were:

The Null Hypothesis: There was no difference in the algometry findings on analysis of the intra-group data, showing that there was no difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

The Alternative Hypothesis: There was a difference in the algometry findings on analysis of the intra-group data, showing that there was a difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

3.3.8.3 The third sub-problem

The third sub-problem was to establish the prevalence of cervical spine dysfunction in tension-type headache subjects, as opposed to non-headache subjects, in terms of the cervical lordotic angle.

The hypotheses for the Group A and Group B were:

The Null Hypothesis: There was no difference in the radiological measurements of the cervical lordotic angle on analysis of the intra-group data, showing that there was no difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

The Alternative Hypothesis: There was a difference in the radiological measurements of the cervical lordotic angle on analysis of the intra-group data, showing that there was a difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

3.3.8.4 The fourth sub-problem

The fourth sub-problem was to establish the prevalence of cervical spine dysfunction in tension-type headache subjects, as opposed to non-headache subjects, in terms of segmental motion analysis by radiography.

The hypotheses for the Group A and Group B were:

The Null Hypothesis: There was no difference in the radiological findings of intersegmental mobility on analysis of the intra-group data, showing that there was no difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

The Alternative Hypothesis: There was a difference in the radiological findings of intersegmental mobility on analysis of the intra-group data, showing that there was a difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

3.3.8.5 The fifth sub-problem

The fifth sub-problem was to establish the prevalence of cervical spine dysfunction in tension-type headache subjects, as opposed to non-headache subjects, in terms of cervical spine range of motion readings.

The hypotheses for the Group A and Group B were:

The Null Hypothesis: There was no difference in the cervical range of motion findings on analysis of the intra-group data, showing that there was no difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

The Alternative Hypothesis: There was a difference in the cervical range of motion findings on analysis of the intra-group data, showing that there was a difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

3.3.8.6 The sixth sub-problem

The sixth sub-problem was to integrate the data obtained from the first five sub-problems, in order to determine the relative prevalence of specific cervical spine dysfunctions in tension-type headache subjects, as opposed to non-headache subjects.

The hypotheses for the group A and group B were:
The Null Hypothesis: There was no difference in the objective clinical findings on analysis of the intra-group data, showing that there was no difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects.

The Alternative Hypothesis: There was a difference in the objective clinical findings on analysis of the intra-group data, showing that there was a difference in the prevalence of cervical spine dysfunction in tension-type headache subjects as opposed to non-headache subjects

3.3.8.7 The seventh sub-problem

The seventh sub-problem was to establish the prevalence of cervical spine dysfunction after manipulation in tension-type headache subjects as opposed to baseline results, in order to ascertain the efficacy of this approach in the management of tension-type headache in terms of objective clinical findings.

The hypotheses for the Group A and Group B were:

The Null Hypothesis: There was no difference in the objective clinical findings on analysis of the intra-group data after treatment, showing that the treatment was ineffective in altering cervical spine function.

The Alternative Hypothesis: There was a difference in the objective clinical findings on analysis of the intra-group data after treatment, showing that the treatment was effective in altering cervical spine function.

3.4 STATISTICAL ANALYSIS

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

3.4.1 Treatment of the Data

-The distribution of fixations, was represented according to the location and the frequency of levels at which the fixations occurred. This data was separately expressed, for the headache, control and treatment group. The quantity of subjects, who had at least one fixation, was also expressed as an percentage of the total of subjects in each respective group.

The quantity of positive findings (i.e., fixations) per subject was recorded separately for the headache, control and treatment group. This data then underwent statistical analysis.

-The computer-generated measurements for flexion and for extension in the segments from C1-C6 were combined and recorded separately for each of the groups. The average values for passive and active inter-segmental motion were represented as degrees at each segment (C1-C6). The combined measurements for flexion and for extension in the segments from C1-C6 were evaluated against the standard of segmental motion provided by Dvorak et al. (1988). The percentage of patients with abnormal passive and active inter-segmental motion findings were presented according to their respective frequency of abnormal findings per segment. The distribution of abnormal segments for combined flexion/extension was expressed according to the location at which the abnormal finding occurred.

The quantity of abnormal inter-segmental motion findings per subject was then recorded separately for the headache group and the control group. This data then underwent statistical analysis.

-The distribution of categories of cervical lordosis were represented as frequency counts.

The measurements of the lordotic angle were recorded separately for the headache, control and treatment group. This data then underwent statistical analysis.

-The readings obtained from the algometer were recorded separately for the headache, control and treatment group. The algometer readings were evaluated against the standard for tender points identification provided by Vernon and Steiman (1992). The quantity of positive findings (i.e., tender points) per subject was then recorded separately for the headache, control and treatment group. This data then underwent statistical analysis.

The distribution of tender points, was represented according to their location and quantity in the subjects.

-The readings from the C.R.O.M were recorded in degrees of flexion, extension, left/right lateral flexion and left/right rotation. This was done separately for the headache, control group, and treatment group. The data then underwent statistical analysis.

The quantity of abnormal inter-segmental motion findings, at the initial consultation and final treatment, was recorded for the treatment group. This data then underwent statistical analysis. The statistical analysis was carried out by this author.

3.4.2 Methods of data analysis

WILCOXON'S SIGNED RANK TEST

The sample size of the treatment group (Group A1) was small (20 per group), therefore the non-parametric Wilcoxon's Signed Rank test was used for data analysis.

3.4.2.1 Procedure 1

Intra-Group Comparisons

For motion palpation findings, tender point findings, CROM, radiographic findings of change in the lordotic angle and inter-segmental mobility, Wilcoxon's Signed Rank Tests were used within the treatment group to find out whether there was any significant improvement between readings taken at baseline and at the end of three weeks or after six treatments. With respect to all measurements, statistically significant findings were based on a 95% confidence level and the above decision rule.

3.4.2.2 Hypothesis Testing and Decision Rule

The Null Hypothesis (H0) states that there is no significant improvement between baseline and after three weeks within group A1 with respect to the variable of interest. The Alternative Hypothesis (H1) states the contrary to the null hypothesis.

H0: There is no significant improvement.

H1: There is a significant improvement.

(= 0.025 = level of significance of test)

3.4.2.3 Decision Rule

For a two tailed test,

Reject H0 if P < (/2 = 0.025)

Accept H1 if P > (/2 = 0.025)

P is the observed significance level of the test.

3.4.2.4 Procedure 2

Summary statistics (median, mean, standard error, and standard deviation) were obtained.

3.4.2.5 Procedure 3

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.

3.4.2.6 Procedure 4

Barcharts were constructed to present major findings of the study as a visual summary of results obtained from the Wilcoxon's Signed Rank Tests. Barcharts were made using the package EXCEL.

TWO SAMPLE UNPAIRED T-TEST

In each of the two groups (A and B), there were 40 subjects. Since the sample size per group was larger than 30, a parametric test was used to do statistical analysis. The purpose of this analysis was to find out whether or not there were significant differences between the two groups with respect to x-ray reading analysis findings of hypomobility and measurements of the lordotic angle, CROM range of motion readings for: forward flexion, extension, left lateral flexion, right lateral flexion, left rotation, right rotation, motion palpation findings of hypomobilty and algometry readings.

3.4.2.7 Procedure 1:

Inter-Group Comparisons

The two-sample unpaired t-test was used to compare Groups A and B. The two groups were treated as being independent of one another (unpaired). The purpose was to find out whether there was any significant difference between the two groups at the a = 0.05 level of significance.

3.4.2.8 Hypothesis Testing and Decision Rule

The Null Hypothesis (H0) stated that there was no significant difference between the two groups with respect to the variable of interest. The alternative Hypothesis (H1) stated that there was a significant difference between the two groups.

H0: A = B

H1: A and B were significantly different from each other.

3.4.2.9 Decision Rule

For a two-sample unpaired t-test between independent samples,

Reject H0 if $P < 0.05$

Accept H0 if $P > 0.05$

P was the observed significance level of the test if the absolute value of the observed value of the t-statistic exceeded the tabulated value of the t-statistic with 78 degrees of freedom (40+40-2). Otherwise, it will be accepted at the same level of significance.

A 95% confidence interval for the difference between the two population means (u1-u2) was also constructed.

3.4.2.10 Procedure 2:

Summary statistics (mean, standard error, the coefficient of variation) were obtained for each of the two groups.

3.4.2.11 Procedure 3:

Barcharts were constructed to present major findings of the study as a visual summary. The barchart were able to summarise results from the unpaired t-test.

CHAPTER 4

4.0 RESULTS

4.1 INTRODUCTION

This study consisted of a sample size of 80 subjects: 40 in Group A (who, according to the IHS criteria, were diagnosed with tension-type headache) and 40 in Group B (who were found to be asymptomatic/non-headache subjects). Group A was further subdivided: 20 in Group A1 (who received chiropractic treatment) and Group A2 (who received no treatment).

This chapter covers the results obtained from the motion palpation findings, inter-segmental motion x-ray findings, goniometer and algometer readings and cervical spine sagital curve findings. The results were obtained from objective data that was recorded only at the initial consultation from both Group A and Group B and from the sixth consultation of Group A1.

In this chapter, two sets of results are recorded. The first set of results gives the mean readings and distribution values obtained from the above mentioned objective investigations. These results were recorded to give an impression when comparing Group A and Group B as well as a basis for further statistical analysis, or as a comparison of data with other research studies.

The second set of results was statistically analysed using the following tests:

1) Two-sample unpaired t-test, to compare Group A and Group B. The data was analysed at a 95% confidence level ($p<0.05$).

2) The Wilcoxon's Signed Rank Test to compare the results for group A1. This data was analysed at a 95% confidence level ($p<0.025$).

The results were tabulated to display the probability value (p-value), which was used to compare the level of significance for all the tests. The p-value was used to determine whether the null or alternative hypothesis was accepted or rejected, as stated in 3.5.

4.1.1 <u>Abbreviations</u>:

Group A: Tension-type Headache Group

Group B: Non-headache Group

Group A1: Treatment Headache Group

Group A2: Non-treatment Headache Group

AM: Active Movement

PM: Passive Movement

S.E: Standard Error

S.D: Standard Deviation

P: P-Value

S: Statistically Significant

NS: Statistically Non-significant

ic:Initial-consultation

fc: Final treatment

He: Hypermobilty

Ho: Hypomobility

4.2 AGE AND GENDER DISTRIBUTION

Table 4.1.a: Age distribution of the Subjects

Age (years)	Group A	Group B
18-22	7	8
23-27	17	20
28-32	7	7
33-37	5	2
38-44	4	3

Table 4.1.b: Gender distribution of subjects:

	Male	**Female**
Group A1	5	15
Group A2	11	9
Group A	16	24
Group B	16	24
Total	32	48

4.3 OCCUPATION AND RACE DISTRIBUTION

Table 4.2 Occupation distribution of the subjects:

	Number of subjects			
	Group A1	**Group A2**	**Group A**	**Group B**
Student	7	15	22	36
Secretary	3	1	4	2
Lecturer	0	2	2	1
Housewife	5	1	6	0
Businessperson	3	0	3	0
Other	2	1	3	1

Table 4.3: Race distribution of subjects:

	Number of subjects			
	Group A1	**Group A2**	**Group A**	**Group B**
European	19	19	38	40
Indian	1	1	2	0

4.4 TABULATED RESULTS

4.4.1 The objective data

4.4.1.1 Motion palpation findings:

Table 4.4: The distribution of motion palpation detected fixations amongst the subjects, according to the frequency of levels at which the fixations occurred (at the upper three segments of the cervical spine):

Number of levels	Group A1	Group A2	Group A	Group B
0	0	1	1	16
1	12	10	22	18
2	8	8	16	6
3	0	1	1	0
1,2or3			39	24
			(97.5%)	(60%)

From Table 4.4, it can be seen that 97.5% of the headache subjects had at least one fixation in the first three cervical segments, as opposed to 60 % of the non-headache subjects.

Table 4.5: The distribution of motion palpation detected fixations among the subjects, according to the location at which the fixations occurred (at the upper three segments of the cervical spine):

Level	Group A1	Group A2	Group A	Group B
C0-1	7	13	20	10
C1-2	14	10	24	10
C2-3	7	6	13	10

4.4.1.2 Inter-segmental motion x-ray findings:

Table 4.6: Average values (Means), in degrees, of Passive and Active Segmental Motion on Flexion/Extension X-rays (C1-6) for the Asymptomatic Group, Headache Group and Dvorak et al.'s (1988) Normal Group:

Level	GroupB		GroupA		Dvorak	
	PM	AM	PM	AM	PM	AM
C1-2	15.52°	12.95 °	10.12 °	8.93 °	15 °	12 °
C2-3	13.23 °	9.20 °	7.13 °	6.56 °	12 °	10 °
C3-4	16.75 °	15.95 °	13.02 °	12.52 °	17 °	15 °
C4-5	20.06 °	19.20 °	19.96 °	18.73 °	21 °	19 °
C5-6	21.33 °	20.03 °	21.25 °	19.79 °	23 °	20 °

Table 4.7: <u>Average Value (Degrees) of Segmental Motion +/- 2 Standard Deviations during Active Flexion/Extension by Healthy Adults (Dvorak et al. 1988)</u>:

	C1-2	C2-3	C3-4	C4-5	C5-6
Average+2SD	20 °	15 °	23 °	26 °	28 °
Average	12 °	10 °	15 °	19 °	20 °
Average-2SD	5 °	5 °	7 °	13 °	13 °

From Table 4.7 the limits of Dvorak <u>et al</u>.'s (1988) values for normal segmental motion, during active flexion/extension, are expressed. These values are used in order to then determine any motion dysfunction in this study.

Table 4.8: <u>Average Value (Degrees) of Segmental Motion +/- 2 Standard Deviations during Passive Flexion/Extension for Healthy Adults (Dvorak et al. 1988)</u>:

	C1-2	C2-3	C3-4	C4-5	C5-6
Average+2SD	22 °	17 °	24 °	28 °	31 °
Average	15 °	12 °	17 °	21 °	23 °
Average-2SD	8 °	6 °	10 °	14 °	16 °

From Table 4.8 the limits of Dvorak et al.'s (1988) values for normal segmental motion, during passive flexion/extension, are expressed. These values are used in order to then determine any motion dysfunction in this study.

Any measurement, in this study, exceeding two standard deviations from the mean, based on the study by Dvorak et al. (1988), was rated as positive in terms of joint dysfunction. Excessive motion was defined as hypermobility (He), reduced motion as hypomobility (Ho).

Table 4.9: Percentage of subjects with abnormal segments(C1-C6) for combined flexion\extension in the sagital plane:

Group A PM		Group A AM		Group B PM		Group B AM	
No. of abn. seg.	% of sub-jects	No. of abn. seg.	% of sub-jects	No. of abn. seg	% of sub-jects	No. of abn. seg	% of sub-jects
1	30	1	32.5	1	15	1	20
2	15	2	20	2	7.5	2	10
3	5	3	10	3	2.5	3	0
4	0	4	2.5	4	0	4	0
5	0	5	0	5	0	5	0

Table 4.10: The distribution of abnormal segments(C1-C6) for combined flexion\extension detected, according to the location at which the fixations occurred:

Group A PM		Group A AM		Group B PM		Group B AM	
Level	No. of abn. segs.	Level	No. of abn. segs.	Level	No. of abn. segs.	Level	No. of abn. segs.
C1-2	10 (4He)	C1-2	17 (2He)	C1-2	4 (1He)	C1-2	4
C2-3	9	C2-3	12	C2-3	3	C2-3	4
C3-4	3	C3-4	5	C3-4	3	C3-4	3
C4-5	1	C4-5	3	C4-5	1	C4-5	1
C5-6	7	C5-6	8	C5-6	4	C5-6	4

4.4.1.3 Cervical spine sagital curve findings:

Table 4.11: Distribution of categories of sagital curve of the cervical spine:

	hyper lordo -sis (>35 °)	normal lordo-sis (25 ° -34 °)	hypo-lor-dosis (5 - 25°)	alordo-sis (+5 to - 5 °)	quasi-alordo sis	kypho sis (<-5)
No. of Sub-jects Grp. A	3	12	18	6	1	0
No. of Males	3	6	5	2	0	0
No. of Females	0	6	13	4	1	0
No. of Sub-jects Grp. B	6	20	10	4	0	0
No. of Males	4	10	2	0	0	0
No. of Females	2	10	8	4	0	0

4.4.1.4 Findings of tender points in the pericervical musculature:

Table 4.12: Tender points: distribution by the number of points:

No. of tender points	Group A	Group B
4	5	0
3	9	4
2	17	8
1	8	20
0	1	8

Table 4.13: Tender points: Distribution (as a percentage)of the tender points by their location in subjects with at least one tender point:

Location of Tender Points	Group A	Group B
	Percentage distribution	
Posterior cervical	79	41
Suboccipital	71	34
Trapezius	41	40
Sternocleidomastoid	38	10

4.4.1.5 Cervical range of motion findings:

Table 4.15: The average range of motion readings taken by the CROM for each of the planes of movement:

RANGES OF MOTION (Deg.)	GROUPA1	GROUP A	GROUP B
FLEXION	65.0 °	56.725 °	53.25 °
EXTENSION	50.0 °	70.25 °	65.5 °
LATERAL FLEXION R	45.0 °	67.8 °	64.625 °
LATERAL FLEXION L	45.0 °	68.675 °	63.375 °
ROTATION R	65.0 °	45.825 °	44.325 °
ROTATION L	63.0 °	45.925 °	45.675 °

4.5 TABULATION OF THE STATISTICALLY ANALYZED DATA

4.5.1 TWO SAMPLE UNPAIRED T-TESTS (GROUP A and GROUP B)

4.5.1.1 The results of the motion palpation findings.

The Two Sample Unpaired T-test was carried out for Group A and Group B, after the initial consultation, in order to compare the positive findings of hypomobility for motion palpation, of the three segments of the upper cervical spine. Motion palpation was performed in the following directions: Flexion-extension, anterior-posterior rotation and lateral bending.

Table 4.15: The inter-group comparison of the quantity of palpable hypomobile findings (i.e. fixation), per subject(C1-3):

	GROUP A	GROUP B
Mean	1.425	0.7
SE	9.396876E-02	0.11
SD	0.5943106	0.7071068
Power	0.9953	
P	0.000015 (S)	

A statistically significant difference between Group A and Group B was noted at the initial consultation. Therefore, the null hypothesis is rejected. Standard deviation revealed a relative familiarity around the mean for both groups.

4.5.1.2 The results of the inter-segmental motion x-ray findings.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the findings of abnormal inter-segmental motion x-ray measurements, including hypo- and hypermobility, at the initial consultation.

Table 4.16: The inter-group comparison of the number of abnormal inter-segmental motion x-ray findings, per subject:

	GROUP A - Passive motion	GROUP B - Passive motion	GROUP A - Active motion	GROUP B - Active motion
Mean	0.725	0.375	1.175	0.375
SE	0.13	0.12	0.18	0.16
SD	0.846402	0.7403222	1.129727	0.6674675
Power	0.493		0.9617	
P	0.052642 (**NS**)		0.000236 (**S**)	

No statistically significant difference between Group A and Group B was noted at the initial consultation for the passive inter-segmental motion data. Therefore, the null hypothesis is accepted.

A statistically significant difference between Group A and Group B was noted for active inter-segmental motion. Therefore, the null hypothesis is rejected. Standard deviation revealed a relative familiarity around the mean for both groups.

4.5.1.3 <u>The results of the cervical sagital curve findings</u>.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the measurements of the lordotic angle at the initial consultation. The values used came from manual measurements made of the lordotic angle.

Table 4.17: <u>The inter-group comparison of the lordotic angle</u>:

	GROUP A	GROUP B
Mean	18.25°	24.025 °
SE	1.76	1.69
SD	11.16714 °	10.67825 °
Power	0.646	
P	0.020573 (S)	

A statistically significant difference between Group A and Group B was noted at the initial consultation. Therefore, the null hypothesis is rejected. Standard deviation revealed a relative familiarity around the mean for both groups.

4.5.1.4 <u>The results of the cervical musculature algometer readings</u>.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the algometer readings at the initial consultation. The values used came from positive findings of tender points, according to criteria set out in the methodology.

Table 4.18: <u>The inter-group comparison of positive findings of tender points per subject</u>:

	GROUP A	GROUP B
Mean	2.25	1.15
SE	0.15	0.14
SD	0.9540736	0.8929927
Power	0.9995	
P	0.000001 (S)	

A statistically significant difference between Group A and Group B was noted at the initial consultation. Therefore, the null hypothesis is rejected. Standard deviation revealed a relative familiarity around the mean for both groups.

4.4.1.5 <u>The results of active flexion measured with the cervical range of motion goniometer</u>.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the values for flexion at the initial consultation.

Table 4.19: <u>The inter-group comparison of flexion</u>:

	GROUP A	GROUP B
Mean	53.25 °	56.725 °
SD	10.0989 °	6.62933 °
P	0.0727028 **(NS)**	

There was no statistically significant difference between Group A and Group B at the initial consultation. Therefore, the null hypothesis is accepted.

4.4.1.6 The results of the active extension measured with the cervical range of motion goniometer.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the values for extension at the initial consultation.

Table 4.20: The inter-group comparison of extension:

	GROUP A	GROUP B
Mean	65.5 °	70.25 °
SD	12.0788 °	8.70529 °
P	0.0470597 **(S)**	

There was a statistically significant difference between Group A and Group B at the initial consultation. Therefore, the null hypothesis is rejected.

4.4.1.7 The results of the lateral flexion to the right measured with the cervical range of motion goniometer.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the values for lateral flexion to the right at the initial consultation.

Table 4.21: The inter-group comparison of lateral flexion to the right:

	GROUP A	GROUP B
Mean	64.625 °	67.8 °
SD	9.01477 °	8.74188 °
P	0.113841**(NS)**	

There was no statistically significant difference between Group A and Group B at the initial consultation. Therefore, the null hypothesis is accepted.

4.4.1.8 The results of the lateral flexion to the left measured with the cervical range of motion goniometer.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the values for lateral flexion to the left at the initial consultation.

Table 4.22: The inter-group comparison of lateral flexion to the left:

	GROUP A	GROUP B
Mean	63.375 °	68.675 °
SD	8.65192 °	8.44101 °
P	0.00694208 **(S)**	

There was a statistically significant difference between Group A and Group B at the initial consultation. Therefore, the null hypothesis is rejected.

4.4.1.9 The results of the rotation to the right measured with the cervical range of motion goniometer.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the values for rotation to the right at the initial consultation.

Table 4.23: The inter-group comparison of rotation to the right:

	GROUP A	GROUP B
Mean	44.325 °	45.825 °
SD	7.81316 °	8.19909 °
P	0.404792 **(NS)**	

There was no statistically significant difference between Group A and Group B at the initial consultation. Therefore, the null hypothesis is accepted.

4.4.1.10 The results of the rotation to the left measured with the cervical range of motion goniometer.

The Two Sample Unpaired T-test was carried out for Group A and Group B in order to compare the values for rotation to the left at the initial consultation.

Table 4.24: The inter-group comparison of rotation to the left:

	GROUP A	GROUP B
Mean	45.675 °	45.925 °
SD	7.10864 °	7.54606 °
P	0.879174 **(NS)**	

There was no statistically significant difference between Group A and Group B at the initial consultation. Therefore, the null hypothesis is accepted.

4.4.2 THE WILCOXON'S SIGNED RANKED TESTS(GROUP A1)

4.4.2.1 The results of the inter-segmental motion x-ray findings.

The Wilcoxon's Signed Ranked test was carried out, for Group A1, in order to compare the number of abnormal inter-segmental motion findings (according to criteria set out in the methodology) per subject, from the initial consultation to the final consultation.

Table 4.25: The intra-group comparison of inter-segmental motion X-ray findings for Group A1:

	Ic-Fc (AM)		Ic-Fc (PM)	
	Ic	**Fc**	**Ic**	**Fc**
Mean	1.3	0.45	0.85	.0.5
SE	0.28	0.17	0.21	0.19
SD	1.267	0.759	0.93	0.89
Average overall improvement in the quantity of fixations detected	0.85		0.35	
Average quantity of positive findings	1.3-0.45		0.85 - 0.5	
Power	0.99		0.858	
P	0.000394 (S)		0.005547 (S)	

According to the above table there was a significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is rejected.

4.4.2.2 The results of the cervical sagital curve findings.

Table 4.26: The intra-group comparison of cervical sagital curve x-ray measurements of the lordotic angle for Group A1:

	Ic-Fc	
	Ic	**Fc**
Mean	19.1 °	23.95 °
SD	12.05 °	10.18 °
SE	2.7	2.26
Average overall improvement	4.85 °	
Average cervical sagital curve findings	19.1 ° - 23.95 °	
Power	0.99	
P	0.000354 (S)	

According to the above table there was a significant change in the lordotic angle, within Group A1, from the initial consultation to the final treatment. Therefore, the null hypothesis is rejected.

4.4.2.3 The results of the algometer findings of tender points.

The Wilcoxon's Signed Ranked Test was carried out for Group A1, in order to compare the number of tender point findings (according to criteria set out in the methodology) per subject, from the initial consultation to the final consultation.

Table 4.27: The intra-group comparison, for Group A1, of the number positive tender point findings per subject:

	Ic-Fc	
	Ic	Fc
Mean	2.25	1.15
SD	0.95	0.89
SE	0.15	0.14
Average overall improvement in the quantity of tender points detected	1.1	
Average quantity of positive findings	2.3 - 1.2	
Power	0.9995	
P	0.000017 (S)	

According to the above table there was a significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is rejected.

4.4.2.4 <u>The results of the flexion measured with the cervical range of motion goniometer</u>.

Table 4.28: <u>The intra-group comparison of flexion for Group A1</u>:

	Ic-Fc
Average overall improvement	0 °
Average range of motion	65.0 ° -65.0 °
P	0.0455 (**NS**)

According to the above table there was no significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is accepted.

4.4.2.5 The results of the extension measured with the cervical range of motion goniometer.

Table 4.29: The intra-group comparison of extension for Group A1:

	Ic-Fc (AM)
Average overall improvement	6°
Average range of motion	50.0°-56.0°
P	0.0613 **(NS)**

According to the above table there was no significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is accepted.

4.4.2.6 The results of the lateral flexion to the right measured with the cervical range of motion goniometer.

Table 4.30: The intra-group comparison of lateral flexion to the right for Group A1:

	Ic-Fc
Average overall improvement	3 °
Average range of motion	45.0°-48.0°
P	0.0161569 **(S)**

According to the above table there was a significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is accepted.

4.4.2.7 The results of the lateral flexion to the left measured with the cervical range of motion goniometer.

Table 4.31: The intra-group comparison of lateral flexion to the left for Group A1:

	Ic-Fc
Average overall improvement	3 °
Average range of motion	45° - 48.0 °
P	0.0161569 (S)

According to the above table there was a significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is accepted.

4.4.2.8 The results of the rotation to the right measured with the cervical range of motion goniometer.

Table 4.32: The intra-group comparison of rotation to the right for Group A1:

	Ic-Fc
Average overall improvement	4 °
Average range of motion	65.0° - 69.0°
P	0.00766083**(S)**

According to the above table there was a significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is rejected.

4.4.2.9 The results of the rotation to the left measured with the cervical range of motion goniometer.

Table 4.33: The intra-group comparison of rotation to the left for Group A1:

	Ic-Fc
Average overall improvement	1 °
Average range of motion	63.0° - 64.0°
P	0.288843 **(NS)**

According to the above table there was no significant improvement within Group A1 from the initial consultation to the final treatment. Therefore, the null hypothesis is accepted.

CHAPTER 5

5.0 DISCUSSION

5.1 INTRODUCTION

This chapter provides a discussion of the results of the objective data from the statistical analysis, summary statistics and demographic representations.

Firstly, Group A and Group B were compared using the inter-group comparison (i.e. Two Sample Unpaired T-Test): The comparison of the initial consultation between the two groups displayed whether or not there was any variance in the objective findings between the two groups.

Secondly, the data of Group A1 was compared using the intra-group comparison (i.e. Wilcoxon's Signed Rank Test): The assessment of the intra-group results of the first treatment to final treatment represent the efficiency of the treatment regime.

5.2 Demographic Data

The baseline demographics for this study groups included that the majority of patients came from the 23-28-year-old age group (Table 4.1), 16 males and 24 females were included in each group (Table 4.2) and over 70% of the subjects were made up of European students (Tables 4.3 and 4.4).

5.3 Inter-Group Comparisons

This author first discusses the objective inter-group results to assess whether there is a statistically significant difference in the findings of cervical spine dysfunction between the headache and non-headache group .

5.3.1 Motion palpation findings

97.5% of the headache group had a fixation of at least one out of three segments, as opposed to 60% of the healthy group (Table 4.5). The distribution of fixations amongst the headache subjects, according to the location at which the fixations occurred, had an equal distribution for the healthy group, while for the headache group, the majority occurred at the C0-C1 and C1-C2 level (Table 4.5).

Comparison of the quantity of motion palpation findings of hypomobility, per group, indicated a statistically significant difference, suggesting a higher prevalence of joint hypomobility for the headache group (Table 4.15).

5.3.2 Inter-segmental motion x-ray findings

A total of 50% of the headache group had an abnormal passive inter-segmental motion finding of at least one out of the six upper cervical segments, as opposed to 25% of the healthy group (Table 4.9). The distribution of abnormal segments amongst the headache subjects, according to the location at which they occurred, had a similar distribution for the healthy group, while for the headache group, the majority occurred at the C1-C2, C2-C3 and C5-C6 level (Table 4.10).

A total of 65% of the headache group had an abnormal active inter-segmental motion finding of at least one out of the six upper cervical segments, as opposed to 30% of the healthy group (Table 4.9). The distribution of abnormal segments amongst the headache subjects, according to the location at which they occurred, had a similar distribution for the healthy group, while for the headache group, the majority occurred at the C1-C2, C2-C3 and C5-C6 level (Table 4.10).

Comparison of the quantity of active inter-segmental motion findings (C1-C6) of hypomobility indicated a statistically significant difference, suggesting a higher prevalence of joint hypomobility for the headache group (Table 4.16).

Comparison of the quantity of passive inter-segmental motion findings (C1-C6) of hypomobility indicated no statistically significant difference. When one looks at the relevant power of this inter-group comparison, one can see that the powers of the test are overall very weak (Table 4.17). This shows that the chance of missing a possible statistically significant result is high (i.e. a high probability of type 2 error occurring).

5.3.3 Radiological cervical sagital curve findings

A total of 62.5% of the headache group had a reduction in the normal lordotic angle, as opposed to 35% of the healthy group (Table 4.11).

Comparison of measurements of the lordotic angle indicated a statistically significant difference, suggesting a possible association of loss of cervical spine lordosis for tension-type headache (Table 4.17).

5.3.4 Algometer readings

A total of 97.5% of the headache group had at least one tender point in one of the four muscles tested, as opposed to 82% of the healthy group (Table 4.12). The distribution of tender points amongst the headache subjects, according to the location at which the tender points occurred, had an equal distribution for the healthy group, while for the headache group, the majority occurred at the Posterior Cervical and Suboccipital muscles (Table 4.13). Comparison of the positive findings of tender points, per subject, indicated a statistically significant difference, suggesting a higher prevalence of tender points for the headache group (Table 4.17).

5.3.5 Range of motion

The goniometer readings were divided into flexion, extension, left lateral flexion, right lateral flexion, left rotation and right rotation (Table 4.14).

Comparison of the cervical range of motion measurements with the goniometer presented no statistically significant difference, except during extension (Table 4.20) and left lateral flexion (Table 4.22), in which a significant difference was indicated, suggesting a higher range of motion for the control group, yet closeness of the P-value to the 95% confidence interval during extension makes this result to be almost insignificant.

When one looks at the relevant powers of the inter-group comparisons, one can see that the powers of the tests are overall very weak. This shows that the chance of missing possible statistically significant results is high (i.e. a high probability of type 2 errors occurring).

5.4 Intra-Group Comparisons

Secondly, the objective intra-group results are discussed to assess the effect of chiropractic treatment in changing cervical spine function. The treatment group was given six treatments or treated until asymptomatic, or where motion palpation disclosed no hypomobile joint lesion. Therefore, motion palpation data was excluded from the intra-group statistical tabulation and discussion.

5.4.1 Inter-segmental Motion findings

Comparison between the findings of the first and final treatments disclosed a statistically significant difference in passive and active intersegmental motion findings for the C1-C6 levels, indicating increased joint mobility after the treatment period (Table 4.25).

5.4.2 Radiological Cervical Sagital Curve findings

Comparison between findings of the first and final treatments disclosed a statistically significant difference in radiological cervical sagital curve measurements, indicating increased cervical spine lordosis after the treatment period (Table 4.26).

5.4.3 Algometer readings

Comparison between the findings of the first and final treatments disclosed a statistically significant difference in algometer readings, indicating reduced tender point findings after the treatment period (Table 4.27).

5.4.4 Range of motion

Comparison of cervical range of motion between the first and final treatments disclosed a statistically significant difference in range of motion, except for lateral flexion to the right (Table 4.30) and left (Table 4.31), as well as rotation to the right (Table 4.32), indicating increased range of motion, after the treatment period, for some of the ranges of motion.

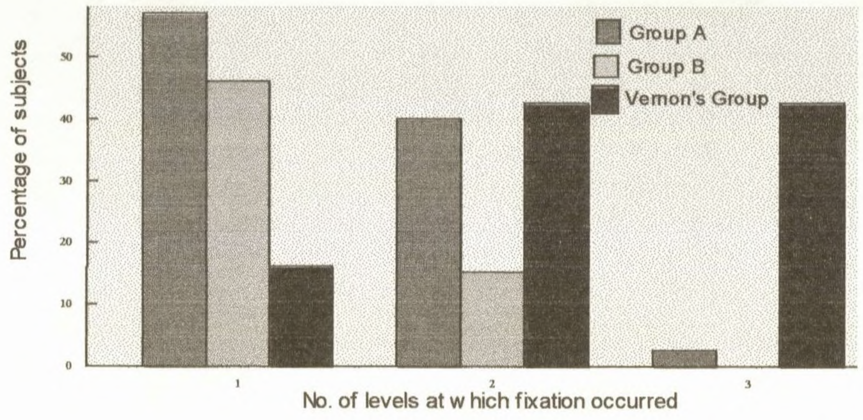
For the above category, when one looks at the relevant powers of those intra-group comparisons, which were not statistically significant, one can see that the powers of the tests are overall very weak. This shows that the chance of missing possible statistically significant results is high (i.e. a high probability of type 2 errors occurring).

5.5 Comparison of Results to Previous Research

5.5.1 Inter-group comparisons

Vernon and Steiman's 1992 study on cervical spine dysfunction in tension-type headache and common migraine can be compared to this study's headache group data, due to the nature of the study and components under investigation, being similar to this study.

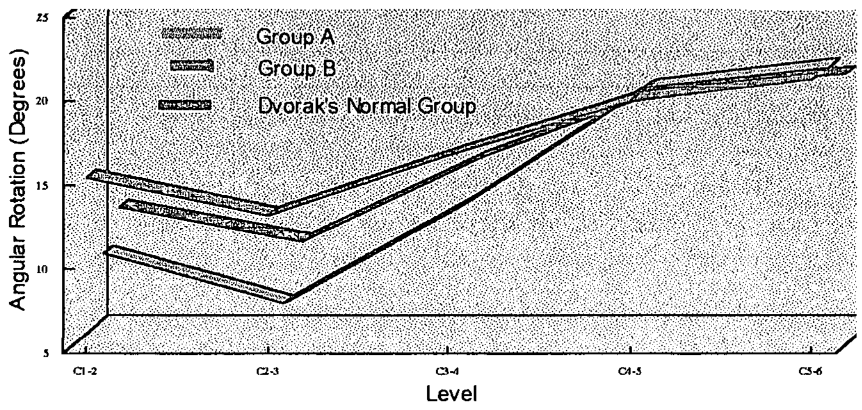
Figure 5.1 Comparison of Motion Palpation findings with Vernon and Steiman's (1992) study on cervicogenic dysfunction:



From Figure 5.1, it can be seen that, like the results from Vernon and Steiman (1992), there was a high prevalence of lesioned segments in the headache group. Compared to the control group, both headache groups had a higher prevalence of lesioned segments, when they occurred in more than one segment.

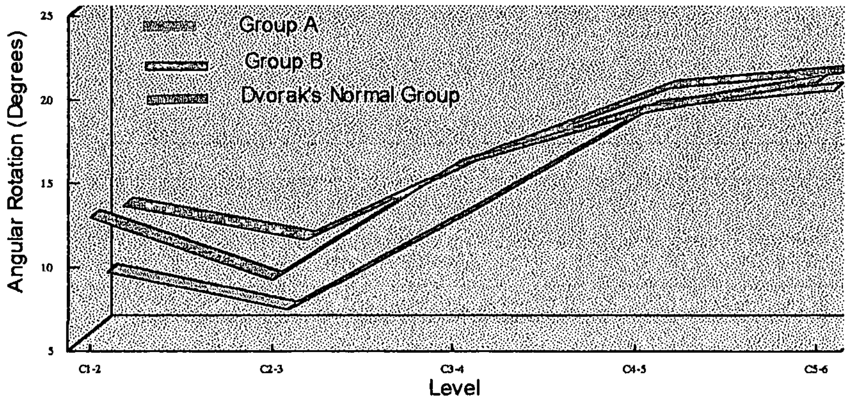
Dvorak et al. (1991) did a study in which they analysed the functional radiographs of normal cervical spines in order to establish values for the intervertebral flexion/extension parameters. The nature and some of the components of the study are similar to this study. Compared to Vernon and Steiman's (1992) study, this study also evaluated the inter-segmental motion against the standard of segmental motion provided by Dvorak et al. (1988).

Figure 5.2 Comparison of Average Passive Inter-segmental Angular Rotation Measurements with Dvorak et al.'s (1988) findings for healthy adults.



From Figure 5.2, it can be seen that, like the results from Dvorak et al. (1988), the proportions of passive motion at each of the consecutive joint segments followed a similar pattern. Compared to the control groups, this study's headache group had a higher prevalence of lesioned segments at the C1-C2 and C2-C3 levels.

Figure 5.3 Comparison of Average Active Inter-segmental Angular Rotation Measurements with Dvorak et al.'s (1988) findings for healthy adults.



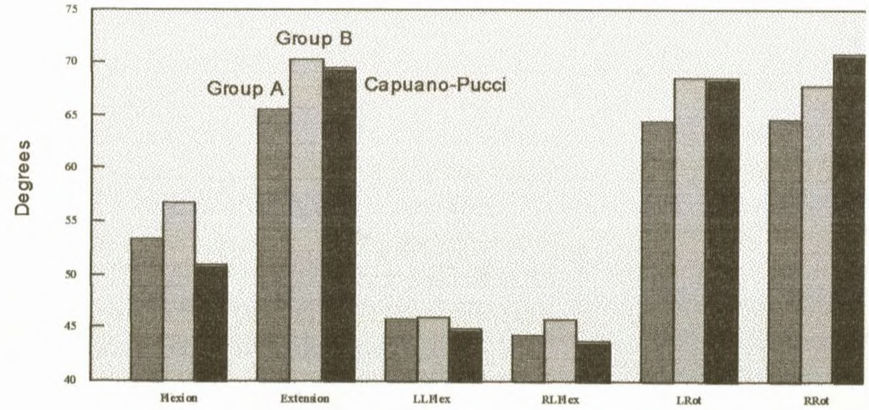
From Figure 5.3, it can be seen that, like the results from Dvorak et al. (1988), the proportions of active motion at each of the consecutive joint segments followed a similar pattern. Compared to the control groups, this study's headache group had a higher prevalence of lesioned segments at the C1-C2,C2-C3 and C3-C4 levels.

Jull (1986) compared upper cervical joint motion palpation in headache and non-headache subjects. These results can be compared with those from this study as both studies had similar methodology and design. Jull (1986) revealed that, like this study, there was a significantly higher prevalence of lesioned segments in the headache group as opposed to the control group.

In conclusion, if one considers, in this study, the predominance of hypomobile motion palpation findings that was confirmed by the prevalence of abnormal segmental motion findings, on flexion/extension X-rays (C1-C6) and back this up with similar findings by Vernon and Steiman (1992) and Jull (1986), tension-type headache may be associated with joint hypomobility lesions.

In a study by Capuano-Pucci et al. (1991), normal ranges of active cervical motion were investigated in 20 asymptomatic subjects. Although the sample size of this study was small, the proportion of each range of motion from the Capuano-Pucci et al. (1991) study can used to disclose any variance in this study, with regard to the control group's range of motion measurements.

Figure 5.4 Comparison of Average Active Range of Motion Measurements with Capuano-Pucci et al.'s (1991) findings for healthy adults.



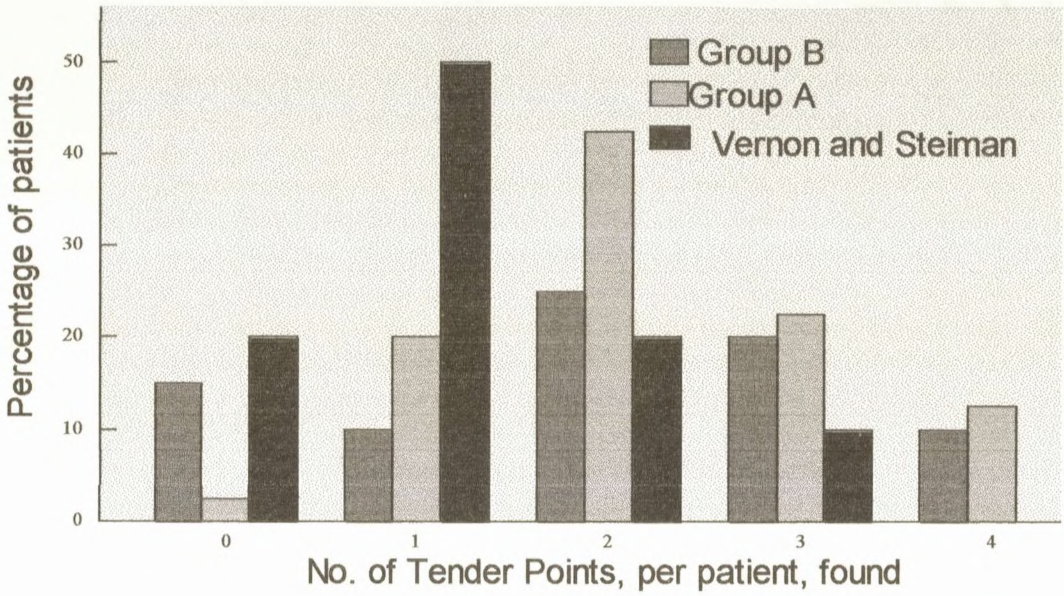
Direction of movement

From Figure 5.4, it can be seen that, like the results from Capuano-Pucci et al. (1991), there was a similar proportion of Active Range of Motion for the various directions of movement. The greatest difference, with regard to the control group and higher range of motion was found for flexion. No explanation can be afforded for this finding. Compared to the control groups, the study headache group had a marginally reduced range of motion for most directions of motion.

Nagasawa et al. (1993) compared the measurements of cervical sagital curve x-rays from 373 tension-type headache subjects with 225 normal controls. Nagasawa et al. (1993) revealed that, like this study, there was a statistically significantly higher prevalence of loss of lordosis in the headache group as opposed to the control group. Therefore, in conclusion, tension-type headache may be associated with loss of cervical lordosis.

Vernon and Steiman's (1992) findings of tender points in tension-type headache subjects can be compared to this study's headache group data.

Figure 5.5 Comparison of the distribution of tender point findings, according to the number of tender points found, per subject, with Vernon and Steiman's (1992) study on cervicogenic dysfunction.



From Figure 5.5, it can be seen that, like the results from Vernon and Steiman (1992), there was a high prevalence of tender points in the headache group. Compared to the control group, both headache groups had a higher prevalence of tender points. Therefore, in conclusion, tension-type headache may be associated with tender points.

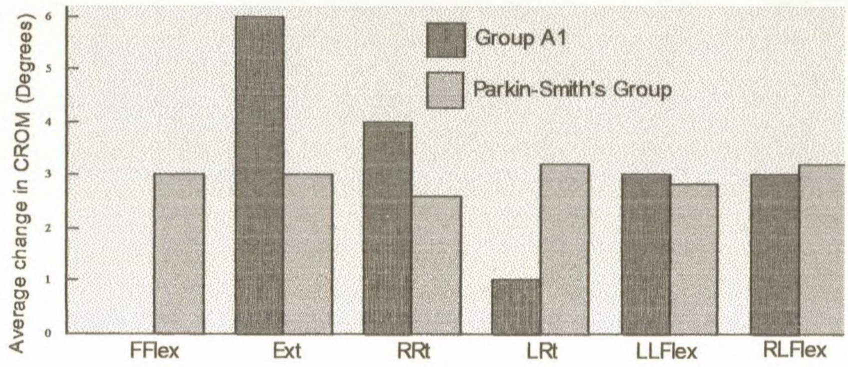
5.5.2 Intra-group comparisons

Yeoman (1992) did a study on patients with mechanical neck pain, where he assessed, using motion palpation, cervical inter-segmental mobility before and after cervical adjustments. The frequency of treatments averaged at three times per week, ranging from two to six weeks i.e. similar to this study. Yeoman (1992) revealed that, like this study, post-manipulative mobility was statistically significantly greater (exception of C1) than before spinal manipulative therapy.

Terret and Vernon (1984) found that there was a statistically significant increase in pain tolerance levels of the paraspinal tissue after spinal manipulation as compared to the control group. The results of their study were found to be similar to the results of this study in terms of decrease in the number of tender points.

Parkin-Smith (1996) found an increased range of motion and decreased neck pain in 15 mechanical neck pain patients, who recieved cervical manipulation, as opposed to 15 control subjects. Due to the frequency and methods of treatments of the study being similar to this study, the results could be comparable.

Figure 5.6 Comparison of Parkin-Smith's (1996) study on the efficacy of manipulation on cervical range of motion, to this study.



From Figure 5.6 one can see that there was an interval difference, for each of the directions of motion, of only 0.2 °to 3° between the different studies. The only noticeable difference found in Figure 5.6 was that, in this study, there was no change in range of motion, in flexion, for Group A1, compared to the other study. No explanation can be afforded for this finding. Therefore, looking at the overall results it may be concluded that the manipulation resulted in an increase in range of motion.

5.6 General Discussion of the Objective Data

For Group A and Group B, according to the null hypothesis, it was hypothesized that there would be no difference in the objective clinical findings on analysis of the inter-group data, showing no higher prevalence of cervical spine dysfunction in the tension-type headache group as opposed to the control group. This is rejected. On inspection of the data it was found that there was an appreciable difference in the mean results and that there was a statistically significant difference in the inter-group results.

The findings describe a high prevalence of cervical spine dysfunction in the headache group, including hypomobile motion palpation findings, confirmed by decreased active inter-segmental motion x-ray findings (especially at the C1-C2 and C2-C3 levels), significant loss of normal cervical spine lordosis and a high prevalence of tender points (especially in the mid- and upper cervical region). These findings were all statistically significant when comparing the two groups.

For range of motion the only statistically significant finding was left lateral flexion and extension in favor of the headache group, which was close to the 95% confidence level.

For Group A1, the null hypothesis was that there would be no difference in the objective clinical findings on analysis of the intra-group data, showing that the chiropractic approach in the management of tension-type headache, in terms of objective clinical findings, is not efficient. This is rejected.

Comparison of the first to final treatment period disclosed a statistically significant difference in passive and active inter-segmental motion findings, cervical spine sagital curve findings and tender point findings, indicating decrease in cervical spine dysfunction after the treatment period.

Comparison of the first to final treatment period disclosed a statistically significant difference for range of motion measurements, indicating increased neck mobility after the treatment period. There was, however, no statistically significant difference for range of motion measurements for left and right lateral flexion, as well as right rotation.

For the above statistically insignificant findings of range of motion, when one looks at the relevant powers of intra-group comparisons, one can see that the powers of the tests are overall very weak. This shows that the chance of missing possible statistical significant results is high (i.e. a high probability of type 2 errors occurring).

As the control group recieved no placebo treatment, and were therefore not reassessed, no comparisons were drawn between the control and treatment group (i.e. Group A1 and Group A2).

5.7 Problems Encountered with regards to the Objective Data

Problems encountered included:

- Accuracy of the goniometer used combined with human error may decrease the efficacy of the result, these errors can be reduced by use of more technologically advanced equipment, if available, that is less likely to be subject to human error.

-Human error of the algometer in terms of the positional placement, force and direction each time the instrument was used, questioning the sensitivity to subtle changes. This author did, however, re-check recordings if he was felt that it was necessary. The use of more technologically advanced equipment could have reduced these errors.

-With motion palpation, meaningful measurements are difficult to conceive due to subjectivity, mainly because the palpatory finger is constantly moving, changing in both direction and intensity. This is further complicated by any incidental feedback situation between therapist and patient, making reproduction vitually impossible. Errors were reduced by having another examiner, blinded to which group the subject belonged to and to what fixations had been detected, palpate for fixations. Only positive confirmations were used in the data.

-In the analysis of kinematic parameters associated with functional radiographs, the following errors can be disclosed:

1. Re-digitizing the same radiographic pair results in very small errors.

2. Re-marking the radiographs results in some degree of errors.

3. A component in the errors of kinematic parameters is the manual superimposition and marking of radiographic films.

4. Errors are associated with motions of end spinal levels in the cervical spine, namely C1-C2.

5. The quality of the radiographic films affects the errors in kinematic parameters.

-Factors that may have contributed to errors in the analysis of cervical lateral films include the following:

1. The quality of the radiographic films, including blurring by involuntary patient movements, affects the errors in kinematic parameters.

2. Incorrect subject positioning, especially with regard to the inclination of the head may result in some degree of errors.

5.8 Statistical Limitations

The sample of Group A1 (i.e. 20) is too small to do more powerful parametric statistical analyses.

Furthermore due to the small size of the sample, there is a predilection for a Type 2 error (Freiman et al. 1992: 358).

In this study homogeneity was a problem. This author consecutively allocated the patients to the headache group and the asymptomatic subjects to the control group. However ideally matched pairs should be used where the subject is matched with someone of the same or similar age, sex, race and history (Fitz-Gibbon and Morris 1987: 109). In this study's clinical setting and time restraint, it was not possible to achieve this.

The data collected from the treatment group, Group A1, was not compared with data from the non-treatment group, neither at the initial consultation nor after three weeks. This did not occur, mainly due to the ethical issue of not treating the headache patients and then re-examining (including x-rays) after three weeks.

5.9 Study Design limitations

A further limitation in the study design is the clinical examination and treating of subjects who may have one of two tension-type headache types (i.e. episodic tension-type headache and chronic tension-type headache). It would have been of increased value to evaluate and treat only one tension-type headache type (for example episodic tension-type headache).

5.10 Conclusion

It was found that a high prevalence of cervical spine dysfunction occurred in tension-type headache patients as opposed to healthy subjects.

It was also found that chiropractic management was relatively effective in treating tension-type headaches in terms of objective clinical findings.

CHAPTER 6

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

This study consisted of two parts:

In the first part, 40 subjects, after undergoing an intensive medical history, physical and orthopedic examination were all diagnosed with tension-type headache and were then compared to, in terms of objective clinical examinations, 40 asymptomatic subjects. The objective examinations revealed a statistically significant high prevalence of cervical spine dysfunction, including joint hypomobility, loss of normal cervical lordosis, increased tender point findings and reduced cervical range of motion, in the headache group as opposed to the control group. Certain clinical examination findings of the cervical spine, as they relate to tension-type headache, were thus identified. These results may encourage any clinician to give rise to careful consideration of the role of the cervical spine when examining and managing patients with tension-type headache.

In the second part, after random allocation, 20 of the 40 headache subjects were treated by the author using light soft tissue massage followed by a chiropractic adjustment(s) of the pertinent level(s). The patients again underwent objective clinical examinations at the end of three weeks. The examinations revealed statistically significant improvements in cervical spine dysfunction, including increased joint mobility, increased cervical lordosis, decreased tender point findings and increased cervical range of motion, at the final consultation as opposed to the initial examination. These results, therefore, show the relative efficacy of the chiropractic management of tension-type headaches.

6.2 RECOMMENDATIONS

With regard to the first part of the study the following recommendations are made:

-Larger sample size should be used in order to increase validity.

-More accurate goniometers and algometers should be used in order to eliminate reliability problems.

With regard to the second part of the study the following recommendations are made:

-A placebo controlled study is needed to accurately assess the effects of manipulation on tension-type headaches.

-A larger sample size is recommended allowing for parametric statistical analysis to be performed. This would make a trend in the results more apparent and sensitive to subtle changes in data. This study with a treatment group of 20, can only be considered a pilot study. It therefore cannot carry the weight that a larger sample size would support.

-It is also advisable that with future studies a follow-up period be allowed to show the relative long-term efficacy of the chiropractic adjustments. Factors like gender, level of joint dysfunction, age and outside variables such as stress of occupation and sports played should be taken into consideration to make these results more valid.

-Lastly, it is recommended that future studies involve only one kind of tension-type headache, for the sake of scientific accuracy and simplicity.

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TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient:________________________________ Date: ____________________
file #:_______ X-Ray#:________________
Age:_______ Sex:_______ Occupation:______________
Intern:__________________________ Signature:______________

FOR CLINICIAN'S USE ONLY
Initial visit clinician:____________________Signature:____________________

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

Case Status:

PTT: Conditional: Signed Off: Final Sign out:

Recommendations:

Intern's Case History

1. Source of History:

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

3. Present Illness:

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

4. Other Complaints:

5. Past Medical History:

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

6. Current health status and life-style:

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

7. Immediate Family Medical History:

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

8. Psychosocial history:

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

9. Review of Systems:

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

APPENDIX B

TECHNIKON NATAL

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

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

1. VITALS

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

2. GENERAL EXAMINATION

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

Urinalysis:

3. CARDIOVASCULAR EXAMINATION

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

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

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

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

Percussion: - borders of heart

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

4. RESPIRATORY EXAMINATION

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

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

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

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

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

5. ABDOMINAL EXAMINATION

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

Inspection
- Shape:
- Scars:
- Hernias:

Palpation
- Superficial:
- Deep = Organomegally:

- Masses (intra- or extramural)
- Aorta:

Percussion - Rebound tenderness:
- Ascites:
- Masses:

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

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

6. G.U.T EXAMINATION

External genitalia:
Hernias:
Masses:
Discharges:

7. NEUROLOGICAL EXAMINATION

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

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

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

Evidence of head trauma:

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

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

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

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

III Ocular Muscles:
Eye opening strength:

IV Inferior and Medial movement of eye:

V a. Sensory - Ophthalmic:
- Maxillary:
- Mandibular:
b. Motor - Masseter:
- Jaw lateral movement:
c. Reflexes - Corneal reflex
- Jaw jerk

VI Lateral movement of eyes

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

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

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

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

XII Inspection of tongue (deviation):

Motor System:

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

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

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

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

Sensory System:

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

b. Joint position sense
- Finger:
- Toe:

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

Cerebellar function:

Obvious signs of cerebellar dysfunction:
= Intention Tremor:
= Nystagmus:
= Truncal Ataxia:

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

8. SPINAL EXAMINATION:(See Regional examination)

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

9. BREAST EXAMINATION:

Summon female chaperon.

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

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

APPENDIX #C

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

Patient: ______________________________ File: __________

Date: ______________ Intern/Resident: ______________________________

Clinician: ______________________________ Sign: ______________

OBSERVATION:

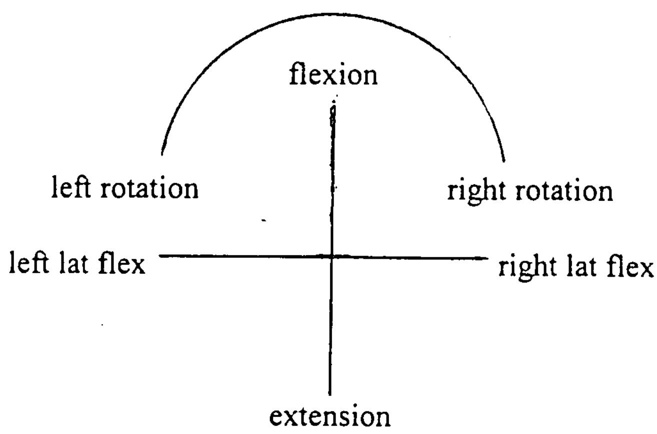
Posture
Swellings
Scars
Discolouration
Hair Line
Bony & Soft Tissue Contours

Shoulder position:
Left:
Right:
Muscle spasm
Facial expression

RANGE OF MOTION:

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

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



PALPATION:

Lymph Nodes
Thyroid Gland

Trachea

ORTHOPAEDIC EXAMINATION:

Tenderness

Trigger Points: SCM
Scalenii
Post Cervicals

Trapezius
Lev Scap

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

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

Dizziness rotation test
Lhermitte's sign
Brachial plexus tension

NEUROLOGICAL EXAMINATION:

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

VASCULAR:

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

MOTION PALPATION & JOINT PLAY:

Left: Motion Palpation:
Joint Play:

Right: Motion palpation:
Joint Play:

Upper T horacics:
Motion Palpation:
Joint Play:

Basic Exam: Shoulder:
Case History:

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

Basic Exam: Thoracic Spine:
Case History:

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

APPENDIX =D

PATIENT CONSENT FORM

Patient: ____

Intern/Clinician: ______________________ Signature: _____________

I, _____________________________________, give my informed consent to be examined, treated and/ or x-rayed at the Technikon Natal Chiropractic Day Clinic under the discretion of the intern/ resident, and will comply with the instructions stipulated by the intern/ resident pertaining to his/ her research project.

Signature: ___________________________

Date: ________________

APPENDIX #E Headache Classification committee of the International headache society (1988) criteria for tension-type headaches:

A. At least 10 previous headache episodes fulfilling criteria B-D listed below.

B. Headache lasting from 30 minutes to 7 days

C. At least 2 of the following characteristics:

1. Pressing/tightening (non-pulsatile) quality

2. Mild or moderate intensity (may inhibit, but does not prohibit activities)

3. Bilateral location

4. No aggravation by walking stairs or similar routine physical activity

D. Both of the following:

1. No nausea or vomiting (anorexia may occur)

2. Photophobia and phonophobia are absent, or one but not the other is present.

APPENDIX #F

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.

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 1: CROM with rotation arm and magnetic yoke

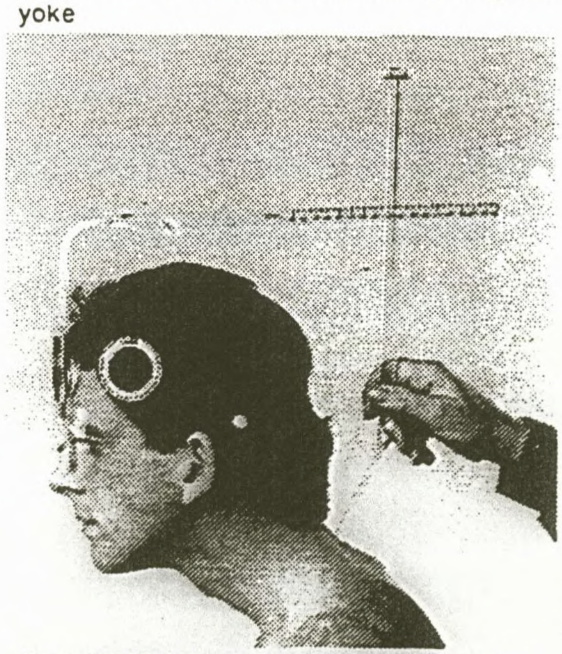


Figure 2: CROM with forward head arm and vertebra locator

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*.

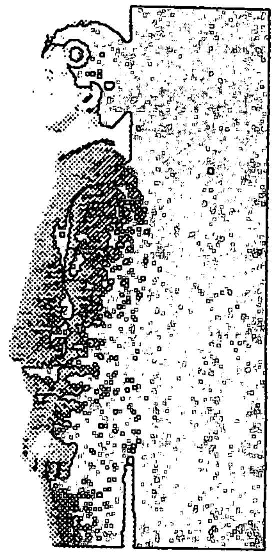


Figure 3: Resting posture

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.

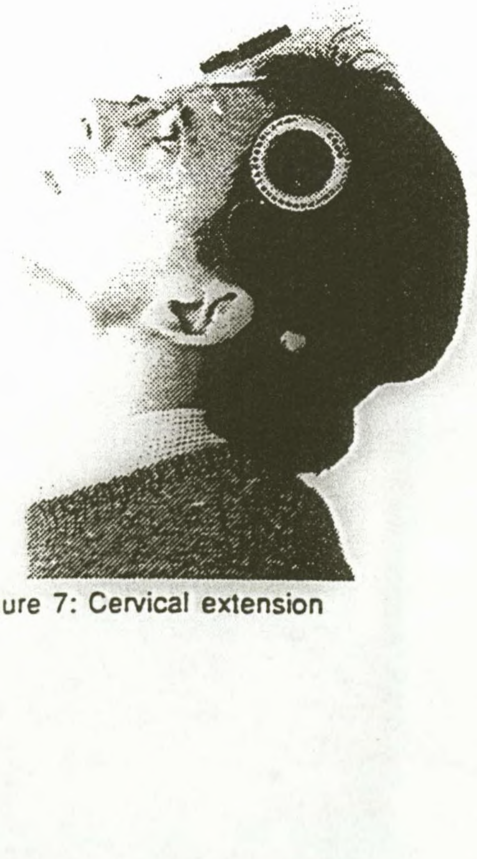


Figure 7: Cervical extension

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.

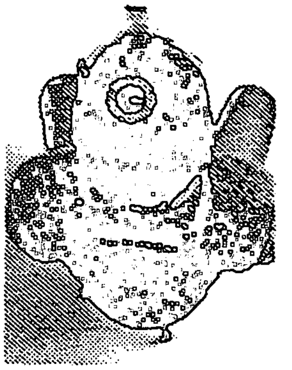


Figure 10: Magnetic yoke pointing north

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 <u>not</u> 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.

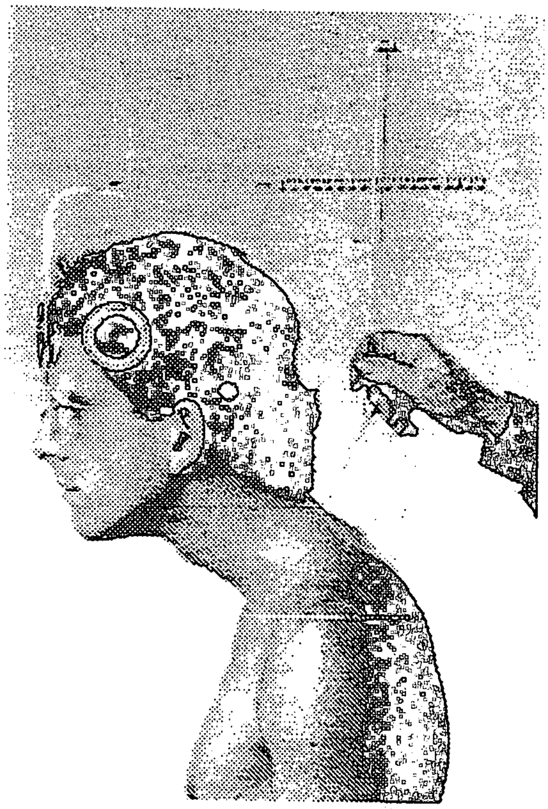


Figure 13: CROM with forward head arm and vertebra locator

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.

Figure 3.24. Locating the tip of the right transverse process of the atlas at the start of atlanta motion palpation.

Rotation of the Occiput on the Atlas. Place the pad of your palpating finger on the tip of a transverse process of the patient's atlas (Fig. 3.24). With your stabilizing hand on the patient's skull, rotate the patient's head slowly to one side, then to the other side (Fig. 3.25). Avoid any flexion, extension, or lateral bending of the patient's neck. This is enhanced by using your palpating finger as a fulcrum. Repeat with your palpating finger on the patient's contralateral transverse process. You will be able to feel the transverse process glide behind the mandible when the patient's head is fully rotated to the side of palpation. If the joint is fixed, this motion will be absent. Occipital rotational end play is sometimes a difficult motion to palpate because of the bulging of the sternocleidomastoideus tendon. Obviously, Gillet and Faye support those authors who report occipital rotation on the atlas because it is palpable.

APPENDIX #G: <u>Motion Palpation Procedure</u>.

Szaraz, Z.T. 1990. Revised Ed. <u>Compendium of Chiropractic Technique</u>.

Flexion-Extension of the Occiput on the Atlas. This is a remarkable two-phase process. During the first phase, the occiput anteflexes on the atlas. During the second phase of flexion, however, Snijders/Timmerman state that the occiput retroflexes relative to the atlas and axis during flexion-extension of the neck.

With your stabilizing hand supporting the patient's vertex, place your palpating finger into the small space between the lateral tip of a transverse process of the atlas and the ramus of the patient's jaw (Fig. 3.26). Push the patient's head with your stabilizing hand so that the patient's chin moves directly forward, parallel to the floor. Have patience in your practice of this palpation, as the skill can be difficult to master. If there is no unilateral fixation, you should feel the space between the transverse process and the jaw open wider. (The pushing hand on the crown of the patient's head should feel for the springy end feel, states Faye.) Then bring the patient's occiput backward, tucking the patient's chin inward against the throat (Fig. 3.27). If there is no unilateral fixation in flexion, the space being palpated will narrow and sometimes become lost to the touch. Repeat this procedure on the contralateral side.

During this evaluation, the ramus of the jaw may be felt to flip distinctly superior rather than rolling anterior. Gillet believes that this hinge-type motion (rather than a rolling motion) is the result of hypertonicity of the rectus posterior minor muscle, either unilateral or bilateral, that produces restricted motion of the posterior atlas but free motion of the anterior atlas. If this is the case, forced motion will produce a shear force. On the other hand, if the anterior muscles are hypertonic, the anterior aspect of the condyle will be compressed against the anterior lateral mass of the atlas, while the posterior aspect opens. This can be palpated on forced motion by placing the palpating

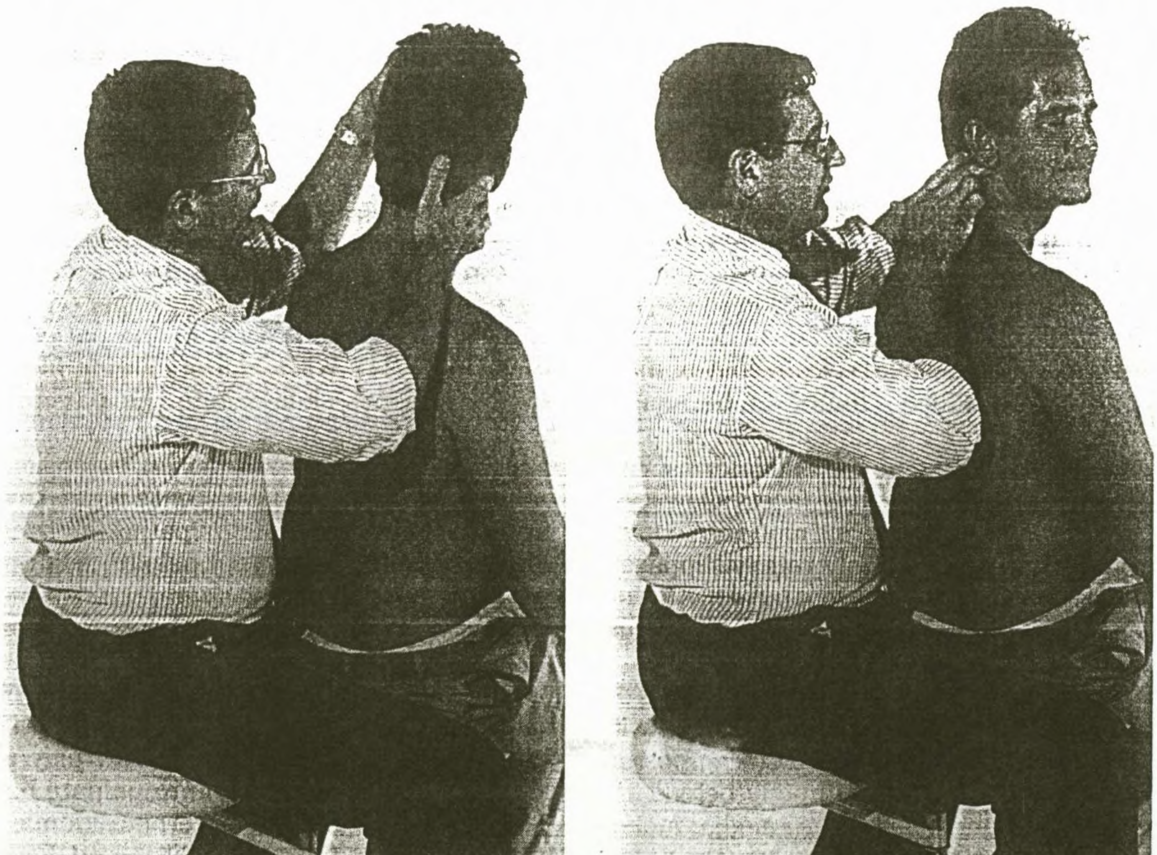


Figure 3.25. *Left,* checking right-to-left rotation of the occiput on the atlas; *right,* left-to-right rotation.

finger in the posterior aspect of the transverse mastoid space while the patient's head is moved into maximum extension and flexion.

Lateral Bending of the Occiput on the Atlas. Place your palpating finger over the tip of a transverse process of the patient's atlas. Place your stabilizing hand on the patient's vertex and flex the crown laterally (Fig. 3.28), first toward one side and then toward the other, taking care to localize motion at the occipitoatlantal level. Avoid midcervical motion by using your palpating finger as a fulcrum. If fixation is absent, you will be able to feel the space above the transverse process open and close as you laterally flex the patient's head away and toward your palpating finger. Again, states Faye, the hand stabilizing the patient's crown feels for joint end play.

Differentiating Occipitoatlantal Muscular and Articular Fixations. The tip of the palpating finger is placed under the posterior occiput, midway between the occipital notch and the mastoid process (Fig. 3.29). Some examiners prefer to cup the atlas in the web of the palpating hand so that the thumb palpates one side while the middle finger palpates the other side. The supporting hand rocks the patient's head into flexion and extension. If a stubborn articular fixation exists, the fibrous tissues will feel like a hard mass that does not change texture during motion. This feeling is characteristic and different from the softness of the tissues surrounding a freely or partially movable atlas. You also have an opportunity here of changing hands and palpating the same spot on the other side. Keep in mind that if a *total* fixation is evident unilaterally, the atlas will not be able to move on the contralateral side even if all tissues there feel normal.

Figure 3.26. Palpating the depression anterior to the right transverse process of the atlas during evaluation of flexion-extension of the occiput on the atlas.

Figure 3.27. Position for checking A-P motion of the occiput on the atlas.

An important exception to the rule that the amount of irritation decreases with the degree of fixation is found with total fixation of the occipitoatlantal joints. Here, for some unknown reason, there is almost never degeneration in the soft tissues and the fixation remains in an acute stage, according to Gillet. Thus, in this disorder, the amount of signs of irritation increases with the degree of fixation.

Atlantal-Axial Palpation

Rotation of the Atlas on the Axis. The pads of the first three fingers are placed horizontally in the suboccipital space so that the first finger firmly presses against the occipital notch, the second finger rests in the space over the posterior tubercle of the atlas, and the third finger rests lightly on the tip of the C2 spinous process. The free hand is used to rotate the head. During passive rotation, several degrees of atlas rotation should take place before the axis begins to move. Normally, the third finger will slip on the spinous process of the axis as the head is rotated because the head moves 1 cm or more prior to axial motion. Bilateral atlantoaxial fixation is indicated if the axis immediately follows the movement of the head (primarily the atlas), noted by the third finger not gliding over the process of the axis. If unilateral (pivotal) fixation is present, this situation will occur during rotation to one side but not to the other, and the center of movement will be at the point of fixation rather than at the odontoid. If the axis is fixed unilaterally, rotary movement will also be felt on the free side during A-P motion.

Faye also checks the mobility of atlas-axis rotation by placing the pads of the palpating fingers against the pillars of the upper cervical vertebra. He pronates his wrist and palm and holds his elbow horizontal during this palpation (Fig. 3.30). At the extreme of pas-

Figure 3.28. Position for checking lateral bending to the right of the occiput on the atlas.

Figure 3.29. Position for differentiating right occipitoatlantal muscular and articular disorders.

sive rotation, he uses an end push to judge the integrity of end play. During atlantal-axial A-P rotation, facet translation is judged with the fingertips placed on the anterolateral aspect of the transverse process of the atlas (Fig. 3.31). These P-A and A-P motions, as all motions, must be checked bilaterally.

Lateral Bending of the Atlas on the Axis. Active lateral bending of the atlas on the axis is questioned by some authorities, but an important and distinct end play can be palpated in healthy spines. It has been Gillet's experience that abnormal lateral flexion of the atlas on the axis is affected most by hypertonicity of the intertransversarii and/or the upper part of the longus colli. Motion restriction can be determined by placing the tip of the palpating finger in the posterolateral space between the transverse processes of the atlas and axis and making contact on the atlas close to the rim of the occiput posterolaterally (Fig. 3.32). It is often necessary to slip off the occiput to contact the atlas. The fulcrum for lateral bending is at the palpating finger, and a springy end feel is tested before any lower cervicals begin movement. Remember, in this type of motion palpation, we are palpating for fixation at the end of the passive range of motion. We are not palpating the gross motion available. Our palpation is a *joint challenge*, and we try to determine if the resistance is (1) more than normal but a springy muscular fixation exists, (2) more than normal with an abrupt end feel, or (3) abrupt with an end feel in all directions.

While intertransversarii hypertonicity restricts lateral bending, a small degree of lateral gliding of the atlas on the axis is usually allowed. This does not appear to be true when hypertonicity of the longus colli exists or if articular fixation is present.

Flexion-Extension of the Atlas on the Axis. Palpate between the transverse proc-

Figure 3.30. Position for checking atlas-axis motion during cervical rotation to the left.

Figure 3.31. Position for checking facet translation during A-P atlantal-axial rotation to the posterior on the right.

esses of the atlas and axis during passive flexion-extension of the patient's head. During normal motion, you should feel the transverse process of the atlas glide forward (anteriorly) during flexion and return (posteriorly) to neutral during extension (Fig. 3.33). [See Clinical Comment 3.5] Keep in mind that there cannot be true posterior extension translation of the atlas on the axis from the neutral position because of the odontoid process. Only tipping can occur.

Another method is to place the palpating finger in the space between the posterior tubercle of the atlas and the spinous of the axis. This space should open on flexion and close on extension of the neck, and the posterior tubercle should become more apparent on flexion and be lost to touch on extension of the neck.

Figure 3.32. Position for evaluating lateral bending to the right of the atlas on the axis.

Occipital and Lower Cervical Relationships

The occiput and axis are not structurally adjacent, thus cannot articulate, but, as previously described, they are combined into a function unit by ligaments, fascia, and several deep cervical muscles, which, when shortened, pull the occiput and lower cervicals into hyperlordosis. This type of fixation is sensed by putting the pads of the palpating fingers into the interspinous spaces, placing your stabilizing hand on the patient's vertex, and then conducting the patient's head into full upper-cervical flexion and extension.

For example, hypertonicity of the rectus capitis posterior major and minor produces extension of the occiput toward the spinous process of the axis in the neutral resting position. The upper- and mid-cervical interspinous spaces will feel closed even during passive flexion of the neck. Hypertonicity of the superior oblique portion of the longus colli and/or rectus capitis anterior and lateralis pull the cervical spine into flexion. The interspinous spaces will feel open even on forced passive extension of the neck. [See Clinical Comment 3.6]

Lower Cervical Palpation

All cervical vertebrae from C2 to C7 partake in flexion, extension, rotation, and lateral flexion, but some segments (eg, C5) are more active than others. Refer to Table 3.4.

Lateral Flexion of C2—C7. The mid and lower cervicals are palpated in lateral bend-

DR. FAYE'S CLINICAL COMMENT #3.5

I palpate the posterolateral portion of the posterior arch of atlas with my wrist pronated and push into extension when the head is extended. For flexion I palpate the anterior of the tip of the atlas transverse. To achieve this the wrist is supinated and the middle finger comes in from the ramus of the jaw to make very gentle contact on the atlas transverse tip. As the head is nodded gentle pressure posterior with the palpating finger determines if joint play is present. The loss of joint play here is very painful, and a cough reflex is elicited if too much pressure is exerted.

ing as moving away from the side of flexion. To evaluate lateral gliding, place your thumb or the pad of your pronated middle finger firmly against the posterolateral aspect of the spinous processes or on the articular pillars of the segments being evaluated, while your supporting hand moves the patient's head in wide lateral flexion (refer to Fig. 3.32). Laterally flex the patient's head over your palpating finger, which will serve as a fulcrum, and check for additional joint play at the end of passive motion.

The importance of palpable asymmetry in response to passive cervical sidebending has been clearly brought out by Johnston and associates who concluded that it appears to be an early indicator of a measurable impairment of cervical function, even in the absence of pain or other complaints. Thus, the role of segmental motion palpation in preventive health-care is underscored.

Segmental motion studies should not be confused with gross motion studies. When a motion-unit becomes dysfunctional, it exhibits asymmetric behavior that is palpable. In addition, secondary (compensatory) effects spread to adjacent units, usually within three segments, which does not necessarily

DR. FAYE'S CLINICAL COMMENT #3.6

The greatest relationship to upper-cervical fixation is a mid- or lower-cervical hypermobility. The neutral lateral radiograph will miss this finding; however, the lateral views of flexion and extension will elicit the hypermobility. More than 3 or 4 mm of stair-stepping is an instability and a sign of ligament pathology. This sign often occurs 6 months after a "whiplash" injury especially if pain occurred within 24 hours of the accident and even if the patient became pain free in less than 6 months. It is worth noting post-traumatic fixations of the upper thoracics: the upper costotransverse joints and the sternoclavicular joints can all contribute to the need for hypermobility of the middle and lower cervicals.

Figure 3.33. Palpating the transverse processes of C1 and C2 during flexion of the atlas on the axis: from the anterior during flexion *(left)*, from the posterior during extension *(right)*.

hand, placed on the forehead or vertex of the patient, rolls the patient's head down and forward, tucking in the patient's chin, to check segmental forward flexion. With the patient's head still in forward flexion, the patient's neck is turned toward the side of palpation to check A-P rotation. During this maneuver, the palpating finger must be controlled by bringing it backward and upward, tugging against the sternocleidomastoideus muscle so that it will not hinder the palpation. After a motion unit has been checked, the patient's head is returned to the neutral position, the palpating fingers are slid to an adjacent motion unit, and the procedure is repeated.

Long-Axis Tension (Elongation). To evaluate the degree of distraction available between the facets of the segments of the cervical spine and the adaptability of the IVDs to tensile forces, place the patient in the supine position. Stand or sit facing the head of the table. Take a bilateral index or middle finger contact on the lamina of each segment, one at a time, and apply moderate traction, keeping the patient's neck in the neutral position by avoiding flexion or extension. The patient's skull should be supported by your palms. You should be able to feel a slight separation at each level.

Common Types of Mid- and Lower-Cervical Fixations. The two most common types of fixation in this area, states Faye, are those involving (1) simultaneous extension, lateral bending, and P-A rotation, and (2) simultaneous flexion and A-P rotation. [See Clinical Comment 3.7]

Interspinous fixation. Hypertonicity of one or more extensors tends to bind spinous processes together so that a segmental lordosis is formed. This condition, often found at the C3—C4 level, is palpable when the spinous processes refuse to open during passive flexion. It is also often evident on lateral stress films during forward flexion where two or more vertebrae do not follow the curve of the neck as a whole.

Covertebral articular fixation. Fixation is common at the lips of the joints of Luschka by longus colli hypertonicity, ligamentous shortening, and exostosis. See Figure 3.34. If it is found during passive motions that the patient's neck stops sharply at a point far short of normal motion, Gillet refers to this "brick wall" sign of strong restriction as an indication of cervical osteophytes. This is a classic sign of chronic degeneration found in the cervical joints of the elderly exhibiting a "dry" cervical spine. These fixations often produce chronic brachialgia.

The joints (or fissures) of Luschka (the uncovertebral joints of the cervical spine)

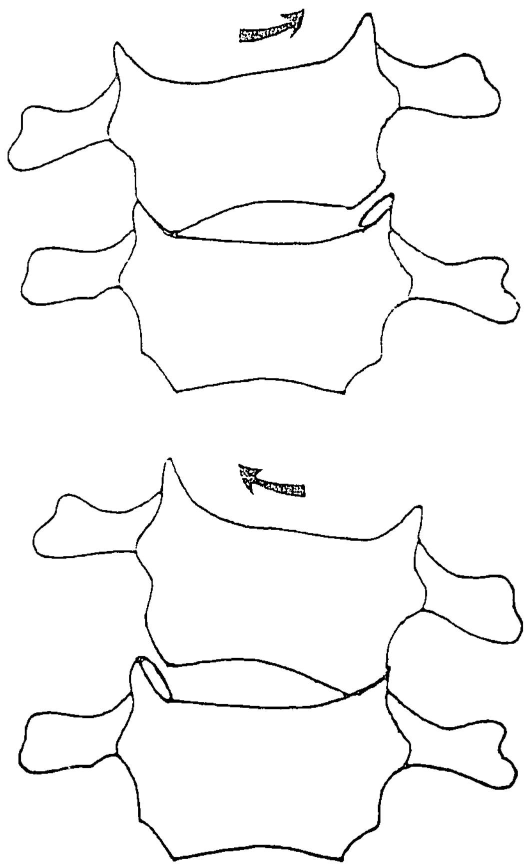


Figure 3.34. Coronal section of two midcervical vertebrae showing the motion of lateral flexion created by the planes of the uncovertebral joints (Courtesy ACAP).

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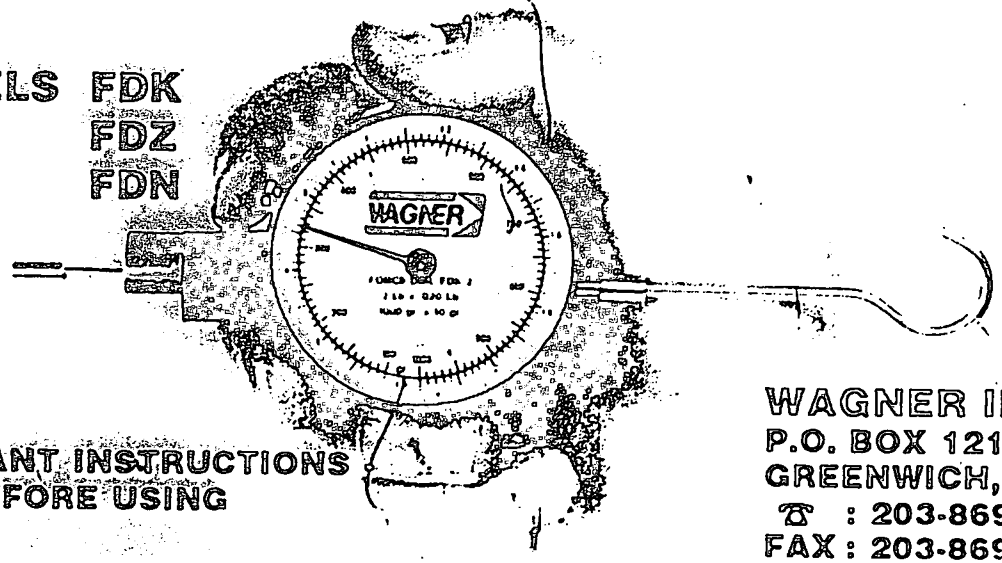

IMPORTANT INSTRUCTIONS
READ BEFORE USING

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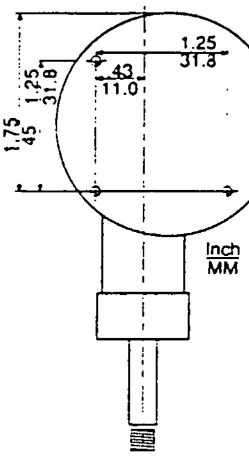
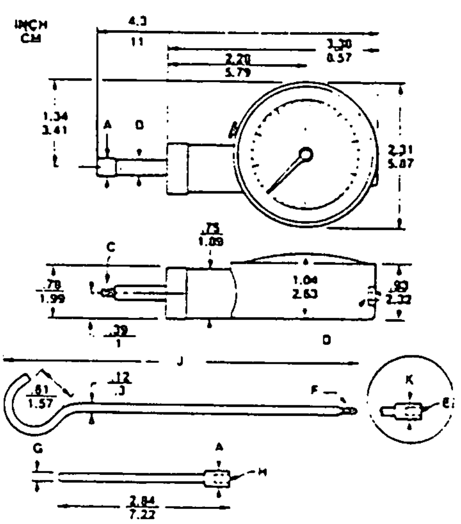
FAX : 203-869-9871

MOUNTING

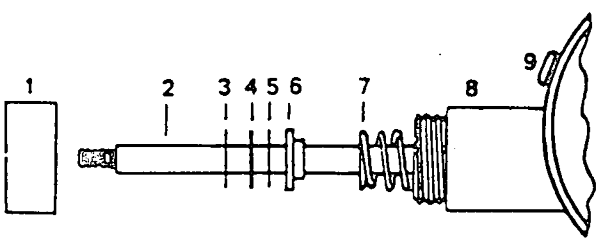
Your FORCE DIAL may be mounted with three #6 (.138 in/3.5 mm O.D.) sheet metal screws using the hole pattern shown below. The three dimples on the rear housing will assist in starting the screws. Sturdy posts are located internally behind the dimples to accept the screws. The screws should penetrate no more than 3/8 inches or 10 mm.



DIMENSIONS



PARTS



(1) Retainer
(2) Plunger
(3) Disc
(4) Clip
(5) Calibration Washers
(6) Plate
(7) Spring
(8) Case
(9) Push Button
(10) Crystal *
(11) Pointer *

ACCESSORIES: *

(12) Flat Tip (thru 2 LB / 1000 G / 10 N)
(13) Flat Tip (5 LB / 2500 G / 20 N & up)
(14) Long Rod (thru 2 LB / 1000 G / 10 N)
(15) Long Rod (5 LB / 2500 G / 20 N & up)
(16) Pull Hook (thru 2 LB / 1000 G / 10 N)
(17) Pull Hook (5 LB / 2500 G / 20 N & up)

* Not shown in diagram.

High and low capacity models differ slightly in design. The lettered dimensions above, along with the corresponding neasurements and comments shown below identify these small variations.

All dimensions are approximate.

Low Capacity (thru 2 LB / 1000 G)			**High Capacity** (5 LB / 2500 G & up		
A	.19"	.45 cm	A	.26"	.65 cm
B	.12"	.3 cm	B	.24"	.6 cm
C	M 3	male	C	M 4	male
D	M 3	male	D	M 3	female
E	M 3	female	F	M 3	male
G	.12"	.3 cm	G	.14"	.35 cm
H	M 3	female	H	M 4	female
J	2.8"	7.1 cm	J	3.4"	8.6 cm
K	.19"	.45 cm			

GENERAL

Your FORCE DIAL should not be used to measure forces below 25% of full scale since true accuracy is degraded as readings decrease from full scale. Before placing the FORCE DIAL into service it is also recommended to test for accuracy according to procedures found in the CALIBRATION section of this manual.

Model FDK FORCE DIALS have no zero on the dial, since setting the pointer at zero has no significance in calibration or accuracy: see CALIBRATION for details.

Lubrication of the FORCE DIAL is not recommended.

IMPORTANT

To prevent damage, keep an implement/ accessory on the plunger even when the gage is not in use and when using the pull hook. This provides a positive stop and prevents the plunger from being pushed too far.

CALIBRATION

The calibration of the FORCE DIAL may be checked by attaching the pull hook and suspending test weights at 1/4, 1/2, 3/4, and full capacity in the vertical position. The weight of the plunger, flat, tip and pull hook (.03 LB, 17/32 OZ, 15 G) should be subtracted from test results. If it is determined that recalibration is required the instrument should be returned to the factory.

IMPLEMENT WEIGHT ADJUSTMENT
The FORCE DIAL is calibrated for use in the horizontal position. When using low capacity models - thru 2 LB/ 1000 G/ 10 N - in the vertical position, add or deduct the weight of the implements used from your readings, as follows:

WEIGHT OF IMPLEMENTS:

- Plunger:	.015 LB/	1/4	OZ/ 7 G
- Flat Tip:	.004 LB/	1/16	OZ/ 2 G
- Long Rod:	.009 LB/	5/32	OZ/ 4 G
- Pull Hook:	.013 LB/	7/32	OZ/ 6 G

ADJUSTMENT:

USE	WITH	+/-
Pushing Down	Plunger/Flat Tip	+9 G
Pushing Down	Pliunger/Long Rod	+11 G
Pulling Down	Plunger/Flat Tip/Hook	+15 G
Pushing Up	Plunger/Flat Tip	-9 G
Pushing Up	Plunger/Long Rod	-11 G
Pulling Up	Plunger/Flat Tip/Hook	-15 G