An investigation into the role of forward head posture as an associated factor in the presentation of episodic tension-type and cervicogenic headaches.

By

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I, Victor Duani, do declare that this dissertation is representative of my own work in both conception and execution, except where acknowledgements indicate to the contrary.

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Approved for final submission

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DEDICATION

I would like to dedicate this dissertation to my parents Eli and Sarah Duani for their unconditional support over the years.

My wife Sinead Duani for believing in me and assisting me with the completion of this journey.

My boys Zohar and Naor Duani for keeping me sane during the write up phase and providing me with the right reasons to finish.

To all with love, respect and gratitude.

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ABSTRACT

Background: Forward head posture (FHP) is a common postural abnormality, often associated with myofascial trigger points which can result in head and neck pain. The craniovertebral (CV) angle lies between a horizontal line running through C7 spinous process and a line connecting C7 spinous process to the tragus of the ear. The smaller the angle the greater the FHP. Cervical musculoskeletal abnormalities have often been linked to headache types, most especially episodic tension-type headache (ETTH) and cervicogenic headaches (CGH). **Objectives:** To determine whether an association exists between FHP, distance of the external auditory meatus (EAM) from the plumbline and cervical range of motion and the presentation of ETTH and CGH. **Method:** This was a quantitative comparative study (n=60) comparing three equal groups, one with ETTH, CGH and healthy controls. The FHP of the Subjects FHP was assessed by measuring the CV angle. A lateral digital photograph was taken to assess the distance of the external auditory meatus from the plumbline. Lastly, cervical range of motion was measured. The two symptomatic groups also received a headache diary for a fourteen day period monitoring frequency, intensity and duration of their headaches. **Result:** The two symptomatic groups had a smaller CV angle and a greater distance from the plumbline ($p<0.05$) than the asymptomatic group. The asymptomatic group had a significantly greater flexion ($p=0.009$), extension ($p=0.038$) and left rotation ($p=0.018$) range of motion than the two symptomatic groups. The CGH group had a significant positive correlation between the distance of the EAM from the plumbline and the intensity of headaches. The ETTH group had a significant positive correlation between the right craniovertebral angle and the mean duration of headaches. **Conclusion:** Therefore, it can be concluded that patients presenting with ETTH and/or CGH may have associated postural abnormalities that may act as a trigger or a contributory factor to the presenting headache.

Key words: Forward head posture, craniovertebral angle, C7 spinous process, episodic tension-type headache, cervicogenic headaches, EAM, plumbline and cervical range of motion.

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DEFENITIONS

Forward head position:

Anterior shift of the head position occurs, resulting in the movement of the body away from the center of gravity (Ho Ting Yip *et al*, 2007).

Upper cross syndrome:

Combination of tight and weak muscles, as a result of this posture, joint dysfunction and myofascial trigger points occur, muscles on the one diagonal side of the joint are tight and hypertonic and on the other diagonal side of the same joint are weak and hypotonic (Liebenson, 1996).

Craniovertebral angle:

The angle between a horizontal line passing through C7 and a line extending from the tragus of the ear to C7 spinous process. The craniovertebral angle values indicate the degree of forward head position (Ho Ting Yip *et al*, 2007 and Anabela, 2009).

Cervicogenic headache:

A syndrome characterised by a unilateral headache that originates from either bony structure or soft tissue in the neck, with referred pain to the head. Caused by dysfunction of the musculoskeletal tissues surrounding the cervical spine (Haas *et al,* 2004 and Moore, 2004).

Episodic tension type headache:(ETTH)

Recurrent episodes of headache, with duration ranging from minutes to days.

These headaches are characterized by bilateral pressure, a band-like sensation, of mild to moderate intensity that does not worsen with routine physical activity.

Nausea is absent, but photophobia or phonophobia may be present (Nicholas *et al*, 2006 and Olesen, 2004).

Plumbline:

The Plumbline is a cord with a plumb bob hung from the ceiling, in line with the standard base point (for a lateral view slightly anterior to the lateral malleolus and for the posterior view midway between the heels (Kendall *et al*, 2005). The line starts from the external auditory meatus (EAM), to the midway point of the shoulder, to the tip greater trochanter, to the anterior axis of the knee joint and to the lateral malleolus (Greenman, 1992).

Body Mass index (BMI):

BMI is a formula that combined the patients weight and height. The actual formula= Weight/Height square (Douglas, Nicol, and Robertson. 2005).

LIST OF ABBREVIATIONS

CGH:	Cervicogenic headache
ETTH:	Episodic tension-type headache
FHP:	Forward head posture
CV angle:	Craniovertebral angle
BMI:	Body Mass Index
IHS:	International Headache Society
NSAIDs:	Non steroidal anti inflammatory drugs
EAM:	External auditory meatus
TMJ:	Temporomandibular joint
MRI:	Magnetic resonance imaging
CROM:	Cervical range of motion

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION TO THE PROBLEM

Forward head posture (FHP) is a common type of postural distortion seen in patients with neck disorders, whereby an anterior shift of the head position occurs, resulting in the movement of the body away from the center of gravity. Ideal posture is considered to be present when the external auditory meatus is aligned with the vertical line (plumbline), which runs along the side view from the anterior aspect of the ankle joint, to the center of the knee, to slightly behind the center of the hip, to the shoulder joint and ends at the external auditory meatus (Ho Ting Yip, Tai Wing Chiu and Tung Kuen Poon, 2007).

This study will investigate the relationship between FHP and two very common headache types: episodic tension-type (ETTH) and cervicogenic headaches (CGH).

ETTH is a primary headache disorder and the most frequent headache found in adults. These headaches are characterized by bilateral pressure, a band-like sensation or an increased tenderness especially in the neck region. The attacks often start in the teenage years, gradually increasing in intensity and reach their peak in the fourth decade. This headache type is believed to be primarily of muscular origin, which could be a result of emotional stress or associated with musculoskeletal pathology in the neck (Boon, Colledge and Walker, 2006 and Fernandez-de-las-Penas, Cuadrado, and Pareja, 2007). A study (n=30) by Fernandez-de-las-Penas *et al*. (2007) showed a remarkable decrease in normal cervical range of motion in subjects with ETTH in comparison to asymptomatic subjects.

CGH are found in 14-18% of patients who suffer from chronic headaches (Zito, Jull, and Story, 2005). Similar to ETTH, the cause of CGH is a dysfunction of the musculoskeletal tissues surrounding the cervical spine. Yet in contrast to ETTH, CGH is described as a pain that originates in the cervical spine with referral to the head, characterized as a unilateral headache with the duration varying from hours to weeks and radiating to the temporal and orbital region of the head (Haas, Groupp, Aickin, Fairweather, Ganger, Attwood, Cummins and Baffes, 2004, Moore, 2004 and

Zito, *et al*., 2005). It is therefore, diagnosed as outlined by the International Headache Society as two distinct disorders (Nilsson and Bove, 2004 and Olesen, 2004).

Cervical musculoskeletal abnormalities have often been linked to different headache types, most especially ETTH and CGH (Fernandez-de-las-Penas *et al*., 2007). Literature has suggested that an association may exist between FHP, CGH and ETTH (Liebenson, 1996, Simons and Travell, 1999 and Magee, 2006). Moore (2004) in a case report on upper cross syndrome, concluded that there is a need for further studies investigating the relationship of postural patterns, to headache symptoms.

1.2 AIMS AND OBJECTIVES OF THE STUDY

The aim of the research is to investigate whether an association exists between FHP and the intensity, frequency and duration of ETTH and CGH compared with an asymptomatic control group.

The objectives:

1.2.1 The first objective

In terms of FHP, to determine the degree of FHP and the position of external auditory meatus from the plumbline and other postural assessment values for each of the three groups. Will also determine the active cervical range of motion.

1.2.2 The second objective

In terms of headache, was to determine the intensity, duration and frequency of the headaches of the symptomatic group.

1.2.3 The third objective:

Was to compare the results of the three groups, in order to determine whether an association exists between the postural assessment values (FHP, EAM and cervical ROM) and the presence and type of headache, as well as the intensity, duration and frequency of the headaches.

1.3 HYPOTHESIS

There is a paucity of studies that have investigated the relationship between cervical posture and headache presentation, it is for this reason that the following null hypothesis were set to address the specific objectives identified in 1.21 to 1.2.3.

1. There will be no association between postural assessment values (FHP, EAM and cervical ROM) and the presence of ETTH.
2. There will be no association between postural assessment values (FHP, EAM and cervical ROM) and the presence of CGH.
3. There will be no association between postural assessment values (FHP, EAM and cervical ROM) and the intensity, duration and frequency of ETTH.
4. There will be no association between postural assessment values (FHP, EAM and cervical ROM) and the intensity, duration and frequency of CGH.

1.4 LIMITATIONS

FHP has been linked to many other types of postural abnormalities such as hyperkyphosis, increased lumbar lordosis with anterior pelvic tilt (Kendall, McCreary, Provance, Rodgers, and Romani, 2005). However for the purposes of this study the main postural assessment values that will be addressed and analyzed include: the degree of FHP, the position of the external auditory meatus from the plumbline and cervical range of motion.

1.5 CONCLUSION

The chiropractic treatment's main aim is to restore proper spinal mechanics - not only relief of symptoms and pain. A variety of aetiological causes have been ascribed to both headaches. However, the role of FHP has not been investigated. Therefore, analysis of postural abnormalities as well as ergonomic education and their impact on headaches would be beneficial to a chiropractic management of this condition (Troyanovich, Harrison, and Harrison, 1998). This study will therefore examine whether an association between FHP and ETTH and CGH exists.

CHAPTER TWO

LITERTURE REVIEW

2.1 Introduction

This chapter will discuss forward head posture (FHP) and its associated condition-the upper cross syndrome. This discussion will be linked to a discussion on two common headache types of musculoskeletal origin: episodic tension-type headache (ETTH) and cervicogenic headache (CGH). The relevant anatomical features will also be presented.

2.2 Forward head posture and headache

FHP is often present in patients complaining of neck pain. It is an anterior deviation of the head from the ideal plumbline (Ho Ting Yip *et al*., 2007). The muscle imbalance present in the FHP, is one in which the neck extensor muscles are in a shortened position and are hypertonic, whereas the neck flexors muscles are in an elongated position and are weak (Kendall *et al*., 2005).

The postural abnormalities that will be mentioned are all linked to FHP. For the purposes of this study the investigation will be limited to FHP alone, in order to focus on one aspect of posture that may have a strong association with headaches. However a brief discussion of upper cross syndrome will be presented in order to understand FHP in its context.

According to Simons and Travell (1999), FHP perpetuates myofascial trigger points that are the contributing, if not the causative factor for many head and neck pain conditions. A case report on upper cross syndrome and its relationship to CGH by Moore (2004), concluded the need for further research into the relationship of postural patterns, such as muscle imbalance, to headache symptoms. Ho Ting Yip *et al*. (2007) investigated the relationship between head posture and neck pain in 114 patients and concluded that the craniovertebral angle in subjects with neck pain is much smaller than in asymptomatic patients. The craniovertebral angle indicates the degree of FHP. The smaller the angle the greater the anterior shift of the head and therefore a more exaggerated FHP (Anabela, David, Paul, Joao and Mark, 2009).

2.3 Posture abnormalities presentation

According to Liebenson (1996), upper cross syndrome is a combination of typical pairs of tight and weak muscles. As a result of this, postural joint dysfunction and myofascial trigger points occur. This can manifest itself in symptoms such as headaches, neck pain, scapula pain, temporomandibular joint (TMJ) and shoulder disorders, with muscles on the one diagonal side of the joint being tight and hypertonic and muscles on the other diagonal side of the same joint being weak and hypotonic.

2.3.1 Upper cross syndrome

Rounded shoulders are often associated with the FHP and are caused by hyperactive pectoral muscles and a kyphotic upper thoracic spine. Weak deep neck flexors with hyperactive neck extensors result in an increase in the lordotic curve of the upper cervical spine. The weakness in the lower fixators of the shoulder girdle results in a hyperactivity of the upper fixators of the shoulder girdle (Lewit, 1991 and Liebenson, 1996).

According to Janda (1983), muscles can be divided into two major groups: postural and phasic. The postural muscles maintain upright posture. This muscle group tends to become short and hypertonic yet rarely atrophies as a result of a trauma. Whereas the phasic muscles tend to become weak and hypotonic, this commonly occurs due to pathology (Magee, 2006). This pattern of muscle imbalance results in the following changes in posture and motion: protraction and elevation of the shoulder, rotation and abduction of the scapula and a FHP (Liebenson, 1996).

2.3.2 Pathophysiology of upper cross syndrome

Upper cross syndrome is a gravity pattern that affects our musculature before it affects our skeleton. It can be divided into Osteokinematic and Arthokinematic coupling. Osteokinematic coupling includes the FHP, an increased first rib angle or dropped sternum, rounded shoulders and increased thoracic kyphosis. Arthokinematic coupling includes a loss of cervical lordosis with an increase in upper cervical extension as a compensatory mechanism in order to maintain the eyes on the optic plane. The decrease in extension range of motion is a result of contracture of the anterior longitudinal ligament (Chaitow, 2008).

A study (n=21) conducted by Jong-Hyuck, Jae-Seop, Heon-Seock, Yong-Wook, Oh-Yun and Chung-Hwi (2009), investigating the effects of FHP on scapular motion, found a significant increase in muscle activities of the upper and lower trapezius muscle and a significant decrease in muscle activities of the serratus anterior muscle during an isometric shoulder flexion, these researchers concluded that a neutral head position is likely to reduce an excessive muscle activity of the upper and lower trapezius muscle and would increase muscle activity of the serratus anterior muscle.

The common abnormal postural presentations are:

- Elevation of the shoulder (due to short upper trapezius and levator scapulae and weak lower and middle trapezius muscles).

- Rounded shoulder (due to short pectoralis major muscles) and winging of the scapulae (due to weak serratus anterior muscles).

- C0-C1 hyperextension (due to short suboccipital muscles), (Lewit, 1991 and Liebenson, 1996).

2.3.3 Etiology of muscle imbalance

According to Janda's theory (cited in Page, Frank and Lardner, 2010), facilitation of antagonistic muscles with inhibition of the agonistic muscles results in muscle imbalance, which leads to change in movement patterns. This facilitation results in over activation of specific muscles and inhibition of the opposing muscles.

Two components that play a role as a causative factor in muscle imbalance are the viscoelastic and the contractile nature of muscle. Some of the contributing factors to muscle imbalance are: stress, fatigue, insufficient physical activity and repetitive movement (Page *et al*., 2010).

2.3.4 Etiology of muscle tightness

Janda states that the primary factor to muscle imbalance is muscle tightness. Muscles that are prone to tightness are about 30% stronger and the first to be recruited in a movement pattern.

Factors that increase muscle tension are:

1. Stress, fatigue, pain and emotion via the limbic system activation
2. Myofascial trigger points
3. Muscle spasm (cited in Page *et al*., 2010).

2.3.5 Etiology of muscle weakness

Weak or inhibited muscles causative factors can be divided into: neurological and adaptive changes.

Neurological factors that result in muscle weakness include:

1. **Reciprocal inhibition**- a reflex that takes place once antagonistic muscle is activated.
2. **Arthrogenic weakness**- occur following joint swelling or dysfunction
3. **Deafferentation**- decrease in nerve input which results in muscle weakness.
4. **Pseudoparesis**- a state of muscle weakness, as a result of decrease in neurological input. This type presents with three clinical signs: low muscle tone, delay in muscle activation and a patient score of 4 out of 5 in a manual muscle test.
5. **Myofascial trigger points**- result in decreased stimulation and early fatigue which leads to muscle weakness.
6. **Fatigue**- can take place due to metabolic or neurological factors (Page *et al.*, 2010).

Adaptive changes that result in muscle weakness include:

1. **Stretch weakness-** occur when muscle lengthens beyond the physiological neutral which often takes place in conjunction with overuse and postural changes.
2. **Tightness weakness-** prolonged overuse muscle shortening results in decrease in muscle elasticity which leads to hypertonicity (Page *et al*., 2010).

2.3.6 The craniovertebral angle

The craniovertebral angle lies between a horizontal line running through C7 spinous process, and a line connecting C7 spinous process and the tragus of the ear. The smaller the angle the greater the FHP, indicating a greater shift of the head from the sagittal plane (plumbline). The larger the angle value is the more it is representative of an 'ideal' sagittal plane of the head and neck alignment (Ho Ting Yip *et al*., 2007).

A study (n=16) conducted by Szeto, Straker, and Raine (2002), of female office workers showed that there was an increase in FHP in subjects with neck and shoulder pain compared to asymptomatic subjects. Another study (n=80) conducted by Anabela *et al*. (2009), found that younger patients with chronic non traumatic neck pain had a greater FHP when compared to the control group.
Ho Ting Yip *et al*. (2007) concluded that patients with smaller craniovertebral angles had greater FHP and the greater the FHP, the greater the neck disability. Similar conclusions were drawn in a study (n=53) conducted by Mun Cheung Lau, Tai Wing Chiu and Lam (2008), which found that subjects with neck pain had a significantly smaller craniovertebral angle than asymptomatic subjects. They also recommended the use of routine craniovertebral angle measuring in order to provide clinicians with a further objective evaluation tool for patient's presenting with neck pain. The same study found no statistically significant difference in terms of the age and gender and therefore concluded that these two factors should not contribute to the variation in the craniovertebral angle values.

Currently, there is no standard range of an "ideal" craniovertebral angle value. However, a study (n=114) conducted by Ho Ting Yip *et al*. (2007), found that the mean craniovertebral angle of the participants who presented with neck pain was 43.9° as opposed to a mean an average of 50.9° in the control group. A similar study (n=53) conducted by Mun Cheung Lau *et al*. (2008), found that the mean craniovertebral angle of participants with neck pain was 49.93° compared to a mean of 55.03° in the control group.

2.3.7 Structural and functional approaches to muscle imbalance

According to Janda as cited in Page *et al.* (2010) there are two approaches to muscle imbalance: structural and functional. The structural approach focuses on the anatomical and biomechanical knowledge which often relies on static imaging such as an X ray or magnetic resonance imaging (MRI). This approach is useful in diagnosing structural lesions (such as damage to ligament or bone), the repair of which may include immobilization, rehabilitation and in some cases surgery. However, some lesions are not cured following routine treatment protocol, which may indicate that the particular lesion is a functional one.

Functional pathology is an inability of a structure or a physiological system to work properly. A functional lesion is harder to diagnose and treat, mainly because of the fact that it can not be picked up on static imaging. Therefore the clinician needs to be able to visualize and understand how the structures interact together as a system. This is a more current way of thinking, which gives the clinician a better understanding of the etiology of the pathology rather than the pathology itself (Page *et al.*, 2010). Functional pathologies describe a disorder in the functioning of a structure rather than damage to a structure. The pathology often arises because of a lack of physical activity along with repetitive movement. It usually begins with an altered joint position sense and / or abnormal joint movement that later result in muscle imbalance, leading to a new faulty movement pattern (Page *et al.*, 2010).

2.3.8 Posture corrective action

Posture corrective exercises are commonly used in practice, yet there is not much literature to support the beneficial effect of this practice. A randomized control trial (n=40) implementing a 10 week home exercises programme for FHP correction, was conducted by Harman, Hubley-Kozey and Butler (2005). They proposed Stretching exercises to target the neck extensor and pectoralis major muscles, as well as strengthening exercises of the deep neck flexor and shoulder retractor muscles. FHP measurements as well as cervical flexion range of motion were taken before and after the exercise programme. The results showed that the exercise group had an improvement in flexion range of motion as well as the postural measurements. These results suggested that home exercises could improve postural alignment related to FHP. There was no statistically significant difference ($p>0.05$) between the groups in terms of age and BMI.

2.4 Upper cross syndrome related muscles review

Table 2.1 and Table 2.2 tabulate the origin, insertion, innervation and action of the postural muscles which tend to become tight and those which tend to become weak.

Table 2.1 Postural muscles that tend to become over activated or tight

Name	Origin	Insertion	Innervation	Action
Upper trapezius	Medial 3rd of superior nuchal line; external occipital protuberance	Lateral 3rd of clavicle, acromion and spine of scapula	Motor: accessory nerve Sensory: C3-C4 nerves	Elevate and rotation of the scapula
Levator Scapula	Posterior tubercles of C1-C4 transverse process	Superior part of medial border of scapula	Dorsal scapular(C5) and C3-C4 nerves	Elevate scapula and tilt its glenoid cavity inferiorly
Suboccipital	Occipital bone	First two cervical spine spinous process	Suboccipital nerve	Rotation, side bending and extension of the head.
Pectoralis major	Anterior surface of medial half of clavicle, anterior surface of sternum and superior six costal cartilages	Lateral lip of intertubercular groove of the humerus	Lateral and medial pectoral nerves,C5-T1 nerves	Adduct and medially rotate humerus, draw scapula anteriorly and inferiorly

(Moore, 2004 and Simons and Travell, 1999).

Table 2.2 Postural muscles that tend to become underactive or weak

Name	Origin	Insertion	Innervation	Action
Lower trapezius	Spinous process of C7-T12	Lateral 3rd of clavicle, acromion and spine of scapula	Motor: accessory nerve Sensory: C3-C4 nerves	Depress scapula
Rhomboid major	Spinous process of T2-T5	Medial border of scapula	Dorsal scapular nerve	Retract and rotate scapula as well as fix scapula to thoracic wall
Rhomboid minor	Nuchal ligament and spinous process of C7-T1	Medial border of scapula	Dorsal scapular nerve	Retract and rotate scapula as well as fix scapula to thoracic wall
Sternocleidomastoid	Mastoid process and lateral half of superior nuchal line	Anterior surface of manubrium and superior surface of medial third of clavicle	Motor: accessory nerve Sensory: C2-C3 nerves	Tilt head to one side
Serratus anterior	External surface of lateral part of the 1st to 8th rib	Anterior border of the medial border of the scapula	Long thoracic nerve	Protracts scapula and hold it against thoracic wall

(Moore, 2004)

Figure 2.1 graphically illustrates the presentation of upper cross syndrome. Whilst Figures 2.2-2.9, demonstrate the postural muscles discussed in Table 2.1 and Table 2.2.

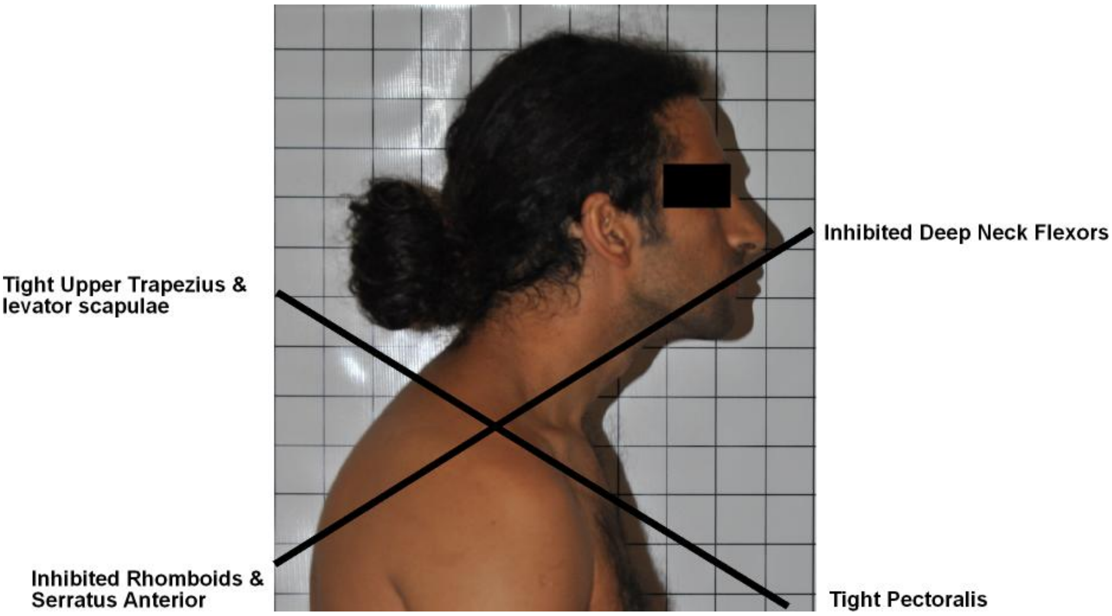


Figure 2.1 Upper cross syndrome illustration

2.4.2 Images of postural muscles that tend to become hypertonic or tight.

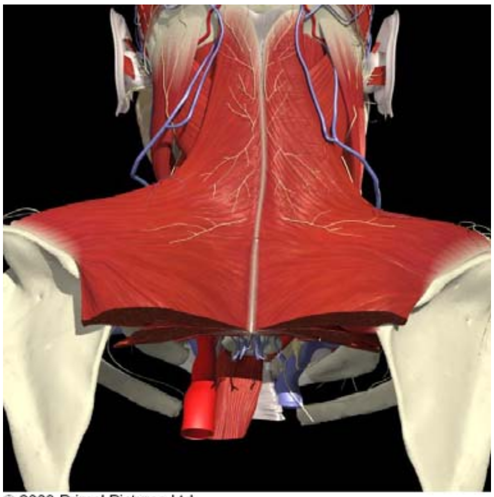


Figure 2.2 Trapezius muscle with permission from primal pictures.

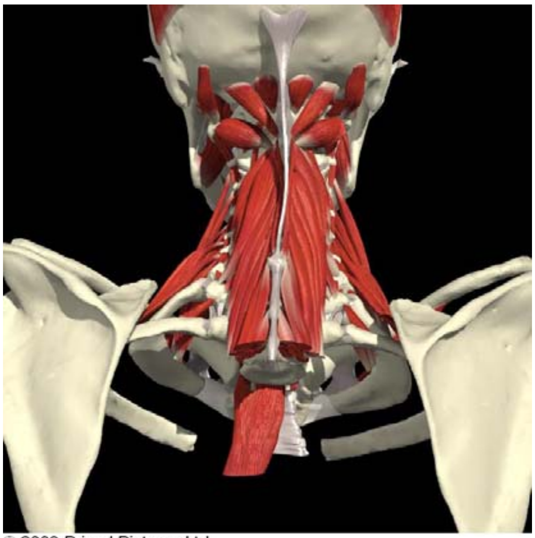


Figure 2.3 Levator scapula and suboccipital muscles with permission from primal pictures.

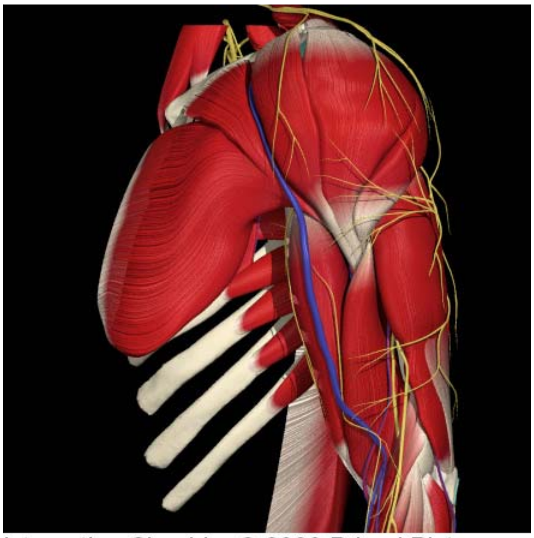
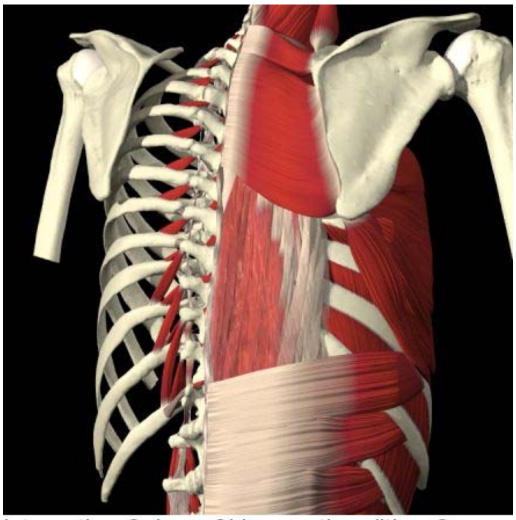


Figure 2.4 Pectoralis major with permission from primal pictures.

2.4.3 Images of postural muscles that tend to become hypotonic or weak.



Interactive Spine - Chiropractic edition ©
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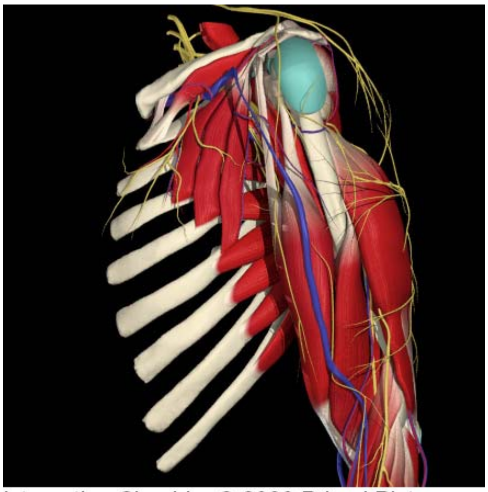
Figure 2.5 Rhomboid major and minor muscles with permission from primal pictures.



Interactive Shoulder © 2000 Primal Pictures
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Figure 2.6 Serratus anterior muscle with permission from primal pictures.

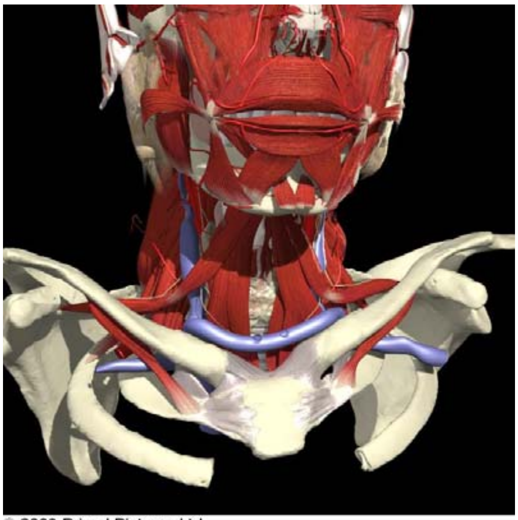


Figure 2.7 Deep neck flexor muscles with permission from primal pictures.

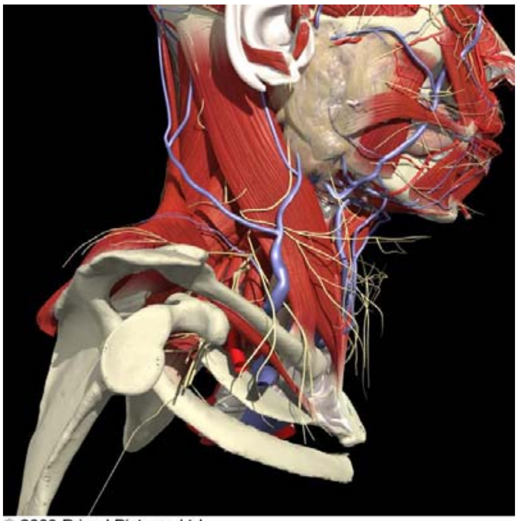


Figure 2.8 Sternocleidomastoid muscle with permission from primal pictures.

2.5 Cervical range of motion

Cervical range of motion includes four basic movements of the head and the degree of active movement is measured to determine any deviation from the normal range of motion (Lewit, 1991).

Herewith the following normal cervical ranges of motion:

1) Flexion: 40 degree.
2) Extension: 75 degree.
3) Lateral flexion: 35 degree.
4) Rotation: 90 degree (Lewit, 1991).

According to Tamara and Zeevi (2008) This form of linear normative range have some disadvantages, in the senses that gender, age groups and the great variety in human size is not taken into consideration. They reviewed cervical motion testing in 130 articles, the cervical motion ranges noted were as follows: flexion 43° to 73°, extension 33° to 77°, rotation 60° to 86° and lateral flexion 41° to 54°. Gender comparison was noted with females presenting with a greater range of motion than males (2 to 4 degrees more) and an average decrease of four degrees in cervical range of motion per decade. Patients with FHP present with weak deep neck flexors muscles, together with a prominent SCM and anterior scalene muscle, which results in an anterior movement pattern of the head. During an examination, when the patient is asked to tuck his/her chin to their chest while lying supine, the head tends to move forward instead of normal neck flexion (Page *et al*., 2010). According to Hall, Briffa and Hopper (2008**),** patients with CGH tend to present with a painful active cervical range of motion which results in a noticeable decrease in flexion range of motion.

2.6 Introduction to episodic tension-type headache

ETTH is a primary headache disorder, it is the most frequent headache found in adults with a prevalence rate of 38% (Stovner, Hagen and Jensen, 2007). This headache is characterized by bilateral pressure, a band-like sensation or increased tenderness especially at the neck region (Boon *et al.*, 2006). The attacks often start in the teenage years, gradually increasing in intensity and reach their peak in the fourth decade. This headache type is believed to be primarily of muscular origin, which could be a result of emotional stress or associated with musculoskeletal pathology in the neck (Boon *et al.*, 2006 and Fernandez-de-las-Penas *et al*., 2007). A study (n=30), by Fernandez-de-las-Penas *et al*. (2007), showed a remarkable decrease in normal cervical range of motion in subjects with ETTH in comparison to asymptomatic subjects.

2.6.1 Classification of episodic tension-type headache (according to the International headache society):

A. At least one episode per month, but not more than 15 episodes per month for at least 3 months.

B. Headaches of 30 minutes to 7 days duration.

C. Headaches must comply with at least two of the following descriptions:
   1. Both sides of the head.
   2. Band pressure and non-pulsating in character.
   3. Intermediate intensity (mild or moderate).
   4. Normal physical activity such as walking or climbing stairs does not aggravate the headache.

D. The following symptoms must be absent:
   1. Nausea.
   2. Vomiting.
   3. Photophobia.
   4. Phonophobia (Olesen, 2004).

2.7 Epidemiology

2.7.1 Incidence and prevalence

In an interview based study (n=740) conducted by Rasmussen, Jensen, Schroll and Olesen (1991), it was found that 78% of the subjects interviewed followed the international headache society (IHS) classification criteria for ETTH.

A study (n=297) by Lyngberg, Rasmussen, Jorgensen and Jensen (2005) found that the prevalence rate over a life time for ETTH was 89%, while the one year prevalence rate was 87%.

2.7.2 Age

ETTH may start in childhood, around 10 years of age, reaches its peak prevalence in the fourth decade of life and decreases with increasing age (Goadsby and Lance, 2005 and Swanson, 2004).

2.7.3 Male / Female ratio

The ratio between male and female with regard to ETTH is found to be 1:1.5. The higher percentage in females is thought to be due to hormonal and personality differences (Rasmussen, 1995).

2.8 Duration and frequency

The duration of the headache episode, ranges from a few minutes to a few hours with less than 15 episodes per month (Swanson, 2004).

2.9 Associated symptoms

During a headache attack patients may experience neck or jaw discomfort with mouth opening, as well as scalp, neck and shoulder muscle tenderness. Other accompanied presenting symptoms may include: loss of appetite, lack of concentration, fatigue and difficulty sleeping (Swanson, 2004).

2.10 Trigger and predisposing factors

Possible triggers to ETTH may include:

- Stress
- Depression and anxiety
- Lack of physical activity
- Emotional conflict
- Lack of sleep
- Hormonal changes
- Side effects from medication
- Over use of headache medication
- Poor posture (Swanson, 2004).

2.11 Causes

The cause of ETTH is not well understood. One current belief is that ETTH may occur as a result of changes in brain chemicals such as serotonin, endorphins and nitric oxide and not muscle tension as previously considered (Swanson, 2004).

2.12 Mechanism and Pathophysiology

2.12.1 Muscular factors

A report by Jensen and Rasmussen (1996), stated that 66% of patients with ETTH presented with pericranial muscle tenderness, as well as showing signs of muscular over activity as demonstrated by electromyolography. In another study (n=58) whereby patients with ETTH were asked to clench their jaw for 30 minutes, 69 % of subjects developed a headache (Jensen and Olesen, 1996).

According to Jensen and Olesen (1996), involuntary muscle tightness that may arise as a result of mental or physical activity plays an important role in the mechanism of ETTH. Further studies are required, however, to clarify the ratio of ETTH patients who present with muscle tightness and ETTH patients who present without muscle tightness.

2.12.2 Psychological factors

Mongini, Rota, Deregibus, Ferrero, Migliarett, Cavallo, Mongini and Novello (2006), investigated whether a correlation exists between psychological factors and headaches, in particular the prevalence of psychiatric comorbidity in migraine and tension type headache sufferers (n=506). They found the prevalence of depression and anxiety to be greater in the headache group than in the control group. With a 42% prevelance of psychiatric comorbidity, 18% generalized anxiety, 16% depression and 5% panic attack in the ETTH group. Additional symptoms such as: colitis, gastritis, dysphasia, insomnia, palpitations, fainting, dizziness, cramps and frigidity were also found to be prevalent in the ETTH group (Mongini *et al.,* 2006).

2.12.3 Vascular factors

A mechanical irritation of the vertebral artery, vertebral nerve and ascending sympathetic chain may result in vascular spasm which gives rise to a headache. Yet although the metabolic changes that occur in muscles following vascular constriction were believed to cause pain, the link between ischemia caused by prolonged muscle contraction and tension-type headache remains inconclusive (Vernon, Steinman and Hagino, 1992).

2.13 Clinical features

One survey as cited in Swanson (2004), revealed that 63% of subjects with ETTH had scalp and neck muscle tenderness as well as head pain.

The most common clinical features of ETTH are:

1. Bilateral or unilateral pain
2. Tightness or band like sensation
3. Pain mainly located at the forehead, temporal, occipital and parietal regions and may be isolated to one of more area (Dalessio, 1987)
4. Mild to moderate in intensity
5. No nausea
6. No vomiting (Goadsby, 2005).

2.14 Differential diagnosis

ETTH is easily diagnosed, but because there are no clear signs, it can be a challenge to diagnose when patients poorly describe their symptoms (Bigal and Lipton, 2005).

Conditions with similar presentation to ETTH include CGH, migraine and sinus headache. However, there are subtle differences as described below.

- **Episodic tension-type headache versus cervicogenic headache:**

CGH is infrequent, usually presents unilaterally with associated active myofascial trigger points in the neck region as opposed to tender spots in an ETTH. Pressure applied on the trigger points can elicits a unilateral headache. This similarity may lead to wrong diagnosis of CGH (Bigal and Lipton, 2005).

- **Episodic tension-type headache versus migraine without aura:**

When a patient presents with a disabling headache attack and complaining of photophobia or phonophobia, without any physical findings it is considered to be a migraine unless proven otherwise (Bigal and Lipton, 2005).

- **Episodic tension-type headache versus probable migraine:**

Patients that present with all migraine symptoms (unilateral throbbing pain, photophobia, phonophobia and nausea), except one (e.g. photophobia), are diagnosed with migraine subtype *viz* probable migraine. If a patient presents with two of the migraine symptoms, the diagnosis will be a combination of ETTH and probable migraine (Bigal and Lipton, 2005).

- **Episodic tension-type headache versus sinus headache:**

ETTH is often characterized as dull, bilateral pain, localized to the frontal region, which is similar to sinus headache presentation and therefore may be misdiagnosed. Headaches located in the sinus area, with associated nasal symptoms without fever and purulent nasal discharge, should not be diagnosed as a sinus headache and can be considered to be an ETTH or a migraine (Bigal and Lipton, 2005).

2.15 Therapeutic intervention

There are various therapeutic approaches in the management of ETTH, the primary aim is to prevent the headache becoming chronic. Therefore, combined interventions are often applied to achieve maximal results (Fumal and Schoenen, 2008).

2.15.1 Manual treatment

Vernon (1995) reviewed the outcome of nine studies that investigated the effect of chiropractic manipulation on ETTH. The results showed a statistically significant decrease in headache frequency, intensity and duration. However in another study (n=75) by Bove and Nilsson (1998) investigating cervical spinal manipulative therapy and soft tissue as a combined intervention, it was found that cervical spinal manipulative therapy alone was less beneficial than combining it with soft tissue therapy.

2.15.2 Pharmacological treatment

Previous drug trials investigating the beneficial effect of simple analgesic and non-steroidal anti-inflammatory drugs (NSAIDs) for the treatment of ETTH concluded that they are the preferred choice (Fumal and Schoenen, 2008).

Aspirin (500 mg or 1000 mg) was found to be an effective drug when compared with a placebo, yet NSAIDs were found to be superior to Aspirin (Fumal and Schoenen, 2008).

Furthermore Ibuprofen (800 mg) was found to be the current drug of choice followed by Naproxen sodium (825 mg). These drugs were less likely to cause gastrointestinal bleeding and ulcers (Fumal and Schoenen, 2008 and Goadsby and Lance, 2005).

2.15.3 Non pharmacological treatment

Relaxation and electromyography (EMG) were found to have a beneficial effect in the treatment of ETTH (Fumal and Schoenen, 2008), with an outcome of almost 50% reduction in headache activity. Cognitive behavioural intervention was also found to have a beneficial effect, with a more favorable treatment outcome occurring when the cognitive behavioral intervention was combined with relaxation or EMG therapy (Fumal and Schoenen, 2008).

Other non pharmacological intervention such as: massage, ergonomic instructions, transcuteneous electrical nerve stimulation, hot and cold therapy have not been shown to be effective in the long term (Fumal and Schoenen, 2008 and Goadsby, 2005). Yet a study (n=62) conducted by Carlsson, Fahlcrantz and Augustinsson, (1990) found that physical therapy reduced the intensity of ETTH by an average of 23%.

2.16 Introduction to cervicogenic headache

Zito *et al*. (2005) found that 14-18% of patients who suffer from chronic headaches have CGH (n=77). This headache is described as a pain that originates in the cervical spine with referral to the head. It is caused by dysfunction of the musculoskeletal tissues surrounding the cervical spine. It is characterized as a unilateral headache of varying duration and radiating to the temporal and orbital region of the head (Moore, 2004 and Zito *et al*., 2005).

2.16.1 Classification of cervicogenic headache (according to the International headache society):

A. Source of pain is of the neck origin that spreads to the head and or face regions.

B. Evidence of cervical spine or surrounding soft tissue disorders or lesions are revealed in a physical examination, laboratory and or diagnostic imaging.

C. Clinical signs that indicate that the source of pain is in the neck (Olesen, 2004).

2.17 Epidemiology

2.17.1 Incidence and prevalence

The prevalence of CGH in the general population is estimated to be between 0.4% and 2.5%. Yet among headache patients the prevalence ranges between 15% and 20%, with females presenting with this particular type of headache four times more often than males (Eldridge and Russell, 2005).

2.18 Duration and frequency

In chronic headache sufferers there is often a high frequency of short lasting attacks. These episodes of headache may vary in duration, with some reports stating the headache lasts for as short a duration as two minutes and occurs up to five times a day (Hall *et al* ., 2008**).**

2.19 Associated symptoms

Associated symptoms such as nausea, photophobia, phonophobia as well as throbbing type pain may occur infrequently (Hall *et al*., 2008).

2.20 Cause

Burger (2007), stated that CGH can be linked to various causes, as well as the surrounding anatomical structures such as muscles, ligaments, annulus fibrosis, facet joint and dura matter can be regarded as possible underlying triggers. According to Bogduk (1992), the possible etiology to CGH lies in the anatomical structures that are innervated by C1-C3 spinal nerve, and includes the upper cervical joints, muscles, as well as C2-C3 disc, arteries and dura mater.

2.21 Mechanism and Pathophysiology

2.21.1 Classification of aetiological mechanisms:

Vernon (2004) as cited in Burger (2007), suggested four categories for classifying the aetiological mechanisms of CGH. They include:

- **Intrasegmental mechanisms**

The intrasegmental mechanisms involve the nerves that surround the intervertebral foramen in the cervical spine, which includes: the ventral and the dorsal ramus of the cervical spine, the sympathetic trunk, the recurrent meningeal nerve, the greater occipital nerve, the third occipital nerve and the suboccipital nerve.

- **Infrasegmental mechanisms**

These mechanisms include the spinal cord, lower brain stem and dorsal horn grey matter of the first three cervical spine segment, which also includes the spinal tract nucleus of the trigeminal nerve which receives descending afferents from the trigeminal sensory ganglion as far caudally as C3 in the spinal nucleus of the trigeminal nerve.

- **Intersegmental mechanisms**

These mechanisms involve the following joint articulation complexes: C0-C1, C1-C2: C2-C3, C3-C4, as well as the proximal ligaments and muscles connecting these segments.

- **Extrasegmental mechanisms**

These mechanisms include the trapezius and long extensor muscles and the superior ligamentum nuchae, as well as the vertebral arteries, ascending sympathetic chain and superior cervical ganglion.

2.22 Clinical features

CGH normally present with dull aching pain and discomfort that begins at the neck or occipital region. It is unilateral in nature although it can present as bilateral without any side shift during the headache attack. The pain may be aggravated by external pressure on the head and neck as well as by active neck movements. Additional signs such as a decrease in cervical range of motion as well as shoulder and arm pain of the involved side are commonly present (Eldridge *et al*., 2005).

Three common clinical signs used as diagnostic guidelines to CGH are:

1. Poor passive neck movement.
2. Increased pain during motion palpation of the first three cervical segments.
3. A decrease in cervical flexor muscle function (Eldridge *et al*., 2005).

2.23 Differential diagnosis

There are a few disorders that have similar presenting signs and symptoms as the CGH. The most alarming differential diagnosis of CGH is a dissecting aneurysm of the vertebral or internal carotid arteries that can present as a headache. Fatal consequences can occur if this differential is disregarded because the aneurysm may erupt. The next significant condition in the differential list is lesions of the posterior cranial fossa. These can be distinguished by the additional neurological findings and the present of a systemic illness. Meningitis of the upper cervical spine can also present as CGH, but again the features of systemic illness as well as rigidity of the neck will provide clues to the appropriate diagnosis.

Since the C2 spinal nerve is located posterior to the lateral atlanto-axial joint, two other conditions may also be confused with CGH. Firstly, neck tongue syndrome, a condition resulting from a rapid movement of the neck that leads to partial subluxation of the atlanto-axial joint. This disorder can be distinguished from CGH by numbness of the tongue following pressure applied to the C2 spinal nerve. Secondly, C2 neuralgia caused by various inflammatory disorders, this condition can be distinguished from CGH by intermittent and lancinating pain in the occipital region (Bogduk and Govind, 2009).

2.24 Therapeutic interventions

There are several treatment approaches to CGH. The following known interventions are: pharmacologic drugs, manual therapy, anesthesia and surgery (Biondi, 2001).

2.24.1 Pharmacologic treatment

Medication such as TCAs (tricyclic antidepressant), muscle relaxants and NSAIDs are used for the management of CGH as well as the management of musculoskeletal and neuropathic pain disorders (Biondi, 2001).

The choice of medication is, however, often based on clinician's previous experience. Although medication enables the patient to be more active, it does not provide complete pain relief (Biondi, 2001).

2.24.2 Manual treatment

According to Bogduk (1992), the origin of CGH lies in the upper cervical spine segment dysfunction. Treatments range from soft tissue therapy to mobilization to manipulative therapy.

The main aim of manual treatment is to restore full cervical range of motion and this can be achieved by the use of manipulative therapy (Grimshaw, 2001), yet additional advice on corrective posture, cervical stretching and strengthening exercises, improve the outcome of the manipulative therapy (Grimshaw, 2001).

2.24.3 Anesthetic treatment

The use of a nerve block or zygapophyseal joint blockage and corticosteroids can be used to assist with the diagnosis of CGH. However they also play a role in the treatment of these headaches, resulting in alleviation of many of the symptoms (Da Silva and Bordini, 2006).

2.24.4 Surgical treatment

Surgical intervention for CGH is only considered once all nonsurgical approaches have failed, there is supporting radiological evidence that indicates that the pathology can be surgically repaired. Procedures such as nerve transection, dorsal transection and microvascular decompression are available (Da Silva and Bordini, 2006).

Surgical release or transection of the greater occipital nerve entrapment in the trapezius muscle provides significant pain relief in many patients, yet the pain tends to return after a few months (Da Silva and Bordini, 2006).

2.25 Cervical spine biomechanics

Cervical spine problems can lead to head pain, which may present as either ETTH or CGH. Since the head and neck motor and sensory innervations primarily originate at the level of C1-C4 of the cervical spine, pathology in this particular area can contribute to both ETTH and CGH (Curl, 1994).

2.26 Myofascial pain syndrome

Myofascial pain syndrome is a very common condition presenting to a health care practice. The muscular pain is as a result of a hyperirritable spot within the muscle, more commonly known as a myofascial trigger points. Myofascial trigger points are typically painful to palpate and in some cases may present with a referred pain pattern on physical compression (Simons and Travell, 1999).

According to Simons and Travell (1999), myofascial trigger points occur as a result of trauma or mechanical stress to a muscle. This usually results in a maximal contracture which leads to interference with the normal physiological process within the muscle, resulting in a vicious cycle of continuous contraction, a process known as "energy crisis theory" .

2.27 Conclusion

FHP which occurs as a result of muscle imbalance may be the trigger if not one of the primary causes of head and neck pain. A study (n=114) conducted by Ho Ting Yip *el al.* (2007), found that patients with neck pain have a smaller craniovertebral angle as opposed to asymptomatic patients. Since the smaller the angle the greater the FHP, Ho Ting Yip *el al*. (2007) concluded that a relationship between FHP and neck pain exists. FHP is one component of a functional pathology often referred to as upper cross syndrome. This syndrome can result in joint dysfunction and active myofascial trigger points which can manifest as either ETTH or CGH.

Very little research has examined the relationship between posture and headaches. Therefore, this study will investigate whether an association can be found between FHP and the characteristic presentations of ETTH and CGH.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter sets out the method used to explore the possible correlation between the characteristics of the two common headaches of episodic tension-type headache (ETTH) and cervicogenic headache (CGH) and the physical measurements of cervical ROM and FHP as compared to an asymptomatic group. This chapter offers a description of the sample under study, the outcome measures and statistical analysis, with a view to fulfill the objectives as set out in the previous chapter.

3.2 Ethical consideration

This study was a quantitative comparative study, utilizing a case-control design. The study was approved by the Faculty of Health Sciences Research and Ethics Committee at the Durban University of Technology that adhere with Helsinki declaration of 1964 (Johnson, 2005). The Ethics clearance certificate number is: 048/09 (Appendix J).

3.2.2 Study location

The study was conducted at the Durban University of Technology chiropractic day clinic. Sixty participants enrolled in this study.

3.2.3 Subjects recruitment

Participants in this research were sourced via advertisements in local shopping centers and fliers were posted in and around the DUT campus (Appendix A).

Prior to the initial appointment, all candidates underwent a telephonic screening for exclusion purposes. The following information was verified:

1. What is your age?

Patients required for the research were required to be between 20 and 45 years of age, males and females from all ethnic groups.

2. How often do you get headaches?

3. How long do the headaches last?

4. How would you describe the headaches?

Five individuals that wanted to enroll in the study had not turned 20 years of age yet and therefore had to be excluded. Telephonic calls were received from two perspective subjects however they presented with symptoms of migraine headache (such as nausea, vomiting and aura during and prior to a headache attack) and therefore were not able to enrol in the study.

The patients were given a Letter of Information and were asked to sign an Informed Consent Form (Appendix B).

During the course of the study, seven individuals dropped out due to unrest on campus.

3.2.4 Clinical assessments

Following the introductory telephonic interview, the patient visited the chiropractic clinic where they underwent a complete case history (Appendix C), physical examination (Appendix D) and cervical regional examination (Appendix E).

3.3 Subject sampling, allocation and inclusion criteria

3.3.1 Inclusion criteria

Patients were included in this study only if they fulfilled the following criteria:

1. Were between the age of 20 to 45 years.

Case Group A:

Twenty patients had to follow the diagnostic criteria for episodic tension-type headaches (based on the international headache society classification cited in Olesen, 2004).

A. At least one episode per month, but not more than 15 episodes per month for at least 3 months.

B. Headaches of 30 minutes to 7 days duration.

C. Headaches had to comply with at least two of the following descriptions:

1. Both sides of the head.
2. Band pressure and non-pulsating in character.
3. Intermediate intensity (mild or moderate).
4. Normal physical activity such as walking or climbing stairs did not aggravate the headache.

D. The following symptoms must be absent:

5. Nausea
6. Vomiting
7. Photophobia
8. Phonophobia (Olesen, 2004).

Case Group B:

Twenty patients had to follow the diagnostic criteria for cervicogenic headaches (based on the international headache society classification cited in Olesen, 2004).

A. Source of pain was of the neck origin that spread to the head and or face regions.

B. Evidence of cervical spine or surrounding soft tissue disorders or lesions as evidenced in a physical examination, laboratory and or diagnostic imaging.

C. Clinical signs that indicated that the source of pain is in the neck (Olesen, 2004).

Case Group C:

Twenty asymptomatic patients as the control group who did not suffer from headaches.

All participants had to read the research information sheet, signed that they agreed to participate in the study.

3.4 Interventions

Following the complete clinical assessments, the subjects were asked to put on leggings, a tight fitting vest over their under garments and remove their socks and shoes. Their right and left craniovertebral angle measurements were taken with the smart tool angle finder (OKC plant 4041 N, Santa Fe Oklahoma City, OK 73118, USA) placed on a tripod. A lateral digital photograph of the subjects was taken from the same position with a grid on the background and a plumbline in front of the subject's side view. The subjects cervical range of motion was measured using Cervical Range of motion goniometer (3600 Labore Road, suite 6, St Paul, MN 55110-41144). The subjects in the two symptomatic groups also received a headache diary for a fourteen days period so to subjectively monitor the frequency, intensity and duration of their headaches.

3.5 MEASURMENT TOOLS

3.5.1 Objectives

The objective measuring tools for this study were the smart tool angle finder, (OKC plant 4041 N, Santa Fe Oklahoma City, OK 73118, USA). It was found to be a reliable device for craniovertebral angle measurement in a study (n=53) conducted by Mun Cheung Lau *et al.* (2008). A lateral digital photographic view of the patient was taken with a plumbline between the patient and the camera and a grid behind the patient as utilized by Kendall *et al.* (2005).

3.5.2 The procedure

The patient was asked to put on leggings and tight fitting vest over their under garments and remove their socks and shoes (luminous marked stickers were placed on allocated points for measurement purposes). They were given an eye mask to cover their eyes in the photographs and thus maintain anonymity. The standing position was found to be the most commonly used stance for the clinical assessment of FHP (Fernandez-de-las-Penas *et al*., 2007, Ho Ting Yip *et al*., 2007 and Kendall 2005). Participants were instructed to place their feet slightly apart and to have their arms by their sides. To facilitate the natural head posture, participants were asked to tilt their head forwards and backwards until they felt that a natural head posture was reached. Once settled, a photograph was taken, the same instructions were applied for the measurement of the craniovertebral angle (Anabela, 2009). All subjects who participated in the study were granted one free chiropractic treatment by the researcher.

3.5.3 The Craniovertebral angle

The C7 spinous process as well as the tragus of the ear were located and marked. A virtual line was drawn between the two makers. The reading from the smart tool angle finder represented the craniovertebral angle (measured in degrees from the horizontal plane). The smaller the angle the greater the FHP (Ho Ting Yip *et al*., 2007). Figure 3.1 below illustrates the method that was used for the measurement of the craniovertebral angle.

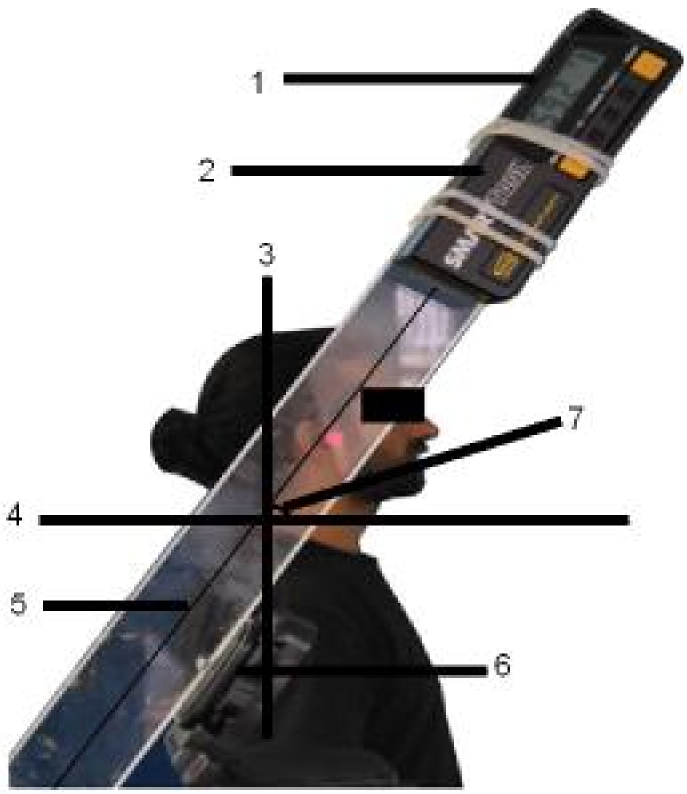


Figure 3.1: Measurement of craniovertebral angle.

Image points:

1. Craniovertebral angle value.
2. Smart tool angle finder.
3. Vertical line.
4. Horizontal line.
5. Line drawn from the C7 spinous process through the tragus of the ear.
6. Tripod.
7. Craniovertebral angle.

3.5.4 The lateral digital photograph

The camera was placed on a tripod and all the patient pictures were taken from the same position, using a specific floor marking to make sure that all participants stood in the same place. The floor was leveled, checked by a spirit level. The plumbline was a vertical line suspended from the ceiling in line with the standard base point, slightly anterior to the lateral malleolus. A moveable point cannot be used as standard point of reference therefore the point of reference must be at the base (the lateral malleolus) (Kendall *et al.*, 2005). The line demonstrated in Figure 3.2 starts from the external auditory meatus to the midway of the shoulder to the tip of the greater trochanter to the anterior axis of the knee joint to the lateral malleolus and thus reference points were marked on the patient in order to measure the distance between the marked points and the plumbline. It was measured in centimeters whereby anterior deviation got a positive value and a posterior deviation got a negative value (Greenman *et al.*, 1992).

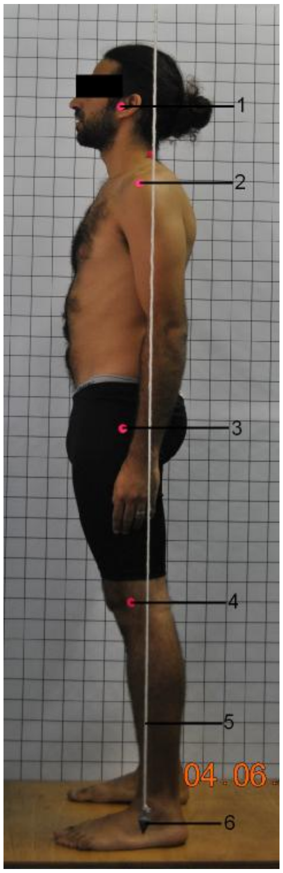


Figure 3.2: The lateral digital photograph.

Image points:

1. External Auditory Meatus.
2. Acromioclavicular joint.
3. Greater trochanter.
4. Anterior Axis of Knee joint.
5. Plumbline cord.
6. Lead weight.

3.5.5 Cervical range of motion

Active cervical range of motion (CROM) was measured by the use of CROM goniometer (3600 Labore Road, suite 6, St Paul, MN 55110-41144), a measuring device that provides the degree of active motion of the cervical spine in flexion (see Figure 3.3), extension (Figure 3.4), right and left lateral flexion (Figure 3.5-3.6) and right and left rotation (Figure 3.7-3.8). The goniometer was proven to be a reliable device for cervical range of motion measurement (Fernandez-de-las-Penas *et al*., 2007 and Rheult, Albright, Franta, Johnson, Skowronek and Dougherty, 1992). While taking measurements the patient was seated (Appendix G).

According to literature (Chaitow, 2008, Eldridge *et al*., 2005, Fernandez-de-las-Penas *et al*., 2007 and Page *et al*., 2010) patients presented with FHP and/or ETTH and/or CGH tend to have a decrease in active cervical range of motion when compared to a control group. This could be as a result of contracture of the anterior longitudinal ligament that occurs with the upper cross syndrome presentation or an abnormal anterior/forward head movement pattern.

Figure 3.3 Flexion with Cervical Range of motion goniometer.

Figure 3.4 Extension with Cervical Range of motion goniometer.

Figure 3.5 Right lateral flexion with Cervical Range of motion goniometer.

Figure 3.6 Left lateral flexion with Cervical Range of motion goniometer.

Figure 3.7 Right rotation with Cervical Range of motion goniometer.

Figure 3.8 Left rotation with Cervical Range of motion goniometer.

3.5.7 Headache diary

The headache diary used in this study has been adapted from one previously used by Prithipal (2003), and consisted of a table with grids, whereby each grid represents one 24 hour period (Appendix I). Patients started recording in the headache diary from the first full day following the assessment and continued for two weeks. Patients returned the headache diary when they arrived for their free treatment at the end of the intervention period.

Patients were asked to record in the diary the headache frequency (number of episodes per day over a 14 day period), intensity (rating from 1 to 10, whereby 10 is the most intense) and duration of each episode (from onset to cessation).

3.6 Study design

This research was a quantitative comparative study, utilizing a case-control design (Estehuizen, 2009).

3.7 Statistical analysis

Head posture and postural misalignments were compared between the three groups using ANOVA testing with Bonferroni post hoc tests, in order to determine if the groups differed significantly from each other at the 0.05 level of significance. Range of motion measurements were compared between the three groups in the same manner. In the two symptomatic groups, headache intensity, frequency and duration were measured quantitatively over fourteen days. These measurements were averaged over the time period for each participant and correlated with the postural variables, range of motion measurements, BMI, age and ethnicity using Pearson's correlation coefficient and gender with the use of a t Test.

3.8 Confidentiality

All data was coded for patient confidentiality and anonymity, as well as for analysis reporting and publication purposes. Data will be disseminated to interested research patients via the department and in a mini dissertation in the library. Research data shall be stored in the patient files in the Chiropractic Day Clinic for a period of 5 years before there after it will be shredded.

CHAPTER FOUR

RESULTS

4. Introduction

The demographic data as well as the data obtained from the objective measures (smart tool angle finder, digital postural analysis and CROM) and subjective measures (headache diary) which were statistically analyzed are presented in this chapter.

4.1 Demographic data

Sixty participants were enrolled into the study in three equal groups: an episodic tension-type headache (ETTH) group (n=20), a cervicogenic headache (CGH) group (n=20) and an asymptomatic control group (n=20) There was no significant difference between the three groups in terms of gender (p=0.490), age grouping (p=0.188) or BMI (p=0.312). There was a borderline significant difference in terms of ethnicity (p=0.043) but the statistical test was not valid.

Although there was no statistically significant difference when comparing the number of male and female participants across the three groups, there was a greater number of female participants as opposed to male participants with a total of 42 females (70%) and 18 males (30%).This is reflected in Figure 4.1.

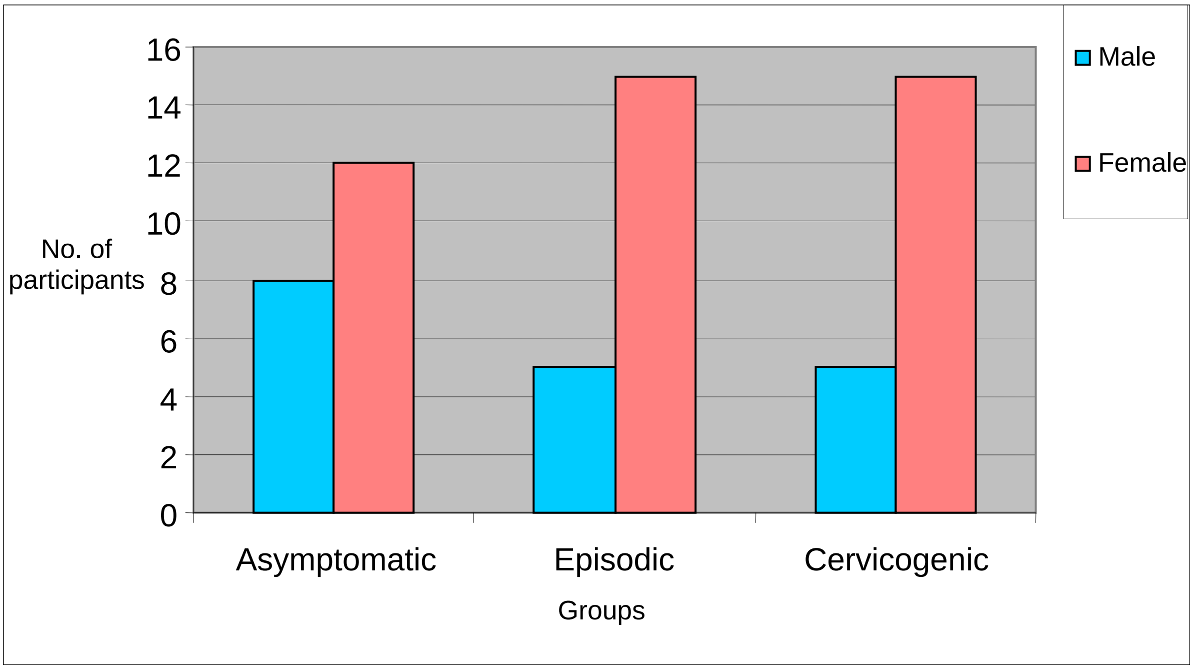


Figure 4.1 Distribution of gender across the three groups (n=60)

Despite the fact that there was a similar age distribution across each of the three groups, Figure 4.2 shows that most of the participants fell into the 20 to 24 year age group (n=37; 61.7%).

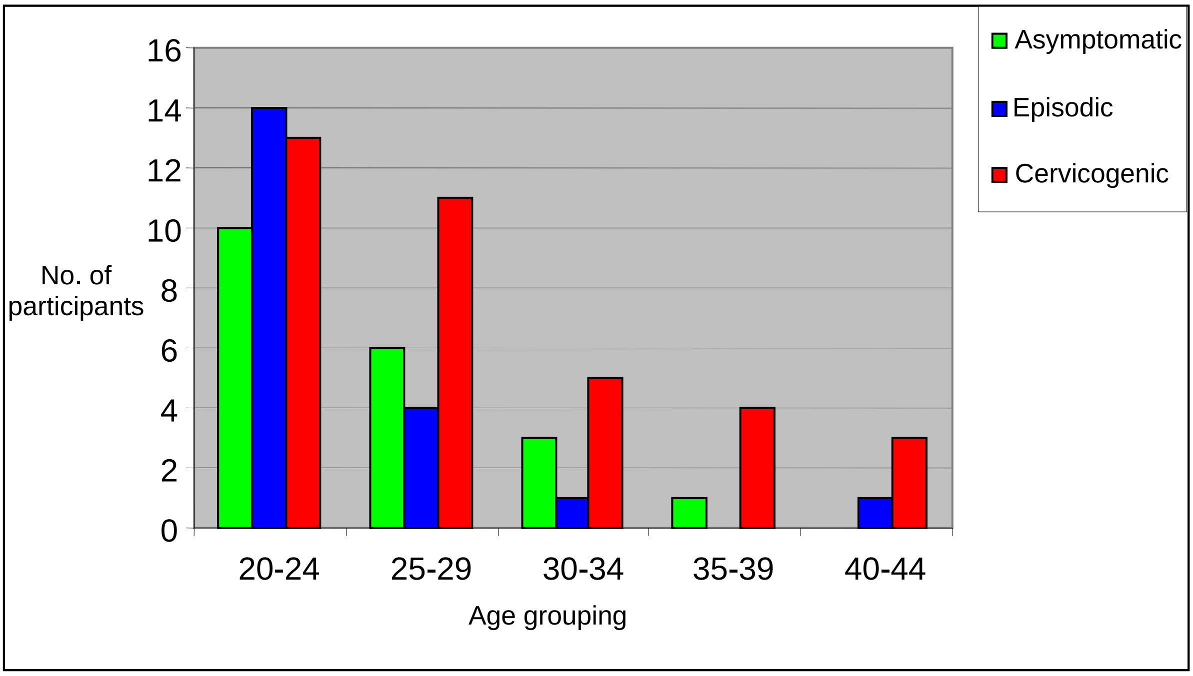


Figure 4.2 Distribution of age grouping across the three groups (n=60)

The majority of the participants were within the normal BMI range (n=33; 55%), whilst 31.7% (n=19) of the group were overweight. This is presented in Figure 4.3.

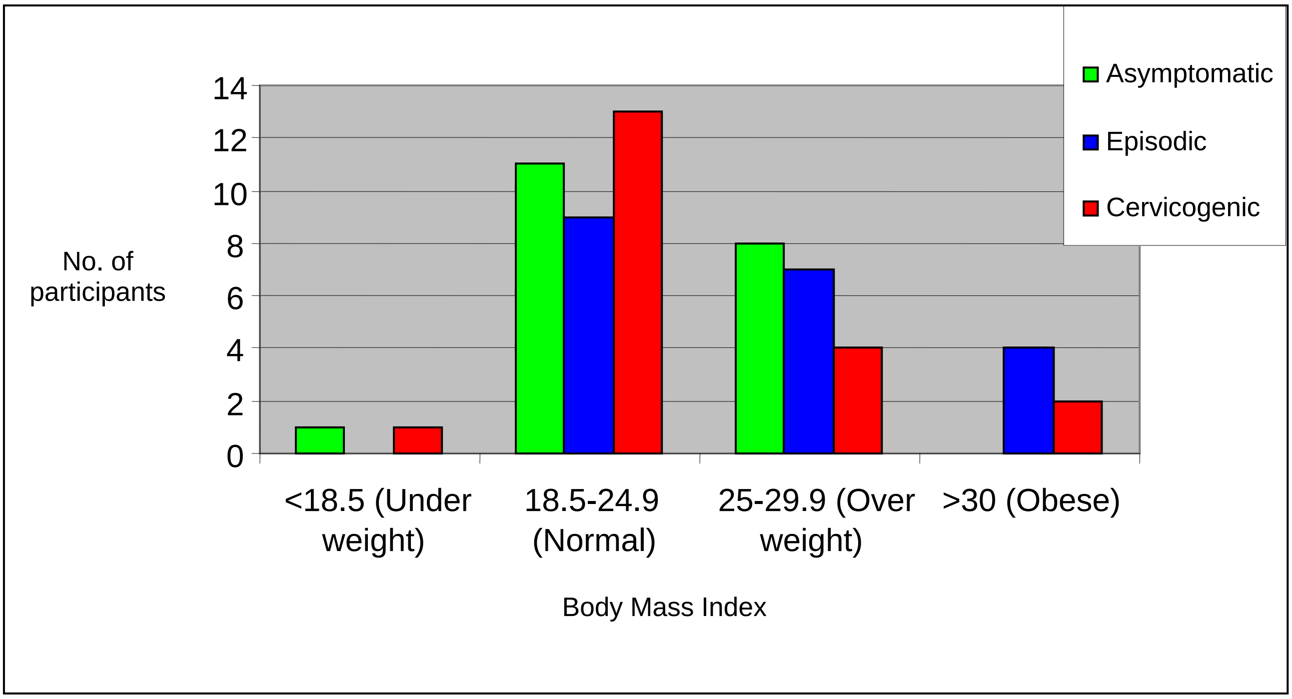


Figure 4.3 Distribution of BMI across the three groups (n=60)

Figure 4.4 reveals that there was a disproportionate number of Whites in the study (n=33; 55 %). Neither the asymptomatic group nor the CGH group had any Indian participants and there was only one Asian participant in the study.

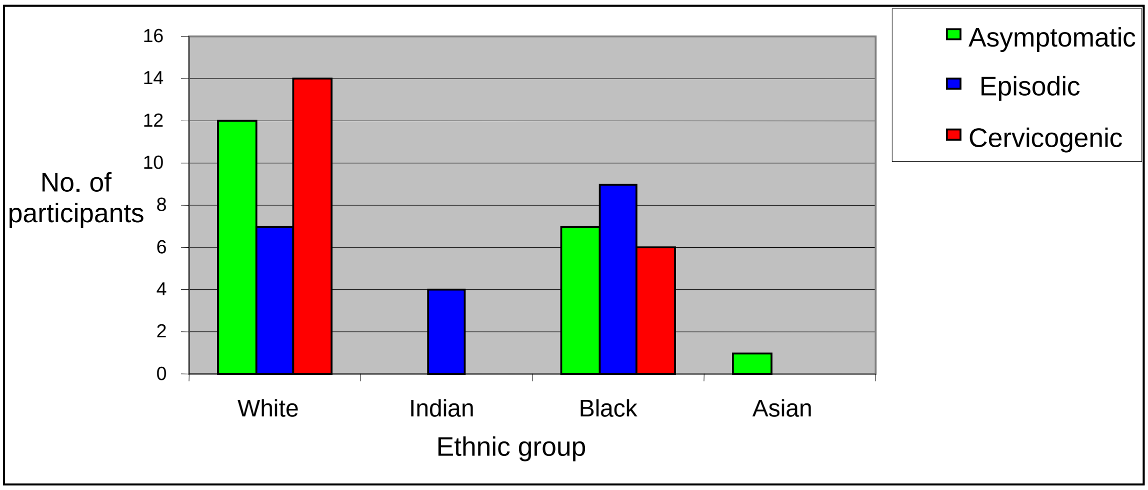


Figure 4.4 Ethnic distribution across the three groups (n=60)

4.2 Headache characteristics

Table 4.1 shows that there was no significant difference with regards to the headache's characteristics, in terms of frequency (p=0.156), intensity (p=0.357) and duration (p=0.853) of the headaches, when comparing the ETTH and CGH groups. Therefore, in terms of the headache's characteristics the two groups were fairly homogenous. The CGH group tended to have a higher frequency and longer duration of headache while the ETTH group had a slightly greater headache intensity.

Table 4.1 Comparison of headache characteristics between the two symptomatic groups (n=40).

Headache Characteristics	Groups				t-test p value
	Episodic		Cervicogenic		
	Mean	Standard Deviation	Mean	Standard Deviation	
Frequency (Number of headaches during a 14 day period).	6.6	4.0	8.6	4.5	0.156
Intensity (Ranging from 0 - 10 or least pain – worse pain, for each headache).	4.8	1.3	4.4	1.5	0.357
Duration (measured in minutes).	97.8	94.3	102.5	64.4	0.853

4.3 Postural assessment variables

Table 4.2 shows the mean and standard deviation for each of the postural assessment variables measured in either degrees or centimeters from the plumbline.

There was a statistically significant difference between the three groups in terms of the forward head posture (FHP) variables *viz* the craniovertebral angle, as well as the

Table 4.2 ANOVA comparison of mean FHP variables, between the three groups.

	Groups						ANOVA p value
	Asymptomatic		Episodic		Cervicogenic		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Right craniovertebral angle (in degrees).	48.7	3.1	43.2	2.5	44.8	1.9	**<0.001**
Left craniovertebral angle (in degrees).	48.8	3.0	43.7	2.1	44.7	2.4	**<0.001**
Craniovertebral angle average (in degrees).	48.7	2.9	43.5	2.2	44.7	2.1	**<0.001**
Distance between the EAM and the plumbline (in cm).	2.30	1.28	3.42	1.90	4.28	2.04	**0.003**
Distance between the AC and the plumbline (in cm).	1.35	.87	2.54	1.54	2.80	1.65	**0.004**
Distance between the greater trochanter and the plumbline (in cm).	2.52	1.96	3.13	1.57	3.00	2.12	0.561
Distance between the axis of the knee and the plumbline (in cm).	1.74	1.25	2.17	1.32	1.69	1.57	0.492

EAM= External auditory meatus
AC= Acromioclavicular joint

The smaller the craniovertebral angle and/or the greater the distance between the external auditory meatus and the plumbline the greater the FHP. For the additional postural values the greater the distance from the plumbline the greater the postural abnormality is from norm. Thus, Table 4.2 and Figure 4.5 show that the asymptomatic group had the greatest craniovertebral angle implying the least FHP of the three groups.

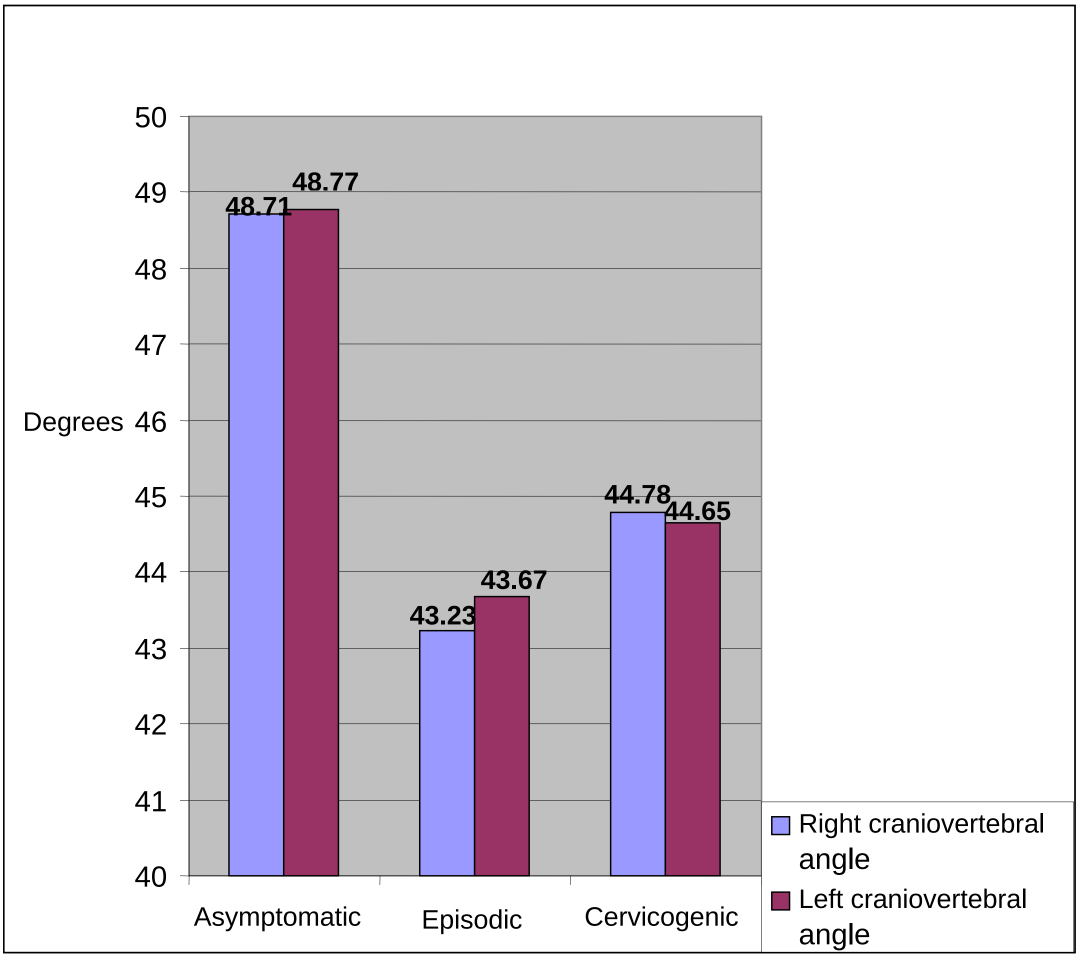


Figure 4.5 Means of the right and left craniovertebral angle across the three groups.

4.4 Cervical range of motions

Table 4.3 expresses the mean (and standard deviation) range of motion of each of the three groups. Flexion, extension and left rotation differed significantly between the three groups (p=0.009; p=0.038; p=0.018). The asymptomatic group had a significantly greater cervical range motion for flexion, than the symptomatic groups, while the two symptomatic groups did not significantly differ from each other. Although extension range of motion was greater in the asymptomatic group, Bonferroni post hoc correction revealed that individually none of the groups were significantly different from each other when compared individually. For left rotation, the asymptomatic group only differed from the CGH group and not the ETTH.

Table 4.3 ANOVA comparison of mean cervical range of motion variables across the three groups.

	Groups						ANOVA p value
	Asymptomatic		Episodic		Cervicogenic		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
FLEXION	65.9	15.2	52.8	13.4	54.2	14.3	**0.009**
EXTENSION	64.9	14.1	55.7	12.3	56.4	10.3	**0.038**
RIGHT ROTATION	68.7	13.5	66.3	10.9	63.3	7.7	0.297
LEFT ROTATION	71.7	10.7	64.2	13.5	61.0	11.2	**0.018**
LEFT LATERAL FLEXION	46.2	8.2	39.7	12.2	41.0	8.3	0.092
RIGHT LATERAL FLEXION	46.9	8.6	42.8	10.3	41.7	11.8	0.251

4.5 Relationship between the headache's characteristics and postural assessment variables.

Table 4.4 shows that in the ETTH group there was a significant positive correlation between the right craniovertebral angle and the mean duration of headaches. This meant that the smaller the craniovertebral angle (and therefore the greater the FHP), the shorter the duration of headaches. In the CGH group there was a significant positive correlation between the distance of the external auditory meatus from the plumbline and the mean intensity of headaches.

Table 4.4 Pearson's correlation between mean postural assessment variables and mean headache characteristics in the symptomatic groups.

Group			Frequency	Intensity	Duration
Episodic	**Right craniovertebral angle.**	Pearson Correlation	0.234	0.409	0.450(*)
		Sig. (2-tailed)	0.321	0.073	0.047
	Left craniovertebral angle.	Pearson Correlation	0.279	0.245	0.426
		Sig. (2-tailed)	0.233	0.298	0.061
	Craniovertebral angle average.	Pearson Correlation	0.262	0.344	0.452(*)
		Sig. (2-tailed)	0.265	0.137	0.046
	Distance between the EAM and the plumbline (cm).	Pearson Correlation	0.176	0.059	0.036
		Sig. (2-tailed)	0.459	0.805	0.880
	Distance between the AC and the plumbline (cm).	Pearson Correlation	-0.043	-0.274	-0.368
		Sig. (2-tailed)	0.857	0.243	0.110
	Distance between the greater trochanter and the plumbline (cm).	Pearson Correlation	-0.015	0.261	0.022
		Sig. (2-tailed)	0.951	0.267	0.928
	Distance between the anterior axis of the knee and the plumbline (cm).	Pearson Correlation	0.126	-0.293	-0.182
		Sig. (2-tailed)	0.597	0.210	0.442

Cervicogenic	**Right craniovertebral angle.**	Pearson Correlation	0.070	0.130	0.221
		Sig. (2-tailed)	0.770	0.585	0.348
	Left craniovertebral angle.	Pearson Correlation	0.140	0.016	-0.111
		Sig. (2-tailed)	0.555	0.948	0.641
	Craniovertebral angle average.	Pearson Correlation	0.113	0.069	0.038
		Sig. (2-tailed)	0.634	0.772	.8730
	Distance between the EAM and the plumbline (cm).	Pearson Correlation	0.071	0.457(*)	0.216
		Sig. (2-tailed)	0.767	0.043	0.360
	Distance between the AC and the plumbline (cm).	Pearson Correlation	0.325	0.142	-0.188
		Sig. (2-tailed)	0.162	0.551	0.428
	Distance between the greater trochanter and the plumbline (cm).	Pearson Correlation	0.096	-0.015	0.037
		Sig. (2-tailed)	0.686	0.951	0.878
	Distance between the anterior axis of the knee and the plumbline (cm).	Pearson Correlation	-0.334	0.037	0.069
		Sig. (2-tailed)	0.149	0.8780	0.772

- Correlation is significant at the 0.05 level (2-tailed).

EAM= External auditory meatus

AC= Acromioclavicular joint

Table 4.5 correlates the difference between postural assessment values and the craniovertebral angle, which is then expressed as a scatter plot in Figure 4.6. The mean of the right and left craniovertebral angles were significantly negatively correlated with the mean of the distance of the external auditory meatus from the plumbline and the distance of the acromioclavicular joint from the plumbline. However, the correlation was weak, indicating that the smaller the craniovertebral angle, the greater the distance of the external auditory meatus and the acromioclavicular joint from the plumbline.

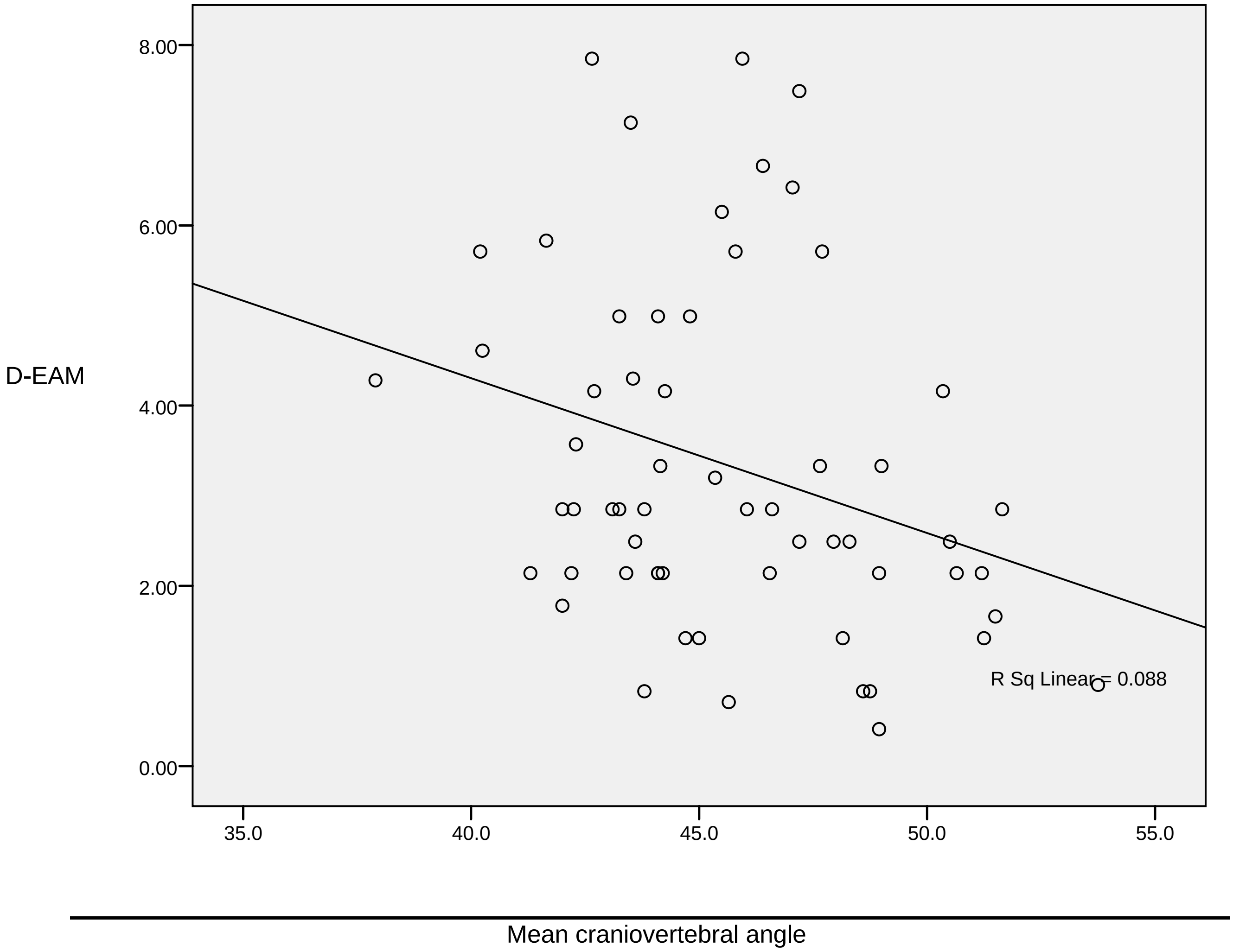
Table 4.5 Pearson's correlation between mean of four distances from plumbline and mean craniovertebral angles

		Distance between the EAM and the plumbline.	**Distance between the AC and the plumbline.**	**Distance between the greater trochanter and the plumbline.**	**Distance between the anterior axis of the knee and the plumbline.**
Right craniovertebral angle	Pearson Correlation	-0.258(*)	-0.321(*)	0.058	-0.149
	Sig. (2-tailed)	0.046	0.012	0.660	0.2550
Left craniovertebral angle	Pearson Correlation	-0.324(*)	-0.299(*)	0.014	-0.125
	Sig. (2-tailed)	.0120	0.020	0.914	0.340
Craniovertebral angle average	Pearson Correlation	-0.296(*)	-0.317(*)	0.037	-0.140
	Sig. (2-tailed)	0.022	0.014	0.778	0.285

*Correlation is significant at the 0.05 level (2-tailed).

EAM= External auditory meatus

AC= Acromioclavicular joint



D-EAM= Distance from the External auditory meatus

Figure 4.6 Scatter plot of the mean distance of the external auditory meatus from the plumbline and the mean right and left cranioverebral angles.

4.6 Relationship between postural assessment variables and demographic data

Table 4.6 correlates the difference of both age grouping and BMI between the postural assessment variables. BMI was significantly negatively correlated with the left and right craniovertebral angles. As BMI increased, so the craniovertebral angle decreased i.e. the greater the BMI value the greater the FHP. The distance between the anterior axis of the knee and the plumbline was significantly positively correlated with BMI but the coefficient was very weak. Age was significantly positively correlated with distance between the greater trochanter and the plumbline.

Table 4.6 Pearson's correlation between postural assessment variables and age and BMI

		Age	**BMI**
Right craniovertebral angle.	Pearson Correlation	-0.099	-0.347(**)
	Sig. (2-tailed)	0.451	0.007
Left craniovertebral angle.	Pearson Correlation	-0.177	-0.344(**)
	Sig. (2-tailed)	0.176	0.007
Craniovertebral angle average.	Pearson Correlation	-0.140	-0.352(**)
	Sig. (2-tailed)	0.285	0.006
Distance between the EAM and the plumbline (cm).	Pearson Correlation	0.201	-0.061
	Sig. (2-tailed)	0.123	0.643
Distance between the AC and the plumbline (cm).	Pearson Correlation	-0.141	0.121
	Sig. (2-tailed)	0.281	0.358
Distance between the greater trochanter and the plumbline (cm).	Pearson Correlation	0.341(**)	-0.172
	Sig. (2-tailed)	0.008	0.1880
Distance between the anterior axis of the knee and the plumbline (cm).	Pearson Correlation	-0.097	0.281(*)
	Sig. (2-tailed)	0.461	0.029

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed).

EAM= External auditory meatus

AC= Acromioclavicular joint

Table 4.7 compares postural assessment variables with gender. There was a statistically significant difference between the males and females in terms of mean distance between the anterior axis of the knee and the plumbline (p=0.033). The females had higher measurements on average.

Table 4.7 T-tests to compare postural assessment variables with genders.

	Gender	n	Mean	Standard Deviation	Standard Deviation. Error Mean	p value
Right craniovertebral angle	Female	42	45.219	3.3660	0.5194	0.222
	Male	18	46.406	3.5248	0.8308	
Left craniovertebral angle	Female	42	45.312	3.1761	0.4901	0.172
	Male	18	46.600	3.5984	0.8481	
Craniovertebral angle average	Female	42	45.265	3.2046	0.4945	0.187
	Male	18	46.503	3.4926	0.8232	
Distance between the EAM and the plumbline.	Female	42	3.1702	1.78110	0.27483	0.309
	Male	18	3.7250	2.22050	0.52338	
Distance between the AC and the plumbline.	Female	42	2.2155	1.58502	0.24457	0.920
	Male	18	2.2589	1.36553	0.32186	
Distance between the greater trochanter and the plumbline.	Female	42	2.5836	1.91615	0.29567	0.059
	Male	18	3.5839	1.65210	0.38940	
Distance between the anterior axis of the knee and the plumbline.	Female	42	2.1110	1.43084	0.22078	0.033
	Male	18	1.2867	1.08321	0.25531	

EAM= External auditory meatus
AC= Acromioclavicular joint

Table 4.8 compares mean FHP across the three ethnic groups (The Asian has not been included as there was only one participant). There was an overall difference between the ethnic group in terms of right craniovertebral angle, as well as the distance between the greater trochanter and the plumbline. The significant differences lay between Whites and Indians in terms of craniovertebral angle and between Whites and Blacks for the distance between the greater trochanter and the plumbline.

Table 4.8 ANOVA comparison of mean postural assesment variables between the ethnic groups

	Ethnicity						ANOVA p value
	White		Indian		Black		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Right craniovertebral angle.	46.2	2.9	40.7	2.8	45.3	3.4	**0.007**
Left craniovertebral angle.	45.9	3.2	42.3	2.5	45.8	3.4	0.105
Craniovertebral angle average.	46.0	3.0	41.5	2.6	45.5	3.4	**0.028**
Distance between the EAM and the plumbline.	3.7	2.1	4.0	1.5	2.7	1.6	0.151
Distance between the AC and the plumbline.	2.0	1.3	2.8	0.5	2.6	1.8	0.234
Distance between the greater trochanter and the plumbline.	3.5	1.8	3.6	2.1	1.8	1.6	**0.002**
Distance between the anerior axis of the knee and the plumbline.	1.7	1.4	1.3	1.2	2.2	1.4	0.257

EAM= External auditory meatus

AC= Acromioclavicular joint

4.7 Summary

Therefore, a statistically significant difference ($p<0.05$) was found between the three groups in terms of the FHP variables, which points toward a greater FHP presentation in the symptomatic groups as opposed to the asymptomatic group. The smaller the craniovertebral angle and/or the greater the distance between the external auditory meatus and the plumbline the greater the FHP.

In terms of cervical range of motion, the asymptomatic group had a significantly greater ($p<0.05$) cervical range motion for flexion, extension and left rotation than the symptomatic groups, while the two symptomatic groups did not significantly differ from each other.

There was no significant difference ($p>0.05$) in terms of headache characteristics between the two symptomatic groups, yet in the CGH group there was a significant positive correlation between the distance of the external auditory meatus from the plumbline and the mean intensity of headaches.

In terms of duration, the ETTH group showed a significant positive correlation ($p=0.450$) between the right craniovertebral angle and the mean duration of headaches.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Introduction

The results obtained from the statistical analysis in this particular study, along with the results and conclusions from previous studies presented in the literature, will be discussed in the following chapter.

5.2 Quality of the data

When looking at the gender ratio in the study, there were a greater number of female (n=42; 70%) versus male (n=18; 30%) participants. This outcome was expected, since literature shows that ETTH is found to be 1.5 times more prevalent in females than males and the CGH are four times more common in females than males (Eldridge and Russell, 2005 and Rasmussen 1995). Yet, there was no statistically significant difference when comparing the gender of participants across the three groups, indicating the homogeneity of the group. The study targeted an age range between 20 and 45, yet most participants fell into the 20-24 year age group (n=37; 61.7%). Thus this study represented a young population group . The majority of the participants were within the normal BMI range (n=33; 55%), whilst 31.7% (n=19) of the group were overweight. Previous studies by Mun Cheung Lau *et al*. (2008) and Harman *et al*. (2005) on FHP, found no statistically significant correlation between age, gender or BMI across the groups in terms of the postural measurements obtained. Mun Cheung Lau *et al*. (2008) concluded that an age and gender contribution to the variation in the craniovertebral angle is questionable. Yet another study (n=80) conducted by Anabela *et al*. (2009), investigating head posture and chronic non traumatic neck pain, found that younger patients with chronic non traumatic neck pain had a greater FHP when compared to the control group. In terms of ethnicity, the majority of participants were White (n=33; 55 %). However, there was an even distribution of White participants across the three groups. Although the p-value was significant, this was not valid due to the presence of only one Asian participant in the study.

5.3 Discussion

5.3.1 Objective One (Craniovertebral angle, external auditory meatus distance from plumbline and cervical range of motion).

A statistically significant difference was noted in the mean craniovertebral angle when comparing the two symptomatic groups with the asymptomatic group. The ETTH group had a mean craniovertebral angle of 43.45°, the CGH group had a mean angle of 44.71°, whilst the mean for the asymptomatic group was 48.74°. A smaller craniovertebral angle implies a greater FHP (Ho Ting Yip *et al*., 2007), as noted in the symptomatic groups. However, there was no statistically significant differences between the two symptomatic groups (Table 4.2). These findings are in keeping with previous studies (Anabela *et al*., 2009, Ho Ting Yip *et al*., 2007, Fernandez-de-las-Penas *et al*., 2007, Mun Cheung Lau *et al*., 2008 and Szeto *et al*., 2002), investigating the craniovertebral angle. Anabela *et al*., 2009, Ho Ting Yip *et al*. (2007) and Mun Cheung Lau *et al*. (2008) found that participants with neck pain had smaller mean craniovertebral angles (45.4°, 43.9° and 49.93° respectively) than asymptomatic individuals (48.6°, 50.9° and 55.03° respectively). Similar findings were noted by Szeto *et al*. (2002) in a study of female office workers with neck and shoulder pain. As previously mentioned, there is no standard “ideal” craniovertebral angle, yet the results of this study were more similar to those found by Ho Ting Yip *et al*. (2007).

A statistically significant difference was noted in terms of the distance of the external auditory meatus from the plumbline when comparing the two symptomatic groups with the asymptomatic group. The ETTH group had a mean distance of 3.42 cm from the plumbline, the CGH group 4.28 cm and the asymptomatic 2.30 cm. An ideal posture is considered to be present when the external auditory meatus is aligned with the vertical line (plumbline), (Ho Ting Yip *et al*., 2007). This means that as the distance of the external auditory meatus from the plumbline increases so does the FHP increases. Therefore, the two symptomatic groups had a greater FHP than the asymptomatic group. However, there was no statistically significant differences between the two symptomatic groups (Table 4.2).

In terms of cervical range of motion, a statistically significant difference was noted with flexion (p=0.009), extension (p=0.038) and left rotation (p=0.018) range of motion, whereby the asymptomatic group had a greater cervical spine range of motion when compared with the two symptomatic groups (Table 4.3). Although cervical spine rotation to the right and left lateral flexion were greater in the asymptomatic group than the two symptomatic groups, the results were not statistically significant ($p>0.05$), nor was there a statistically significant difference noted between the two symptomatic groups (Table 4.3). Chaitow (2008) states that a decrease in normal extension range of motion is a result of contracture of the anterior longitudinal ligament, which is a part of the process that results in the upper cross syndrome. Whilst Page *et al*. (2010) explained that in patients with FHP, an abnormal anterior movement pattern results in a reduced flexion range of motion. Both these results are in keeping with the findings of this study in that the headache groups had a greater FHP. Further to this, a study (n=30), conducted by Fernandez-de-las-Penas *et al*. (2007), found that participants who presented with ETTH showed a decrease in active cervical range of motion in all directions, when compared with the control group. Another study conducted by Hall *et al*. (2008), stated that patients with CGH have a tendency to develop a painful "poker chin posture" which results in a decrease in active cervical flexion range of motion.

5.3.2 Objective Two (headache characteristics).

The results of the headache diary completed by the ETTH group were as follows: mean frequency of 6.6 (in a fourteen days period), mean intensity of 4.8 (range 0 - 10) and mean duration of 97.8 minutes (in a fourteen day period). The CGH had a frequency of 8.6 (in a fourteen day period), mean intensity of 4.4 (range 0 - 10) and mean duration of 102.5 minutes (in a fourteen day period). These findings are in keeping with the literature, according to Hall *et al*. (2008), CGH can occur as frequently as five times a day with a minimal duration of two minutes and ETTH with a maximum of fifteen episodes per month, with a duration ranging from a few minutes to few a hours (Swanson, 2004). In a study (n=30) conducted by Fernandez-de-las-Penas *et al*. (2007) of participants who presented with ETTH, the headache diary was recorded over a four week period and the results were as follows: mean frequency of 2.8 days per week, mean intensity of 4.6 (range 0 - 10) and mean duration of 7 hours during a day with a headache. No studies on CGH with the use of a headache diary and without any intervention, were located in the literature, therefore comparing the results of these CGH characteristics to other CGH studies was not viable. The headache diary results of both symptomatic groups were also within the international headache classification guidelines (the guidelines were adhered to in this study) for ETTH and CGH.

In terms of headache characteristics, the ETTH and CGH groups were not significantly different. As a result of this, the two groups were for the purpose of this study homogenous in terms of severity of headache presentations.

5.3.3 Objective Three (determined whether an association exists between the postural assessment values (FHP, EAM and cervical ROM) and the presence and type of headache, as well as the intensity, duration and frequency of the headaches).

In terms of intensity, the CGH group had a significant positive correlation between the distance of the external auditory meatus from the plumbline and the mean intensity of headaches (p=0.457). This implies that the greater the distance of the external auditory meatus from the plumbline, the greater the headache intensity. The ETTH showed no significant correlation between the postural variable and the headache intensity (Table 4.4). In terms of frequency, no statistically significant correlation was detected between the number of headache occurrences of either the ETTH or CGH groups during the fourteen day headache diary and the postural variables (Table 4.4). In terms of duration, the ETTH group showed a significant positive correlation between the right craniovertebral angle and the mean duration of headaches (p=0.450). This meant that the smaller the craniovertebral angle (and therefore the greater the FHP), the shorter the duration of headaches**.** The CGH showed no significance between the postural variables and the headache duration (Table 4.4).

As previously discussed and highlighted, both ETTH and CGH groups were found to have a greater FHP, a greater distance of the EAM from the plumbline, as well as a decrease in active cervical range of motion, when compared with the asymptomatic group. These results are similar to those of other related studies (Ho Ting Yip *et al*., 2007, Fernandez-de-las-Penas *et al*., 2007, Mun Cheung Lau *et al*., 2008 and Szeto *et al*., 2002) that found a greater FHP in participants with neck and/or shoulder pain.

Jong-Hyuck et al., (2009), found and concluded that FHP results in excessive upper and lower trapezius muscle activation and a decrease in the serratus anterior muscle activation. These findings correspond with studies conducted by BIgal and Lipton, (2005) and Fernandez-de-las-Penas *et al*., (2007), which concluded, that active myofascial trigger points in the trapezius muscle as well as muscle tenderness are a common presentation in patients with ETTH. However, a strong link was not found between the headache characteristics and the postural variables. This was an unexpected finding and is in contrast with the studies mentioned earlier (Ho Ting Yip *et al*., 2007, Fernandez-de-las-Penas *et al*., 2007, Mun Cheung Lau *et al*., 2008 and Szeto *et al*., 2002). The possible reason for these unexpected findings could be due to participants inaccurately filling out the headache diary on a daily basis despite numerous remainder by the researcher.

Another potential reason is the small sample size of the study thus leading to a type 2 error. Perhaps a larger sample size would have provided a clearer picture. FHP is part of a functional pathology that is an ongoing process, as opposed to a more obvious presentation of a structural pathology (Page *et al*., 2010) and the fact that this study represented a young population group, (most participants fell into the 20-24 year age group, n=37; 61.7%), may have effected the outcome. The headache types investigated in this study, were not chronic in nature, possibly chronic headache type characteristics have a stronger link to postural variables. Lastly most studies (Ho Ting Yip *et al*., 2007, Mun Cheung Lau *et al*., 2008 and Szeto *et al*., 2002) that investigated FHP, concentrated on patients with neck and/or shoulder pain rather than headaches, therefore further studies are needed to clarify the results.

In terms of postural assessment variables, the ETTH and CGH groups were not significantly different. Thus, FHP may be a cause/ trigger for both headache types, although the mechanism of action would be different. A possible reason for the link between FHP and ETTH is the presentation of the surrounding muscular pathology, such as active myofasical trigger points, where as the possible link between FHP and CGH is the presentation of cervical joint dysfunction and its effects on the normal cervical range of motion.

5.4 Hypotheses revisited

Null hypothesis one

1. There will be no association between postural assessment values (FHP, EAM and cervical ROM) and the presence of ETTH.
2. There will be no association between postural assessment values (FHP, EAM and cervical ROM) and the presence of CGH.

Null hypothesis 1 and 2 were rejected due to a statistically significant difference noted for most of the postural assessment variables. This points towards a greater FHP presentation in the symptomatic groups as opposed to the asymptomatic group. This is in keeping with similar studies that have investigated the association between FHP and neck and/or shoulder pain (Ho Ting Yip *et al*., 2007, Fernandez-de-las-Penas *et al*., 2007, Mun Cheung Lau *et al*., 2008 and Szeto *et al*., 2002).

Null hypothesis two

3. There will be no association between the intensity, duration and frequency of ETTH and postural assessment values (FHP, EAM and cervical ROM).
4. There will be no association between the intensity, duration and frequency of CGH and postural assessment values (FHP, EAM and cervical ROM).

Null hypothesis 3 and 4 were accepted, although a correlation was noted in the CGH group between the distance of the external auditory meatus from the plumbline and the mean intensity of headaches. This implies that the greater the distance of the external auditory meatus from the plumbline, the greater the headache intensity. In the ETTH group there was a significant positive correlation between the right craniovertebral angle and the mean duration of headaches. This meant that the smaller the craniovertebral angle (and therefore the greater the FHP), the shorter the duration of headaches**.** However, no other associations were noted between headache characteristics and the postural assessment variables.

5.5 Conclusion

From the results in Chapter Four, it can be noted that an association does exist between FHP/postural assessment variables and the presentation of ETTH and CGH when compared with an asymptomatic control group ($p<0.05$). Yet a statistically significant link between the FHP and the headache's characteristics (intensity, frequency and duration) was not found. As well as no significant difference was found when the postural assessment variables as well as the headache characteristics results were compared between the two symptomatic groups.

Therefore, it can be concluded that patients presenting with ETTH and/or CGH may have associated postural abnormalities that may act as a trigger or a causative factor to the presenting headache.

CHAPTER SIX

CONCLUSION AND RECOMANDETION

6.1 Conclusion

This study was motivated due to the high prevalence rate of episodic tension-type (ETTH) and cervicogenic headaches (CGH), along with literature which suggested a link between postural abnormalities (increase in FHP) and neck, shoulder and/or headaches.

The results indicated:

- The presence of ETTH and CGH was significantly ($p<0.05$) related to a greater FHP, larger distance of the EAM from the plumbline, as well as a decrease in cervical flexion, extension and left rotation range of motion when compared to a control group.
- The headache characteristics: intensity, duration and frequency, were not significantly associated ($p>0.05$) with the postural assessment variables in either symptomatic groups (ETTH and CGH).

The results from this research indicated that the management of ETTH and/or CGH should not only focus on manual therapy but on the correction of existing postural abnormalities, in particular FHP.

FHP forms a part of a functional pathology which possibly if corrected early would prevent frequent reoccurrence of headache symptoms.

6.2 Recommendations

1. To ensure accurate data with respect to a headache diary it would be preferabe for the researcher to be in contact with the participants on a daily basis.
2. Although the smart tool angle finder as well as the digital photograph used in this study, were reliable data collection tools. From a practical perspective, the use of posture analysis software (e.g. posture pro) would be favourable for chiropractors to use in practice since they are much quicker and easier to use.
3. The study sample size was 60 participants (20 in each group), perhaps the use of larger sample size in each group may produce a greater statistically significant result.
4. Further research needs to be done to determine a normalized range for the craniovertebral angle to be utilized as a point of reference for future studies and clinicians assessing posture in practice.
5. Future studies need to expand on the effects of FHP by objectively measuring the surrounding muscles strength and flexibility in order to determine the extent of the functional pathology on headaches.

Appendix A

Advertisement

Are between the ages of

20-45 years?

Do you suffer from Headaches?

or

Do you <u>not</u> suffer from Headaches

Research is currently being carried out by the Chiropractic Department Durban University of Technology

Should you qualify to take part in the study you will receive:

FREE POSTURAL ANALYSIS AND TREATMENT

For more information contact

Victor Duani

on

031 – 3732205 / 083 7008790

Appendix B

Letter of information and consent form.

Letter of Information and consent form

Title of the research:

An investigation into the role of forward head position as an associated factor in the presentation of Episodic tension-type and Cervicogenic headaches.

Name of supervisor: Dr. N. De Busser, M.T Chiropractic, MMed (Sports Med) (031-2016870)

Name of Co supervisor: Dr. J. Nell, M.T Chiropractic, (031-2666337)

Name of Research Student: Victor Duani (031- 3732205)

The purpose of this study will be investigating the possible association between forward head position (FHP) and the duration, intensity and frequency of Episodic tension-type, Cervicogenic headaches, an asymptomatic control group will also be included.
The patient will visit the chiropractic clinic where they will undergo a complete case history (Appendix C), physical examination (Appendix D) and cervical regional examination (Appendix E).

There will be three sample groups. All participant posture will be assessed by means of Lateral digital photographic view, craniovertebral angle measurement by the use of smart tool angle finder and Active Cervical range of motion by the use of CROM goniometer.
Each patient in the Episodic tension-type and Cervicogenic headaches groups will be given a headache diary that must be fill and return to the student in a course of two weeks.

Digital photograph will be taken of the patient side view. These will be used to obtain measurements only and will not be published. The participant will be asked to put on a legging, a tight fitting vest over their under garment and remove their socks and shoes (luminous marked stickers will be placed on the allocated points for measurement purposes). They will be given an eye mask to cover their eyes in the photographs and thus maintain anonymity.
The data will be collected via both objective and subjective measurements:

1) Lateral digital photographic view of the patient in front of a grid to measure postural changes. The photographs will be used to obtain measurements and will not be in any of the publications.
2) Craniovertebral angle measured by Smart tool angle finder.
3) Active Cervical range of motion by the use of CROM goniometer.
4) Headache diary.

Reasons why you may be withdrawn from the study:

If you do not meet the inclusion criteria you will not be admitted into this research. If at any stage you wish to withdraw from the research you are free to do so and you shall not suffer any adverse consequences.

Remuneration and costs.

Treatment for the duration of the research programme will be free of charge. Subjects taking part in the study will not be offered any other form of remuneration for taking part in this study.

Confidentiality

All patient information is confidential. The results of the study will be made available in the Durban University of Technology library in the form of a mini- dissertation

Persons to contact in the event of any problems:

Researcher: Victor Duani (031 373 2205 / 083 700 8790)

Supervisor: Dr. N. De Busser (031-2016870)

HOD : Dr Charmaine Korporaal (031-3732611)

Statement of Agreement to Participate in the Research Study:

I, ……………………………………………………(Full name and Surname), ID number…………………………… have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by ……………………………..to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study. I here by indemnify the researcher, the supervisor and DUT from any harm that may occur during the research.

Participants name :……………………………………

Signature: ……………………………………………..

Date:……………………………………………………

Researchers name: …………………………………..

Signature:……………………………………………….

Date:……………………………………………………

Witness name:……………………………………….

Signature:……………………………………………...

Date:……………………………………………………

Supervisor name:…………………………………………..

Signature :…………………………………………………

Date:…………………………………………………………

Appendix C

Case history

DURBAN UNIVERSITY OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: ______________________________ Date: __________

File # __________ Age: __________

Sex __________ Occupation ____________________

Intern : ____________________ ____________________

Signature

FOR CLINICIANS USE ONLY:

Initial visit

Clinician: Signature :

Case History:

Examination:

Previous: Current:

X-Ray Studies:

Previous: Current:

Clinical Path. lab:

Previous: Current:

CASE STATUS:

PTT: Signature: Date:

CONDITIONAL:

Reason for Conditional:

Signature: Date:

Conditions met in Visit No:	Signed into PTT:	Date:

Case Summary signed off:	Date:

Intern's Case History:

1. **Source of History:**

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

3. **Present Illness:**

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

4. **Other Complaints:**

5. **Past Medical History:**

< General Health Status

< Childhood Illnesses

< Adult Illnesses

< Psychiatric Illnesses

< Accidents/Injuries

< Surgery

< Hospitalizations

6. Current health status and life-style:

< Allergies

< Immunizations

< Screening Tests incl. x-rays

< Environmental Hazards (Home, School, Work)

< Exercise and Leisure

< Sleep Patterns

< Diet

< Current Medication
Analgesics/week:
< Tobacco

< Alcohol

< Social Drugs

7. Immediate Family Medical History:

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

8. Psychosocial history:

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

9. Review of Systems:

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

Appendix D

Senior physical examination

1.1.1.1 Durban University of Technology

1.1.1.1.1 PHYSICAL EXAMINATION: SENIOR

Patient Name : ______________________ **File no :** ____ **Date :** ___

Student : **Signature :**

VITALS:

Pulse rate:			Respiratory rate:	
Blood pressure:	R	L	Medication if hypertensive:	
Temperature:			Height:	

Weight:	Any recent change? Y / N		If Yes: How much gain/loss	Over what period

GENERAL EXAMINATION:

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

SYSTEM SPECIFIC EXAMINATION:

CARDIOVASCULAR EXAMINATION

RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION

NEUROLOGICAL EXAMINATION

COMMENTS

Clinician: **Signature :**

Appendix E

Cervical spine regional

DURBAN UNIVERSITY OF TECHNOLOGY
REGIONAL EXAMINATION - CERVICAL SPINE

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

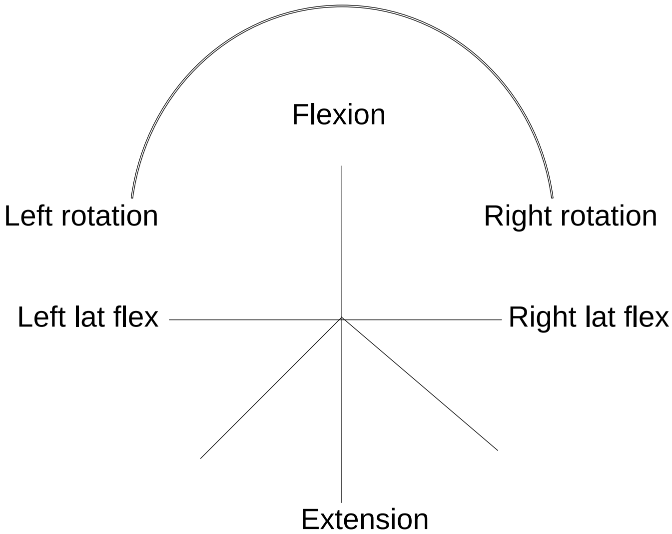
Date: .... Student: ....

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

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

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

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



PALPATION:
Lymph nodes
Thyroid Gland
Trachea

ORTHOPAEDIC EXAMINATION:

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

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

NEUROLOGICAL EXAMINATION:

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					

Cerebellar tests:	Left	Right
Disdiadochokinesis		

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

MOTION PALPATION & JOINT PLAY:

Left: Motion Palpation:

Joint Play:

Right: Motion Palpation:

Joint Play:

BASIC EXAM: SHOULDER:

Case History:

ROM: Active:

Passive:

RIM:

Orthopaedic:

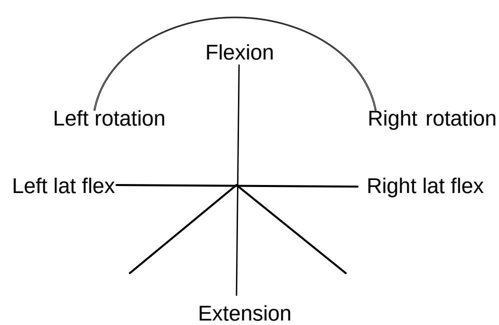
Neuro:

Vascular:

BASIC EXAM: THORACIC SPINE:

Case History:

ROM:



Motion palpation:

Orthopaedic:

Neuro:

Vascular:

Observ/Palpation:
Joint Play:

Appendix F

SOAPE NOTE

DURBAN UNIVERSITY of TECHNOLOGY

DURBAN UNIVERSITY OF TECHNOLOGY

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

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

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

0: ***P:***

E:

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

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

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

O: ***P:***

E:

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

Appendix G

Data collection sheet

Data Collection Sheet

Patient Name: …………………………..

File Number :……………………

CROM Goniometer:

Date	Degree
Flexion	
Extension	
Right Rotation	
Left Rotation	
R Lateral Flexion	
L Lateral Flexion	

Appendix H

Postural Analysis

Patient Name:………………………………..   File number:…………………

Postural Analysis:

Measurement	1	2
Craniovertebral angle.		
Distance between plumb-line and ext. auditory meatus.		
Distance between plumb-line and midway of the shoulder.		
Distance between plumb-line and greater trochanter.		
Distance between plumb-line and anterior axis of the knee joint.		

Appendix I

Headache diary

Headache diary

Date (exact dates will be written out to the patients).	Frequency (Number of headache per day).	Intensity per headache (1-10) 1=no pain, 10=maximum pain	Duration of each headache in minutes.
1		1. 2. 3 4. 5.	1. 2. 3. 4. 5
2		1. 2. 3 4. 5.	1. 2. 3. 4. 5
3		1. 2. 3 4. 5.	1. 2. 3. 4. 5
4		1. 2. 3 4. 5.	1. 2. 3. 4. 5
5		1. 2. 3 4. 5.	1. 2. 3. 4. 5
6		1. 2. 3 4.	1. 2. 3. 4.

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12		1. 2. 3 4. 5.	1. 2. 3. 4. 5
13		1. 2. 3 4. 5.	1. 2. 3. 4. 5
14		1. 2. 3 4. 5.	1. 2. 3. 4. 5

Appendix J

Ethics clearance certificate

ETHICS CLEARANCE CERTIFICATE

Student Name	Victor Duani	**Student No**	20408996
Ethics Reference Number	048/09	**Date of FRC Approval**	12/10/2009
Qualification	MTech Chiropractic		
Research Title:	An investigation into the role of forward head position as an associated factor in the presentation of Episodic tension-type and Cervicogenic headaches.		

In terms of the ethical considerations for the conduct of research in the Faculty of Health Sciences, Durban University of Technology, this proposal meets with Institutional requirements and confirms the following ethical obligations:

1. The researcher has read and understood the research ethics policy and procedures as endorsed by the Durban University of Technology, has sufficiently answered all questions pertaining to ethics in the DUT 1B6 and agrees to comply with them.
2. The researcher will report any serious adverse events pertaining to the research to the Faculty of Health Sciences Research Ethics Committee.
3. The researcher will submit any major additions or changes to the research proposal after approval has been granted to the Faculty of Health Sciences Research Committee for consideration.
4. The researcher, with the supervisor and co-researchers will take full responsibility in ensuring that the protocol is adhered to.
5. ***The following section must be completed if the research involves human participants:***

	YES	NO	N/A
❖ Provision has been made to obtain informed consent of the participants	X		
❖ Potential psychological and physical risks have been considered and minimised	X		
❖ Provision has been made to avoid undue intrusion with regard to participants and community	X		
❖ Rights of participants will be safe-guarded in relation to: - Measures for the protection of anonymity and the maintenance of Confidentiality.	X		
- Access to research information and findings.	X		
- Termination of involvement without compromise	X		
- Misleading promises regarding benefits of the research	X		

15·10·09
DATE

15·10·09
DATE

15/10/09
DATE

19-10-09
D

SIGNATURE: CHAIRPERSON OF RESEARCH ETHICS COMMITTEE

Appendix k

Research Budget

Section A: Budget		**(Motivate below – see PG Guidelines)**	
1.	**Consumable Details** (Motivate)	R0.30 for single side	
		R0.60 for double side	
		Letter of information: 2 pages Case history : 4 pages Senior physical exam: 1 page Cervical regional: 3 pages Soap Note: 1 page Data collection: 1 page Postural analysis: 1 page Total number of pages: 780 Advertisement:	**R234** **R1000**
2.	**Outside Specialist Services** (Motivate)		
3.	**Books/Journal/Documents**		**R300**
4.	**Library Charges**		
			R300
5.	**Equipment** (Motivate)	Tripod at R600 for the use of the angle finder and the camera	**R600**
		Digital angle finder at R2100 Costume R300	**R3000**
6.	**Travel Costs** (Motivate)		
7.	**Other** (Motivate)	Statistician Phone Proof reading	**R3200** **R500** **R1000**
		Total	**R4500**
	TOTAL		**R9534**