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A COMPARATIVE STUDY FOR THE TREATMENT OF TENSION-TYPE HEADACHES IN INDIVIDUALS PRESENTING WITH FORWARD HEAD POSTURE

A research dissertation submitted to the Faculty of Health Sciences, University of Johannesburg, as partial fulfilment for the Masters Degree in Technology: Chiropractic

By:

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Supervisor: ________________________ Date: _______________________

Dr C Yelverton
DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the Masters Degree in Technology in the program Chiropractic at the University of Johannesburg. It has not been submitted before for any degree or examination in any other Tertiary Institute.

On this ___________________ day of ___________________ 2015

__________________________
Patrick Newman
DEDICATION

In completion of this study I would like to thank my family for allowing me to follow my dream. It was only through all of your love and support that I was able to complete this degree.
ACKNOWLEDGEMENTS

Dr Chris Yelverton, my supervisor, thank you for all your time and effort spent on guiding me throughout this process. Your input is greatly appreciated.

To all my friends and classmates who have been my pillar of strength over the years, thank you for all your love and support. Thank you for guiding me and being by my side through all the struggles presented to me over the duration of this course.

To all those that took part in this study, without you, none of this would have been possible.
ABSTRACT

Objective: The purpose of the study was to determine whether manipulating the relevant restricted cervical segments versus a stretching and strengthening programme, targeted at releasing hypertonic muscles and strengthening weakened muscles, was effective in reducing tension-type headaches in individuals presenting with forward head posture.

Study Design: This was a randomised comparative study.

Setting: The participants were treated at the University of Johannesburg Chiropractic Day Clinic.

Subjects: Thirty participants were randomly divided into three groups consisting of ten individuals in each. There was a random selection of males and females, which was not limited to any particular race or gender. Participants were limited between the ages of 18-50 years. Participants presenting with a forward head posture who were diagnosed with tension-type headaches, were eligible for this study.

Method: The subjective data was collected by having the participants complete the Vernon-Mior Neck Pain and Disability Questionnaire [NDI], which was issued to each participant on the first consultation day as well as, on the last consultation day of the study. The objective data readings involved hypertonic muscles being evaluated using a pressure algometer on the first, fourth and seventh consultations. The data was recorded and compared at various intervals throughout the duration of the trial. The forward head posture of each participant was evaluated with the use of photographs. Each participant was required to assume the relaxed neutral position. A lateral cervical spine photograph was taken on the first and last day of the trial in order to measure the craniovertebral angle. Group 1 had their cervical spine evaluated for cervical segment restrictions. The use of a chiropractic manipulation was used on these segments to correct any found restrictions. Group 2 was evaluated using flat palpation to identify hypertonic suboccipital and sternocleidomastoid muscles or weakened longus capitus muscles. A soft tissue protocol was issued to treat the various muscles affected. The treatment consisted of releasing hypertonic muscles and strengthening weakened muscles. Group 3 followed the same evaluation and treatment procedures as both group 1 and group 2. Each participant was evaluated using flat palpation to identify hypertonic suboccipital and sternocleidomastoid muscles or weakened longus capitus muscles. A soft tissue protocol was issued to treat the various muscles affected, which consisted of releasing hypertonic muscles and strengthening weakened muscles. The participants were then evaluated for cervical spine restrictions and the use of a chiropractic manipulation was used on these segments, to correct any restrictions detected.

Results: After completion of this study it became evident that all three groups demonstrated statistically significant changes. The chiropractic manipulation group showed the greatest improvements with regards to subjective data, followed by the combination
group and finally the soft tissue group, which consisted of releasing hypertonic muscles and strengthening weakened muscles, showed the least amount of improvement.

All groups showed improvement with regards to objective data. The chiropractic manipulation group showed the greatest improvements with regards to the algometer data, followed by the combination group, with the soft tissue group showing the least improvement. The soft tissue group showed the greatest improvement with regards to the objective data collected from measuring the craniovertebral angle, followed by the spinal manipulation group and finally the combination group showed the least improvement.

**Conclusion:** The results of this study suggest that a spinal manipulation is the best way to reduce pain threshold and perceived pain levels in individuals suffering with tension-type headaches as a result of a forward head posture. A soft tissue protocol aimed at releasing hypertonic muscles and strengthening weakened muscles is the most beneficial way in reducing forward head postures
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CHAPTER ONE: INTRODUCTION

1.1 Introduction

Tension-type headaches are among the most commonly occurring headaches that are experienced today; the majority of the population have experienced them at one point of time in their lives. The use of analgesic medication has been shown to have little, to no effect in the reduction of the patient symptoms (Boon, Colledge & Walker, 2006).

It has been established that a forward head posture is a clinical entity that can contribute to a variety of various musculoskeletal pain syndromes which, in turn, affect an individual’s daily living (Haughie, Fiebert and Roach, 1995). Although reports are subjectively incorporated into this problem, several reports were conducted to implement the effects of this by comparing controls with participants with presenting complaints. The result established suggest that a forward head posture is a clinical entity which has consequences on the musculoskeletal system, which can affect an individual’s daily living (Greenfield, Catlin and Coats, 1995).

1.2 Problem Statement

Tension-type headaches can be associated with a muscular origin (Millea & Brodie, 2002) which, in turn, is closely associated with posture. Many of the individuals presenting with tension-type headaches also present with a forward head posture.

Postural abnormalities can have a significant influence on the state of one’s musculoskeletal system. An imbalanced posture requires an increase in energy expenditure and muscular contractions in order to support the body’s frame; this, in turn, leads to a loss of strength and flexibility which alters the performance of even the simplest of daily activities (Haldean & Dagenais, 2001).

Abnormalities of posture can be accountable for the histopathology, myopathology, neuropathology and kinesiopathology encountered by chiropractors in patients with tension-type headaches (Smart & Smith, 2000).

1.3 Aim of the Study

The study was aimed at comparing whether manipulating the relevant restricted segments of the cervical spine in conjunction with a soft tissue protocol, aimed at releasing hypertonic muscles (namely the suboccipital and sternocleidomastoid muscles) and strengthening weakened muscles (namely the longus capitus muscle), would be effective
in treating individuals with tension-type headaches which occur as a result of a forward head posture. The study was also aimed at potentially reducing the amount of forward head posture by correcting the patient’s muscular imbalances.

1.4 Benefits of the Study

It was postulated that both methods of treatment would benefit tension-type headache sufferers presenting with forward head posture. By conducting this research the possibility of a safe, less invasive and cost effective treatment to tension-type headache sufferers, brought on by a sustained forward head posture may be suggested to minimise the implications brought about by this disorder. The potential outcome of this study was to have a better understanding of the burdens brought about from a sustained forward head posture, as well as to provide practitioners with additional information in treating patients with tension-type headaches, which are a result of this clinical entity.
CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter serves as a detailed overview on relevant published literature and research, thereby forming the necessary background literature specific to this study. Emphasis is placed on the anatomy of specific skeletal muscles, the effects of poor posture, tension-type headaches, the development of myofascial trigger points and their contribution to tension-type headaches, chiropractic manipulation and ischemic compression as a form of treatment.

The World Health Organisation (WHO) (2005) defines chiropractic as being a primary health care profession which is focused on the diagnosis, treatment and prevention of various neuromuscular skeletal disorders and the effects of these disorders on an individual’s health (WHO, 2005). Emphasis is placed on manual techniques, which include spinal manipulative therapy, with a particular focus on facet dysfunction. The relationship between the body’s structure, especially that of the musculoskeletal system and the spine, and its function, especially as coordinated by the central nervous system, is key to a chiropractor’s approach to the preservation and restoration of an individual’s health (Coutler, 1997).

Articular dysfunction is core to what chiropractors treat and can be defined as “a lesion or dysfunction of a particular joint or motion segment in which its alignment, movement integrity and/or physiological function are altered, although contact between joint surfaces remain intact”. It is essentially a functional entity, which may have influences on biomechanical and neural integrity (WHO, 2005).

Haldeman (2005) stated that a dysfunctional segment can be considered an abnormal biomechanical relationship within the vertebral column. These abnormalities are assumed to result in the stimulation of receptors that are within the vertebral column and within paraspinal tissues, e.g. muscles, ligaments and facet joints. It is presumed that the impulses generated by the stimulation of these spinal structures results in the activation of neural reflex centres within the spinal cord or higher brain centres which, in turn, can cause various somatovisceral responses within the sympathetic and parasympathetic nerves and/or somato-somatic responses which result in muscle spasm.

2.1.1 Osteology of the Cervical Spine

There are a total of seven vertebrae which form the cervical portion of the vertebral column; these vertebrae enclose the meninges and spinal cord. Their stacked, centrally placed vertebral bodies serve to support the intervertebral articulations and the head,
especially at the craniovertebral joints superior end. They also provide the fundamental flexibility needed for positioning of the head (Moore, Dalley and Agur, 2010).

The four typical cervical vertebrae, namely vertebrae C3-C6, have the following characteristics:

- They all have vertebral bodies, which are smaller and longer transversely than anteroposteriorly. Their inferior surface is convex while their superior surface is concave.
- Their vertebral foramens are large and have a triangular shape.
- All cervical vertebrae have transverse processes which include transverse foramina. The purpose of these foramina is to provide passage for the vertebral vessels.
- The superior facets of their articular processes are organised in an inferoposterior direction.
- Their spinous processes are shorter than the rest of the vertebral column and are generally bifid. (Moore et al., 2010).

There are three atypical cervical vertebrae as seen in figure 2.1, namely C1, C2 and C7, which have the following characteristics:

- The C1 vertebra, also known as the atlas, is a ring-like bone which lacks both a spinous process and a vertebral body. It has two lateral masses which are connected both anteriorly and posteriorly by arches. The concave superior facets articulate with the occipital condyles (Moore et al., 2010). The atlas (C1) is often described as a ‘washer’ and is situated between the axis (C2) and the occipital condyles as seen in figure 2.2. Its function is to support the occiput and transmit any generated forces from the occiput to the rest of the cervical vertebrae. The functions of C1 are reflected in its osseous structure (Levangie & Norkin, 2011).
- The C2 vertebra, also known as the axis, has a peg like dens (odontoid process) which projects in a superior direction from its vertebral body (Moore et al., 2010). The dens has an anterior facet which articulates with the anterior arch of the C1; and a posterior groove which articulates with the transverse ligament (Levangie & Norkin, 2011).
- The vertebral prominence (C7) has a long spinous process which, unlike the rest of the cervical vertebrae, is not bifid. Although the transverse processes of C7 are large, they have small transverse foramina (Moore et al., 2010).
Figure 2.1: Typical and Atypical Cervical Vertebrae (Available from: http://pocketdentistry.com/2-the-back/)

Figure 2.2: Articulation of the Occiput, C1 and C2 (Available from: https://web.duke.edu/anatomy/Lab22/Lab22.html)
2.1.2 Function of the Cervical Region

The cervical region demonstrates the greatest degree of flexibility within the vertebral column. The stability created in the cervical region, especially at the atlanto-occipital and atlantoaxial joints, is crucial for supporting the head and the projection of the vertebral arteries and spinal cord (Levangie & Norkin, 2011).

a) Kinematics

The cervical spine is specifically designed to allow for a relatively large degree of mobility. Flexion, extension, rotation and lateral flexion are the permitted motions within this region. Translations which increase in magnitude from C2-C7 accompany these motions. The primary translation within this region occurs in the sagittal plane during the motions of flexion and extension (Levangie & Norkin, 2011).

The nodding type movements permitted between the head and the atlas occur primarily at the atlanto-occipital joints. During the motion of flexion, the occipital condyles glide forward and slide backward on the lateral masses of C1 (atlas). In extension, the occipital condyles move in the opposite direction of flexion. A small degree of rotation and lateral flexion are also available at this segment (Levangie & Norkin, 2011).

Motions at the atlanto-axial joint include rotation, lateral flexion, flexion and extension. Over half of the total amount of rotation that is permitted within the cervical region occurs at the atlanto-axial joints. The remainder of rotation is evenly distributed between the lower cervical segments (Levangie & Norkin, 2011).

The lower cervical segments favour the motions of flexion as well as extension; however there are varying degrees in the ranges of motions within individual cervical segments. Generally, the ranges of flexion and extension increase in magnitude from the C2/C3 segment to the C5/C6 segment and then decrease again at the C6/C7 segment (Levangie & Norkin, 2011).

The loads that are placed on the cervical spine may vary with the position of the body and head and are minimized in a reclining, well supported body posture (Levangie & Norkin, 2011). The opposite can be assumed if one has abnormalities within their posture.
2.1.3 Anatomy of the Muscles Affected by a Forward Head Posture

a) Postural Muscles

The primary function of the postural muscles is to maintain posture in the field of gravity. Postural muscles are comprised of mainly slow-twitch muscles fibres which have an increased capacity for sustained work. These muscles are therefore prone to hyperactivity (Lamb, 2014).

The anatomy of postural muscles associated with this particular study are summarised in table 2.1.

**Table 2.1: Postural Muscles Affected by Forward Head Posture (Moore et al., 2010)**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Suboccipitals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectus Capitus Posterior Major</td>
<td>Spinous process of the axis (C2)</td>
<td>Lateral part of the inferior nuchal line</td>
<td>Dorsal ramus of C1</td>
<td>Extension, ipsilateral rotation and lateral flexion</td>
</tr>
<tr>
<td>Rectus Capitus Posterior Minor</td>
<td>Posterior tubercle of the posterior arch of the atlas (C1)</td>
<td>Medial part of the inferior nuchal line</td>
<td>Dorsal ramus of C1</td>
<td>Extension and ipsilateral lateral flexion</td>
</tr>
<tr>
<td><strong>Obliquus Capitus Inferior</strong></td>
<td>Posterior tubercle of the posterior arch of the axis (C2)</td>
<td>Transverse process of the atlas (C1)</td>
<td>Dorsal ramus of C1</td>
<td>Extension and ipsilateral rotation</td>
</tr>
<tr>
<td><strong>Obliquus Capitus Superior</strong></td>
<td>Transverse process of the atlas (C1)</td>
<td>Occipital bone between the superior and inferior nuchal lines</td>
<td>Dorsal ramus of C1</td>
<td>Extension, ipsilateral rotation and lateral flexion</td>
</tr>
</tbody>
</table>
**Sternocleidomastoid (SCM)**

| Lateral surface of the mastoid process of the temporal bone and the lateral half of superior nuchal line | **Sternal Head:** Anterior surface of the manubrium of sternum | **Cranial Nerve XI-Spinal Accessory Nerve (motor)** | **Unilateral Contraction:**
| Causes the head to tilt to the same side and rotates it so that the face is turned superiorly toward the opposite side. |

| Clavicular Head: Superior surface of the medial third of the clavicle |  | C2-C3 (pain and proprioception) | **Bilateral Contraction:**
| - Extends the cervical spine at the atlanto-occipital joints. |
| - Extends the superior cervical vertebrae while flexing the inferior cervical vertebrae so that the chin is thrust forward while keeping the head level. |

**b) Phasic Muscles**

Phasic muscles consist of mainly fast-twitch fibres which are better suited to movement. These muscles are therefore easily fatigable and prone to inhibition (Lamb, 2014).

The anatomy of phasic muscles associated with this particular study are summarised in table 2.2.
Table 2.2: Phasic Muscles Affected by Forward Head Posture (Moore et al., 2010)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longus Colli</td>
<td>-Anterior tubercle of the atlas (C1)</td>
<td>-Bodies of vertebrae C5-T3</td>
<td>Anterior rami of the C2-C6 spinal nerves</td>
<td>Causes flexion of the neck with rotation to the opposite side if acting unilaterally</td>
</tr>
<tr>
<td></td>
<td>-Bodies of C1-C3 vertebral and the transverse processes of C3-C6</td>
<td>-Transverse processes of C3-C5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longus Capitus</td>
<td>Basilar part of the occipital bone</td>
<td>Anterior tubercles of the C3-C6 transverse processes</td>
<td>Anterior rami of the C1-C3 spinal nerves</td>
<td>Flexes the neck</td>
</tr>
</tbody>
</table>

Postural muscles often become shortened in response to physical stimuli such as under-use, over-use or trauma, whereas the phasic muscles of the body become prone to lengthening and weakening in response to the above mentioned stimuli. These effects can result in musculo-skeletal imbalances and joint instability when the postural and phasic muscles are located on opposing sides of the agonist-antagonist relationship (Lamb, 2014).

2.2 Postural Effects on the Body

2.2.1 Static and Dynamic Postures

Posture is defined as being either static or dynamic. In a static posture, the body and all of its motion segments are aligned and maintained in certain positions, whereas a dynamic posture refers to a posture in which the body and/or its individual segments are moving (Levangie & Norkin, 2011).

2.2.2 Postural Control

Even though only a small amount of muscular activity is required to maintain one in an erect stable standing posture, the control of posture is more complex and forms part of the body’s motor control system (Levangie & Norkin, 2011).
Postural control may be defined as being either static or dynamic, and refers to the ability of maintaining stability of the body and its segments in response to forces which threaten to disturb the body’s natural state of balance (Levangie & Norkin, 2011). According to Sutherland et al., (2002), the ability to maintain ones stability in an upright standing posture is a skill which is acquired over time, using our central nervous system, by incorporating the use of information acquired from sensory systems, passive biomechanical elements and various muscles. Our central nervous system then interprets and organises these sensory inputs from the various structures and systems within the body and then selects the appropriate responses, which are based on past experience and the goal of the response.

Compensatory, or reactive responses occur to reactions of external forces, which displace the body’s centre of mass; whereas anticipatory, or proactive responses occur in anticipation of destabilising forces, which are generated internally, such as raising ones arms in response to catching a ball or bending down to tie ones shoes (Levangie & Norkin, 2011).

2.2.3 Analysis of Sitting Postures

The overall goal in a sitting posture has the same goal as for an erect standing posture, namely, to attain a stable alignment of the body or its segments and to maintain these positions with the least amount of energy expenditure. It is also aimed with placing the least possible stress on the individual’s body segments (Levangie & Norkin, 2011).

In a way, sitting postures are often more complex than standing postures. The gravitational moments that are seen in standing postures must be considered, but, in addition, one should also take into consideration the contact forces that are created when certain portions of the body interfere with various parts of the chair, such as the head, the back, foot rests and seats. The location and the amount of support provided to various portions of the body by the chair may result in a change in the position of various body parts and thus change the magnitude of stress that is placed on the body’s structures (Levangie & Norkin, 2011).

2.2.4 Cervical Spine Posture

The Line of Gravity (LoG) should pass anterior to the transverse axis of rotation for flexion and extension of the head which creates an external flexion moment. This moment, which usually tilts the head forward, may be counteracted by internal moments generated by tension in the tectorial membrane, nuchal ligament, posterior aspects of the zygapophyseal (facet) joint capsules and by activity of the capital extensors (Levangie & Norkin, 2011).
Ideally, a plumb line (Figure 2.3) that extends from a ceiling should pass through the external auditory meatus (EAM) of the ear, and the head should be located directly over the body's centre of mass (CoM) at C2 (Levangie & Norkin, 2011).

![Figure 2.3: A Plumb Line Comparing an Ideal Posture to an Abnormal Posture (Speck, 2012)](image)

In a study conducted by Hardacker, Shuford, and Capicotto (1997), on the configuration of the cervical spine in a standing posture, a lateral radiographic study was conducted on the spines of 100 standing men and women between the ages of 20-70 years. Plumb lines extending from the odontoid process to C2 fell within a relatively narrow range of 16.8 mm anterior to the centre of C7. The greatest lordosis was at C1 to C2 (standard deviation=+7.0), with little lordosis found in the rest of the cervical spine. On average, the occiput-C1 segment was kyphotic, and a segmental kyphosis of 5 degrees or greater was present in 39% of the total group, although there was no total kyphosis present between the occiput and C7. It was also noted that as the cervical lordosis increased, the thoracic kyphosis also increased (Hardacker et al., 2000).

### 2.2.5 Occupation and Recreational Influences in Posture

Each particular occupation and recreational activity has a unique set of postures and injuries (associated with these postures). Many of the injuries sustained during both occupational and recreational activities are associated with overuse injuries. These types
of injuries are caused when repetitive stress exceeds the physiological limits of the body’s tissues. Muscles, ligaments and tendons are especially vulnerable to the effects of these repetitive tensile forces, where as bones and cartilages are more susceptible to injury from the application of excessive compressive forces (Levangie & Norkin, 2011).

2.3. Forward Head Posture

A forward head posture occurs as a result of an individual’s head being positioned too far anteriorly. The anterior cervical convexity is slightly increased, with the apex of its lordotic curve being situated at a considerable distance from the line of gravity (LoG) in comparison with optimal posture (Levangie & Norkin, 2011).

2.3.1 Upper Cross Syndrome

Magee (2008) described upper cross syndrome as being an entity which occurs as a result of muscles on one diagonal at a joint becoming hypertonic and tight, whereas muscles on the other diagonal become weakened and lengthened (refer to figure 2.4). Upper crossed syndrome according to Janda (1988), is characterized by the impediment of the upper trapezius muscle as well as the pectoralis muscles, levator scapulae and sternocleidomastoids. The deep cervical flexors, lower trapezius and serratus anterior muscles are also inhibited.

![Figure 2.4: Upper Cross Syndrome (Adapted from Magee, 2008)
2.3.2 Synergistic Dominance

In a forward head posture, an individual’s suboccipital muscles are usually maintained in a state of hypercontraction as they struggle against gravity to keep the eyes in level with the horizon. As one’s head extends and moves forward on the neck, the antagonist longus capitus muscles, whose sole purpose is to connect the anterior surface of the upper cervical vertebrae to the occipital base, become weak and overstretched (Dalton, 2011).

As the longus capitus muscles can no longer carry out their assigned duty as the primary head-on-neck flexors, the sternocleidomastoid muscles become activated. The sternocleidomastoid muscles assist with neck flexion when they contract in the proper order; however, they cannot serve as substitutes for longus capitus as they insert on the mastoid process. When simultaneously weakened, the longus capitus muscles fail to maintain a contraction and the sternocleidomastoids are forced to contract first, resulting in the head moving into extension (Dalton, 2011).

Although the suboccipitals respond to the added hyperextension, neural and vascular structures embedded within the posterior atlanto-occipital joints do not as this adds compressive forces which compromise their function (Dalton, 2011). When the neck muscles normal sequence of contraction is altered, the synergistic muscles compress the facet joints which can result in headaches, chronic degenerative conditions and a Dowagers hump. This in turn causes compensatory layering of protective muscle spasm which leads to the perpetuation of pain-spasm-pain cycles as the necks firing order pattern is further disrupted (Dalton, 2011).

2.3.3 Relationship between Head Posture and Neck Pain

A forward head posture can result in the accumulation of noxious substances and physical stimuli which contribute to the production of pain. Potential mediators of pain, which include shortening of the posterior cervical muscles, stretching of the anterior neck structures, accumulation of noxious substances and fatigue within the muscles, counterbalance the head’s tendency to tip forward and increase compressive forces imposed on the cervical zygapophyseal (facet) joints and posterior aspects of vertebral bodies (Goncalves Silva, 2009).

2.4 The Reduction of Forward Head Postures

It was discussed and proposed that by stimulating joint mechanoreceptors, a regulating function will be exerted on the muscle tone of associated musculature of the involved joints (Sandoz, 1981). Esposito and Philipson (2005) explain that the manipulation may stretch the surrounding musculature of the particular vertebral level being manipulated; this in turn
will result in the activation of muscle spindles and golgi-tendon reflexes which decrease the state of hypertonicity and remove myofascial trigger points in the associated muscles. As a result, by correcting musculature abnormalities in theory the degree and resultant symptoms of a forward head posture may be decreased.

2.5 Tension-Type Headaches Defined

2.5.1 General Introduction

Tension-type headaches can be regarded as head pain which occurs as a result from excessive contraction of the pericranial muscles, and since roughly 10-20% of the general population complain of tension-type headaches, they can therefore be considered to be one of the symptoms that are most commonly recognized with interfering in daily life (Tsuboi, 2002).

Although these headaches are not life-threatening in nature, the most severe symptoms associated with this disorder may, in turn, affect one’s ability to perform activities of daily living. These headaches are commonly associated or triggered by the stresses of daily life, although they are commonly reported to be physical side effects of depression, various forms of anxiety and/or of a somatoform disorder (Tsuboi, 2002).

2.5.2 Definition

Tension-type headache can be defined as pain that radiates bilaterally in a band-like fashion from the occiput to the forehead. Pain often radiates to the muscles of the neck and is described as a dull ache, tightness or pressure. Migraine-type features such as photophobia, unilateral pain, throbbing and nausea are not present (Millea & Brodie, 2002).

Although tension-type headaches are common occurrences in daily living, the likely mechanism and the pathophysiology behind their existence remain unclear. Investigations on the nociceptive (pain receptor) system suggests that the pain occurring from a tension-type headache has a muscular origin. Myofascial or muscular pain is often described as being dull, achy, radiating and poorly localized, whereas pain that originates from cutaneous structures is described as being localized, sharp and non-radiating. The idea that the pain felt has a muscular origin and is related to an increase in resting muscle tension corresponds with the derived treatment approaches and clinical understanding of tension-type headaches (Millea & Brodie, 2002).

In a study conducted by Mootz, Hess, Cook and Schorr (1994), on the effectiveness of chiropractic management in the treatment of chronic episodic muscle tension-type headache in male patients, it was established that mean pre-treatment to post-treatment
headache frequency had a significant decrease from 6.4 episodes per two week period to 3.1. Mean pre-treatment to post-treatment headache duration also had a statistically significant change as the headache duration decreased from 6.7 hours per episode to 3.88 hours. This is an indication that manipulative therapy is capable of significantly reducing symptoms in patients who suffer from headaches as a result of muscular abnormalities (Mootz et al., 1994).

2.5.3 Classification

The International Headache Society classifies tension-type headaches into four categories:

A) Frequent episodic tension-type headaches typically present bilaterally and have a tightening or pressing type quality, which ranges from mild to moderate intensity and can last anywhere from minutes to days. These headaches do not present with nausea, however, photophobia and/or phonophobia may occur (Olesen, Bes, Kunkel & Lance, 2013). These headaches occur at least once but no more than 15 days per month for at least 3 months (a minimum of 12 days but no more than 180 days per year) (Stovner, Hagen, Jenson, Katsarava, Lipton, Scher, Steiner, & Zwart, 2007).

B) Infrequent episodic tension-type headaches are typically described as being bilateral, pressing or tightening in quality and of mild to moderate intensity, lasting minutes to days. These headaches are not associated with nausea, however, photophobia and/or phonophobia may be present (Olesen et al., 2013). Patients must have experienced at least 10 episodes of headaches that occur less than one day per month (12 days per year). Due to the fact that these headaches do not occur frequently, they do not impact a patient's quality of life as severely as frequent episodic headaches and they do not require attention from medical professionals (Stovner et al., 2007).

C) Chronic tension-type headaches. These headaches occur at least 15 days per month for at least 3 months (180 days per year). The headache can persist for hours at a time and may be continuous (Stovner et al., 2007).

D) Probable tension-type headaches may be classified as either being probable frequent episodic, probable infrequent episodic, or probable chronic. They have the majority, but not all, of the symptoms associated with tension-type headaches and are not attributed to migraine without aura or neurological disorders. Probable chronic tension-type headaches may be related to medication overuse (Stovner et al., 2007).
2.5.4 Primary versus Secondary Tension-Type Headaches

When a headache occurs for the first time and has characteristics of a tension-type headache with a close physical relation to another disorder, which in turn is known to cause headaches, or fulfils other criteria’s concerned with another particular disorder, the new headache is diagnosed as a secondary headache which is attributed to the causative disorder (Olesen et al., 2013). Primary headaches cannot be attributed to any underlying pathological process. Although severe in nature, it poses no serious threat to the patient other than pain and disability from the headache (Chapman-Smith, 1995).

When a pre-existing tension-type headache becomes chronic and is in close relation to a causative disorder, both the initial tension-type headache diagnosis and the secondary diagnosis should be given (Olesen et al., 2013). Secondary headaches are a result of underlying pathologies and may be a threat to the patient’s health. Secondary headaches can be classified as space occupying lesions, brain abscesses, subdural haematomas, hypertension, temporal arteritis, meningitis, encephalitis, acute glaucoma and subarachnoid haemorrhages (Chapman-Smith, 1995).

When a pre-existing tension-type headache becomes significantly worse, meaning an increase in both frequency and severity, and is in close relation to a specific causative disorder, both the initial tension-type headache diagnosis and the secondary diagnosis should be given, provided there is sufficient evidence to prove that the disorder can cause a headache (Olesen et al., 2013).

In the case of chronic-tension type headaches with medication overuse, a close temporal relation is often difficult to establish, therefore, both diagnoses should be given in all such cases (Olesen et al., 2013).

2.6 Myofascial Trigger Points as a Cause of Tension-Type Headaches

2.6.1 Definition of a Myofascial Trigger Point

A myofascial trigger point is a hyperirritable spot within a taut band of skeletal muscle. It is painful on tissue compression, overload, stretch, or contraction and usually responds by referring pain that is perceived by the patient as being distant from the source (Travell & Simons, 1999).

There are two types of trigger points that can be identified, namely, active and latent trigger points. The local and referred pain from active trigger points reproduces symptoms that the patient is experiencing and is recognised by the patient as their usual or familiar pain (Travell & Simons, 1999). Both active and latent trigger points cause allodynia, which is
pain to a stimulus that does not normally provoke pain, and hyperalgesia away from the trigger point following applied pressure. In latent muscular trigger points, the local and referred pain do not reproduce symptoms familiar or usual to the patient (Travell & Simons, 1999).

Both active and latent trigger points can provoke motor dysfunctions, e.g. muscle weakness, inhibition, increased motor irritability, spasm, muscle imbalance and altered motor recruitment in either the affected muscle or in functionally related muscles (Travell & Simons, 1999).

### 2.6.2 The Integrated Hypothesis

Muscle trauma, repeated low-intensity overload of a muscle and/or intense muscular contractions may create a recurring cycle of events (seen in figure 2.5), whereby the sarcoplasmic reticulum or cell membrane becomes damaged which results in an increase in calcium concentration, shortening of actin and myosin filaments, a shortage of adenosine triphosphate and an impairment of the calcium pump (Travell & Simons, 1999).

In 1981, Travell & Simons developed a hypothesis called the energy crisis hypothesis, which has been described as the most accepted theoretical model to describe the pathophysiology of myofascial trigger points (Dommerholt & Fernandez-De-Las-Penas, 2011). As time passed the model has become known as the integrated hypothesis. This hypothesis proposes that abnormal depolarization of the post-junctional membrane of motorendplates creates a localized hypoxic energy crisis which is associated with sensory autonomic reflex arcs which are sustained by various sensitization mechanisms (McPartland & Simons, 2006).

Figure 2.5: Schematic Diagram of the Integrated Hypothesis (Modified diagram from Travell & Simons, 1999)
The motor endplate hypothesis, illustrated in figure 2.6, is also thought to contribute to some degree of muscle shortening. The motor nerve synapses with a specific muscle cell at the motor endplate. The amount of activity at the motor endplate is not enough to result in a muscle contraction. However, it may be enough to activate contractile elements, thereby contributing to muscle shortening (Simons, 1996).

The integrated hypothesis and the motor endplate hypothesis can co-exist with one another (Huguenin, 2004). This is due to a synaptic junction being present between individual muscle cells and the motor endplate. Needle EMG studies have identified that each trigger point contains minute loci that produce characteristic electrical activity. Active loci are clustered within the myofascial trigger point and are found at the motor endplate zone (Hubbard & Berkhoff, 1993).

Experiments have shown that the endplate potentials are a result of an abnormal increase in acetylcholine released by the nerve terminal (Travell & Simons, 1999). A small amount of muscle activity is capable of producing action potentials that are propagated at a small distance from the cell membrane of the muscle. This may lead to activation of a few contractile elements that may cause a small degree of muscle shortening (Huguenin, 2004).
2.6.3 The Presence of Myofascial Trigger Points in Individuals with Tension-Type Headaches

In a study conducted by Marcus et al. (1999), it was noted that patients with tension-type headaches had a larger number of either active or latent trigger points compared to healthy controls; however the study did not specify as to which muscles were affected.

In a series of blinded controlled studies conducted by Fernanandez-de-las-penas et al. (2006), it was found that active trigger points were extremely common in individuals with chronic and episodic tension-type headaches; the muscles most commonly affected include the extra-ocular superior oblique muscles, the suboccipital muscles, the upper trapezius, temporalis, sternocleidomastoids and the extra-ocular rectus lateralis muscle. Additionally, patients with chronic tension-type headaches and active trigger points in these muscles experienced more severe headaches with greater intensity and duration compared to patients with chronic tension-type headaches and latent trigger points in the same muscles (Fernandez-de-las-penas et al., 2007).

In another study conducted by Fernandez-de-las-penas et al. (2009), 13 women who had been previously diagnosed with chronic tension-type headaches were recruited in order to analyze and compare the differences in the referral pain patterns and size of the areas of the myofascial trigger points involved in their tension-type headache. The study showed the presence of numerous active trigger points in the head, neck and shoulder muscles. Both the local and the referred pain elicited by the active trigger points reproduced the headache pattern in the patients. The muscles that exhibited trigger points bilaterally were the suboccipitals, upper trapezius, sternocleidomastoid, temporalis and masseters (Fernandez-de-las-penas et al., 2009).

2.7 The Vertebral Subluxation Complex

The vertebral subluxation complex as described by Lantz (1995) is a theoretical model used by chiropractors on spinal dysfunction from a clinical perspective. It allows one to describe the essential elements of spinal degeneration and dysfunction in an attempt to make them more understandable in the context of chiropractic manipulative procedures. It is recognized that if a joint complex becomes dysfunctional, all the tissues become involved in such a way that it is practically impossible to distinguish where one tissue involvement ends and another begins (Lantz, 1995).
The five components of the chiropractic subluxation complex (Lantz, 1989):

1) Kinesiopathology
2) Neuropathology
3) Myopathology
4) Histopathology
5) Biomechanical abnormalities

**Figure 2.7: The Vertebral Subluxation Complex (Modified version from Repka, Ebrall & Draper, 2007)**

According to Lantz (1989), the kinesiopathology is the functional component of the model and is the final product of the synergistic activity of the various tissue level components of the vertebral subluxation complex. The tissue level components are represented by figure 2.7 and are the supporting structures of for the kinesiological component. Osseous structures provide the structural integrity and rigidity that is essential for the transmissions of forces that are generated by muscles. Fibrous connective tissue allows for the
necessary formations of joints which, in turn, provide movement. The circulatory system functions to nourish and cleans the affected tissues. The nervous system controls movement through its action.

The inflammatory response is a process that is common to all tissues and is a crucial factor in tissue repair and remodelling after injury. Histopathology represents the disruption of the degenerative process occurring on a cellular level. Each tissue component within the body is represented by its own characteristic histology (Lantz, 1989).

Joint dysfunction leads to kinesiopathy which causes hypomobility of the joint complex. Neural elements become compromised, compressed and irritated as a result from the fixation leading to neurological symptoms (refer to figure 2.8). This in turn will eventually lead to anatomical, physiological, inflammatory, histological, biomechanical and degenerative changes (Esposito & Philipson, 2005)

![Figure 2.8: Effects of the Vertebral Subluxation Complex](http://www.sheradinchiro.com/chiropractic.php)

2.8 Chiropractic Manipulative Therapy

Chiropractic manipulative therapy is a manual procedure whereby a low amplitude thrust is delivered at high speed to a joint that exhibits a decrease in mobility within its normal range of motion. Once the surrounding joints have been stabilised the target joint is moved to the elastic barrier of resistance. At this point a thrust is delivered to the joint to move it into its paraphysiological range of motion. It is this movement into the paraphysiological range that ensures that both the active and the passive ranges of motion are clear of restrictions to movement (Sandoz, 1976).
Sandoz (1970) describes four zones (figure 2.9) in the range of motion of a diarthrodial joint:

- Zone 1 is where active range of movement occurs and is motion produced by active muscles.
- Zone 2 is where passive range of movement occurs and is described as motion produced by traction or springing of the joint up to the elastic barrier of resistance. This zone is characterized by mobilization and is where joint play is examined.
- Zone 3 represents the paraphysiological range of movement or the motion that extends beyond the elastic barrier of resistance up to the limit of anatomical integrity. This occurs as a result of manipulation and is often accompanied by an audible release or crack.
- Zone 4 represents pathologic movement or motion that extends beyond the limit of normal anatomical integrity. This zone is where damage to ligaments and the capsule occurs resulting in joint hypermobility. This zone can be reached if manipulation is too forceful, resulting in the joint moving beyond the limit of anatomical integrity, creating or accentuating joint instability.

Figure 2.9: A Picture Depicting a Joints Paraphysiologica Range of Motion (Modified version from Esposito & Phillipson, 2005)

2.8.1 Neurophysiological and Biomechanical Mechanisms of Spinal Manipulation

There have been numerous theories proposed to explain the effects of spinal manipulative therapy (Leach, 2004). A common trend that is shared by many of these proposed theories is that abnormal changes within the normal physiological, anatomical or biomechanical dynamics of adjoining vertebrae can adversely affect the function of the central nervous
system. Spinal manipulative therapy is thought to correct these abnormal changes (Triano, 1992).

The mechanical force that is introduced to the spinal column during spinal manipulative therapy can alter segmental biomechanics by releasing trapped meniscoids within the zygapophyseal (facet) joints, releasing or breaking down adhesions, or by reducing torsion placed on the annulus fibrosis (Pickar, 2002). The mechanical changes that are elicited by spinal manipulation may provide the energy required to restore a dysfunctional segment, thus reducing the mechanical stress or strain placed on the paraspinal tissues (Pickar, 2002). The resultant biomechanical changes that are caused by a manipulation are thought to induce a physiological effect on the body by altering the involvement on the inflow of sensory information to the central nervous system. By releasing discal material, segmental adhesions, and trapped meniscoids within the zygapophyseal (facet) joints or by normalizing the dysfunctional segment, the mechanical input may decrease the nociceptive input carried by receptive nerve endings within the paraspinal tissues (Pickar, 2002). In addition, the mechanical thrust of a spinal manipulation may either stimulate or inhibit non-nociceptive and/or mechanosensitive receptive nerve endings within paraspinal tissues, these include the skin, muscles, tendons, ligaments, facet joints and intervertebral discs. These neural inputs may have an influence on pain producing mechanisms as well as other physiological systems that are controlled or influenced by the nervous system (Pickar, 2002). Refer to Figure 2.10 below.

![Neurophysiological Mechanisms Underlying Manipulation](image)

Figure 2.10: Neurophysiological Mechanisms Underlying Manipulation (Sueki & Chaconas, 2011).
2.8.2. The Effects of Spinal Manipulation on Sensory Receptors in Paraspinal Tissues

Korr (1975) stated that spinal manipulative therapy may result in an increase in joint mobility by producing a barrage of impulses within smaller diameter afferents and muscle spindle afferents, which may result in the inhibition of facilitated gamma motoneurons. It was further postulated that these gamma motorneurons may have a resultant increase in the discharge of impulses within the muscles surrounding the vertebral segments targeted by the spinal manipulation (illustrated in figure 2.11). The high gain of the gamma loop would impair joint mobility by sensitizing the stretch reflex to abnormally small changes in muscle length. It was further stated by Korr (1975) that spinal manipulative therapy stimulates muscle spindle afferents, namely, Group I mechanoreceptors and possibly Group II afferents.

Pikar & Wheeler (2001) conducted a study which recorded a single unit of activity from a muscle spindle and Golgi tendon organ. Receptive fields were noted in the afferents of the lumbar multifidus and longissimus muscles when a spinal manipulative-like load was applied to lumbar vertebrae. The golgi tendon organ afferents were silent during rest and became activated by the impulsive thrust delivered during the spinal manipulation. Their silence resumed after manipulation was implemented.

Central sensitization refers to a physiological process whereby there is an increased excitability or an enhanced responsiveness of the dorsal horn neurons to an afferent input. Thus is can be assumed that central sensitization may be manifested by spontaneous central neural activity, by the increased discharge of central neurons to an afferent input or by a changes occurring within the receptive field properties of central neurons (Pikar & Wheeler, 2001).

In a review by Pickar (2002), it was noted that spinal manipulation can create an increase in a patient’s pain tolerance and/or pain threshold. One of the mechanisms underlying this ability to alter pain threshold and/or tolerance is the manipulations ability to alter central sensory processing by removing sub-threshold chemical or mechanical stimuli from the paraspinal tissues. Spinal manipulative therapy causes an increase in proprioceptive/mechanoreceptive (Group I, II and III afferents) input which results in reflex inhibition on the transmission of pain by blocking Group IV afferents or nociceptors (Kirkaldy-Willis & Bernard, 1999).
2.8.3 The Effects of Spinal Manipulation on Neural Tissue within the Intervertebral Foramen

The spinal nerve roots which pass through the intervertebral foramens (IVF) possess unique anatomical properties. There is less protective and supportive connective tissue around the nerve roots compared with peripheral nerves (Berthold et al., 1984). As the peripheral nerve trunk enters the intervertebral foramen, the epinerium is separated and becomes continuous with the dura mater. The perineum, which surrounds individual fascicles, separate into dorsal and ventral roots. The endoneurium, which surrounds individual Schwann cells, ensheath both myelinated and unmyelinated axons and continue into the nerve roots. However, the collagen content of the endoneurium becomes less dense and is no longer organized as a protective sheath (Thomas et al., 1993). This may explain why the neural tissue within the intervertebral foramen may be rendered vulnerable to the effects of mechanical compression and the chemical environment produced by changes within the intervertebral disc or facet joints. More research is needed to determine whether or not spinal manipulative therapy could alter neural function by mechanically changing the pressures brought on by compression (Pickar, 2002).

2.9 Ischemic Compression

By incorporating the manual therapy techniques used in this study as proposed by Dalton, (2011) (Refer to Chapter 3, Subheading 3.6.3) one can assume that hypercontracted muscles may be released using a form of ischemic compression.

Figure 2.11: The Sensory Pathway that could modulate a Gamma Motorneuron Pathway (Pickar, 2002)
Ischemic compression is a term that used to describe manual pressure being applied over a myofascial trigger point (Peterson & Bergmann, 2002).

Application of ischemic compression can involve various body parts of the body including the elbow, thumb and finger or by mechanical pressure from a rubber tipped T-bar. All of these applications may induce a varying degree of trauma to the tissues; therefore some minor bruising may occur as a result during treatment (Hains, 2002). However, when applied during the treatment procedure, the pressure is only applied for a short period of time and therefore this occurrence is minimized considerably (Peterson & Bergmann, 2002).

Ischemic compression is delivered to the patient by applying sustained pressure for a period of a few seconds to a minute on a trigger point to ease the tension within the taut bands of a muscle (Montanez-Aguilera et al., 2010). The applied compression inhibits blood flow into the area, and thereby inhibits the metabolic activity and reduces the contractile potential within the target muscle. Upon its release a resurgence of blood flow occurs in the area which, in turn, removes any metabolites, pain and local muscle hypertonicity (Travell and Simons, 1998). It is through this mechanism that an increase in the active range of motion and a decrease in sensitivity are noted in myofascial trigger points (Montanez-Aguilera et al., 2010).

Simons (1998) believed that the deep pressure applied while holding a muscle creates a contracted stretch to contracted sarcomeres that are associated within the muscles trigger point, which would create separation of the muscles actin-myosin heads. An added explanation is that once pressure is released, a reflex vasodilation and hyperaemia occurs in the area which, in turn, produces an increase in circulation that is involved in removing chemical irritants and metabolites as well as introducing oxygen and adenosine triphosphates into the tissues. The last theory incorporated the idea that deep pressure produces pain which hyperstimulates inter-neurons in the dorsal horn to release endorphins that block pain perception. Combinations of these theories are believed to be the effects of ischemic compression (Peterson & Bergmann, 2002).

2.10 Conclusion

The benefits of chiropractic manipulation have been discussed previously. This justifies the use of chiropractic manipulation as part of the treatment protocol for tension-type headaches in individuals presenting with a forward head posture. The mechanical changes that are elicited by spinal manipulation may provide the energy required to restore a dysfunctional segment, thus reducing the mechanical stress or strain placed on the paraspinal tissues (Pickar, 2002).
In this chapter the effects of ischemic compression have been discussed. Ischemic compression is therefore a safe and effective way in reducing the severity and tenderness of myofascial trigger points.

With regards to this particular study, corrections of postural imbalances will involve any of the above mentioned methods.
CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter serves to elaborate on the construction and procedures that were involved in this study.

3.2 Study Design

This was a comparative study with a random group allocation to determine whether manipulating the relevant restricted cervical segments versus a stretching and strengthening programme, aimed at stretching hypertonic muscles and strengthening weakened muscles, was effective in reducing tension-type headaches in individuals presenting with forward head posture.

3.2.1 Sample Size and Selection Criteria

Participants were recruited through advertisements (Appendix A) that were posted throughout the University of Johannesburg (UJ) Health Clinic on the Doornfontein Campus, as well as through word of mouth.

There were 30 participants recruited for the purpose of this study via random group allocation. Participants were required to meet the inclusion criteria and exclusion criteria in order to participate.

3.2.2 Inclusion Criteria

In order to be included into the study, participants needed to comply with the following criteria:

- Symptomatic males and females who have a forward head posture. Patients are considered to have a forward head posture when their head is positioned too far anteriorly and their normal anterior cervical convexity is increased with the apex of their lordotic curve at a considerable distance from the line of gravity (LOG) in comparison with optimal posture (Levangie & Norkin, 2011).
- Participants were between the ages of 18 and 50 years (these are the individuals who are most susceptible to developing a forward head posture due to continual studying positions, work positions, sleeping positions (Dalton, 2011).)
Participant had to be suffering from tension-type headaches. The diagnostic criteria for tension-type headaches, according to the International Headache Society are (Stovner et al., 2007):

A) At least 10 previous headache episodes fulfilling criteria B through D
B) Headaches lasting anywhere from 30 minutes to 7 days
C) At least two of the following characteristics:
   - A pressing or tightening (nonpulsating) quality around the head
   - Mild to moderate intensity
   - Bilateral location
   - No aggravation from walking stairs or similar routine activities
D) Absence of the following:
   - Nausea or vomiting
   - Phonophobia and photophobia; however, one may be present but not both

3.2.3 Exclusion Criteria

Participants were excluded if they presented with the following:

- Any known congenital anomalies that in turn can result in a forward head posture e.g. wedge vertebrae
- Contra-indicated to cervical spine manipulative therapy (Appendix B)
- History of cervical spine surgery
- Participants who demonstrate a forward head posture but are asymptomatic for headaches.
- Red flags of headaches are tabulated below (Vizniak & Carnes, 2013).

Table 3.1 Pathological Headache Warning Signs

<table>
<thead>
<tr>
<th>Abrupt onset or very severe</th>
<th>Nuchal rigidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>New headache in older patient</td>
<td>Anticoagulant therapy</td>
</tr>
<tr>
<td>Headache due to trauma</td>
<td>Headaches with diastolic pressure &gt;115mmHg</td>
</tr>
<tr>
<td>Associated neurological symptoms</td>
<td>Persistent or severe headache in child</td>
</tr>
<tr>
<td>Cognitive changes</td>
<td>Suspicion of alcohol or drug dependence</td>
</tr>
<tr>
<td>Seizures, vomiting without nausea</td>
<td>Known cancer</td>
</tr>
<tr>
<td>Persistent/Progressive headache</td>
<td>Signs of papilledema</td>
</tr>
</tbody>
</table>
3.3 Consultation Procedure

Each participant underwent an initial assessment on the first day of their clinical trial. The assessment included:

- Signing an information form regarding the study (Appendix C)
- Signing of an informed consent form (Appendix D)
- Signing of a photographic consent form (Appendix E)
- Completing a case history (Appendix F)
- Completing a full physical exam (Appendix G)
- Completing a full cervical spine regional examination (Appendix H)
- Completing a SOAP note (Appendix I)

Following completion of the assessment each participant was issued the Vernon-Mior Neck Pain and Disability Questionnaire (Appendix J) which was completed before any further treatment and evaluation took place. Objective measurements were then taken using a hand held pressure algometer. The algometer tip was placed on the chosen trigger point and pressure was applied to determine the amount of pain and the amount of pressure that was most painful for the patient. The participants were then required to assume the relaxed neutral position which was followed by a lateral cervical spine photograph being taken, which later was used to assess the degree of forward head posture by measuring the craniovertebral angle.

Group 1 had their cervical spine evaluated for cervical segment restrictions through the use of motion palpation. The use of a chiropractic manipulation was used on these segments to correct any restrictions detected.

Group 2 was evaluated using flat palpation to identify hypertonic suboccipitals and sternocleidomastoid muscles or weakened longus capitus muscles. A soft tissue protocol was issued to treat the various muscles affected. The treatment consisted of releasing hypertonic muscles and strengthening weakened muscles.

Group 3 followed the same evaluation and treatment procedures as both group 1 and group 2. Each participant was evaluated using flat palpation to identify hypertonic suboccipitals and sternocleidomastoid muscles or weakened longus capitus muscles. A soft tissue protocol was issued to treat the various muscles affected, which consisted of releasing hypertonic muscles and strengthening weakened muscles. The participants were then evaluated for cervical spine restrictions through the use of motion palpation and the use of a chiropractic manipulation was used on these segments to correct any restrictions found.
Each participant received treatment twice during the 1\textsuperscript{st} week, twice during the 2\textsuperscript{nd} week, twice during the 3\textsuperscript{rd} week and once during the 4\textsuperscript{th} and final week.

Pressure algometer readings were taken on the first, fourth and seventh visits.

During the last consultation of the trial in the 4\textsuperscript{th} week, another Vernon-Mior Neck Pain and Disability Questionnaire (Appendix J) was issued to each participant for completion. After completion the participants assumed the relaxed neutral position where another lateral cervical spine photograph was taken, which was used to assess if there had been an improvement in the reduction of the forward head posture.

All treatments and consultations were done at the University of Johannesburg’s Chiropractic Clinic on the Doornfontein Campus, under supervision of a qualified practitioner.

3.4 SUBJECTIVE DATA

The subjective data for this study was done by having the participants fill out the Vernon-Mior Neck Pain and Disability Questionnaire [NDI] (Appendix J) which was issued to each participant on the first consultation day as well as on the last consultation day.

3.4.1 Vernon-Mior Neck Pain and Disability Questionnaire

This is a subjective test that is comprised of a ten-item questionnaire addressing neck pain and disability. Each question was scored on a zero to five point basis. This indicates that a maximum of fifty points were available for the entire questionnaire. The first statement received a score of zero whereas the last point in each section received a score of five (Vernon, 2008).

The sum of the ten sections was expressed as a percentage

- Example: \( \frac{30 \text{ (total score)} \times 100}{50 \text{ (total possible)}} = 60\% \)

If one section was left out, the score was then calculated as follows:

- Example: \( \frac{30 \text{ (total score)} \times 100}{45 \text{ (total possible)}} = 67\% \)
The questionnaire was issued on the first and seventh visits before treatment was performed. The participants were instructed to answer the questionnaire as honestly and as accurately as possible. Their scores remained confidential and scores were not issued to them until the trial was completed and only on request.

A reliability study was conducted by Vernon and Mior (1991) on a sample group with whiplash injuries in an outpatient clinic, this study showed a statistical significance difference at the end of the trial (Pearson's r = 0.89, with a p value of ≤0.05). The p-values were calculated from the use of questionnaires that were completed by 52 participants, resulting in a total index alpha of 0.80, with all items having individual scores above 0.75. The validity of this particular study was assessed in two different ways. Firstly, a small group consisting of 10 participants completed a course of conservative care. The percentage change on the Vernon-Mior Neck Pain and Disability Questionnaire (NDI) scores before and after treatment was compared to a visual analogue of scale scores of percent of perceived improvement in activity levels. These scores correlated at 0.60. Secondly, in a larger group consisting of 30 participants, the Vernon-Mior Neck Pain and Disability Questionnaire scores was compared to scores on the McGill Pain Questionnaire, with showed similar correlations (0.69-0.70). While the sample size of some of the analyses was somewhat small, the study demonstrated that the Vernon-Mior Neck Pain and Disability Questionnaire achieved a high degree of reliability (Vernon and Mior, 1991).

3.5 OBJECTIVE DATA

The objective data for this study was conducted using two different methods for the purpose of this study.

3.5.1 The Pressure Algometer

Hypertonic muscles were evaluated using an algometer (figure 3.1) on the first, fourth and seventh consultations. The data was recorded and compared at various intervals throughout the duration of the study.

The algometer was used to quantitatively assess the participants pressure pain threshold of a specific myofascial trigger point (De Las Penas, Campo, Camero and Miangolarra-Page, 2005). The pressure pain threshold in turn is defined by the minimum amount of pressure one can tolerate before pain (Ylinen et al., 2007).

The algometer was placed perpendicular to the skin overlying the involved muscle. Pressure was then administered until the patient indicated, by word of mouth, the first point of pain as well as the point at which pain tolerance was reached. A reading was taken in kg/cm² after the removal of the algometer.
According to Potter, McCarthy & Oldham (2006), the use of an algometer has been shown to be effective in quantifying pressure pain threshold (PPT). Potter, McCarthy & Oldham (2006), also describe that a pressure pain threshold assessment by algometry is a reliable tool of measuring a subject’s pain both within-session and between-sessions.

Figure 3.1: A Replica Model of the Pressure Algometer used in this Study

3.5.2 The Craniovertebral Angle

The forward head posture of each participant was evaluated with the use of photographs. Each participant was required to assume the relaxed neutral position. A lateral cervical spine photograph was taken on the first day of the clinical trial. Another photograph was taken on the last day of the clinical trial in order to re-evaluate the degree of forward head posture. The method to measure the degree of forward head posture was accomplished using the craniovertebral angle as seen if figure 3.2.
Figure 3.2: Example of the Craniovertebral Angle used to Assess Forward Head Posture  
(Fernandez-De-Las-Penas, 2007a)

A) The Relaxed Neutral Position

The participants were required to assume the relaxed neutral position (refer to figure 3.3) by flexing and extending their head with their eyes closed, stopping at the point where they feel most comfortable. They were required to hold this position until the photograph was taken. All participants assumed this position while seated.

The repeatability of the relaxed neutral position has been demonstrated and recorded by Sandham (1988). In the study, participants were asked to flex their head as well as extend their heads repeatedly, while gradually decreasing the amplitude with each successive turn. They were instructed to stop when they felt the most comfortable position was reached. They then had to open their eyes and view themselves in a mirror placed two metres away (Sandham, 1988). In another study conducted by Harrison, Jackson and Trojanovich (1994), the participants were only asked to flex and extend their head twice and to stop in the most comfortable position.

In all of the studies, the reliability of the relaxed neutral position was proved, seeing as the test subjects returned to the same point over various amounts of time.
B) Photographic Measurement

A photograph of each participant's cervical spine was taken, while the patient was in the seated position, to objectively assess forward head posture. The camera was set to the level of the participants shoulders. The tragus of the participant's ear was clearly marked using a plastic pointer which was taped to the skin overlying the spinous process of their 7th cervical vertebrae. The picture was used to assess the craniovertebral angle (the angle between the horizontal line passing through C7 and a line extending from the tragus of the ear to C7 as seen in Figure 3.2) (Fernandz-De-Las-Penas C et al., 2007b). A smaller craniovertebral angle was associated with an increased forward head posture (Fernandz-De-Las-Penas C et al., 2007b). High reliability of this procedure (ICC= 0.88 to 0.98) (Raine & Twomey, 1997; Brunton et al., 2003) has been previously reported.

3.6. Treatment

3.6.1 Diversified Technique

The chiropractic diversified technique as described by Kirk, Lawrence & Valvo (1995) was incorporated for the purpose of the research study. These specific manipulations were used to correct detected cervical spine dysfunction.

3.6.2 Soft Tissue Protocol

Hypertonic muscles were treated using manual receptor release techniques, while weakened muscles were strengthened through the use of various exercises.
The release of hypertonic muscles was achieved using the following techniques:

- **Suboccipital receptor release**: To activate various golgi receptors and stretch the suboccipital muscles, the researcher flexed the participants head as their thumbs searched for myospasm along the occipital ridge. The participant was instructed to inhale and gently hyperextend the head against the researcher’s resistance for 5 seconds. The participant was then instructed to exhale while thumb pressure was applied to produce a postisometric and golgi receptor release of the suboccipitals. The participants head was brought to a new flexion barrier and the techniques was repeated, rotation of the participants head was induced to treat all capital extensors (Dalton, 2011).

- **SCM receptor release**: The participant was placed in the side lying position with their head rotated toward the table to expose the SCM muscle belly. The researcher hooked the finger pads around the SCM as the participant rotated against the researcher’s resistance (Dalton, 2011).

Strengthening of weakened muscles was achieved using the following technique:

- **Chin-tucking exercise**: The participant was instructed to tuck his/her chin while attempting to raise the head toward the ceiling, while counting to three and then releasing. This was repeated ten times, twice a day to strengthen longus capitus and longus colli (Dalton, 2011).

### 3.7 DATA ANALYSIS

Data was gathered and recorded on a score sheet (Appendix K); from here it was sent to STATKON where further evaluation of the information took place. Basic frequencies and demographics were used to describe the sample in terms of age, gender and group comparisons.

If assumptions for parametric tests were met, inter-group analysis was performed using the Independent Sample T-test while intra-group analysis was performed using repeated measures ANOVA. If assumptions for parametric tests were not met, inter-group analysis was performed using the Mann-Whitney U-test while intra-group analysis was done using the Friedman test. These tests were used to determine whether or not significant changes occurred over time. The Wilcoxon Signed Rank test was then used to determine where the differences were noted.
3.8 ETHICAL CONSIDERATIONS

The participants who met the inclusion criteria were invited to participate in the study. All participants that wished to partake in this particular study were requested to read the information form (Appendix C) and sign the consent form (Appendix D) and photographic consent (Appendix E) form specific to this study.

The information and consent forms highlighted the name of the researcher and the supervisor, the purpose behind conducting the study, the benefits of partaking in this particular study, the participant assessment and treatment procedures. The risks, benefits and discomforts pertaining to the various forms of treatment involved were explained to the participant's and their safety was ensured. The information and consent forms explained that the participant's privacy would be protected as only the clinician, patient and researcher were involved in the treatment and that anonymity was ensured as their information was converted into raw data and therefore could not be traced back to the individual. The forms also highlighted that standard doctor/patient confidentiality was to be adhered to at all times when compiling the research dissertation.

The participants were informed that their participation was entirely on a voluntary basis and that they were free to withdraw from the study at any stage of their choosing. If the participants had any questions, they were explained thoroughly by the researcher on the day of consultation. The contact details of the researcher were also made available. The participants were required to sign the information and consent forms, signifying that they understood all that was required of them for this particular study. The results of the study will be made available on request.

The participants were informed that they have freedom of choice and expression and if they choose to, they could withdraw consent and participation from the study at any time of their choosing.

With regards to this particular study, the following risks, even though very unlikely were as follows:

- Neurovascular compromise (Di Fabio, 1999)
- Cerebrovascular accident (Di Fabio, 1999)
- Mild transient reactions- exacerbation of neck pain or headache (Di Fabio, 1999)

Participants were referred when necessary.
CHAPTER 4: RESULTS

4.1 Introduction

All the information in this study was statistically analysed by a statistician. The sample group consisted of 30 participants, who presented with a forward head posture and whom suffered from tension-type headaches. The participants consisted of 3 groups of which each received a different treatment protocol i.e. Chiropractic manipulation, a soft tissue protocol, aimed at stretching hypertonic muscles and strengthening of weakened muscles, and finally a combination of the two. The results were based on the change in degree of forward head posture, the participants feeling towards treatment and a change in the amount of muscle tension each individual was able to tolerate.

The analysis comprised of

I. Demographic data analysis comprised of gender and age
II. Subjective measurements in the form of the Vernon-Mior Neck Pain and Disability Questionnaire
III. Objective Measurements in the form of Pressure Algometer readings and the Craniovertebral Angle.

4.2 Demographic Data Analysis

Thirty participants took part in this study and were randomly divided into three separate groups.

4.2.1 Gender Distribution

A total of 30 participants were used in this study. All three groups consisted of 10 participants each. Each group consisted of 5 male and 5 female patients. All groups therefore had an identical number of participants and distribution of male and female patients. Please refer to table 4.1.

Table 4.1: Gender Distribution of the Total Number of Participants

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
</tr>
<tr>
<td>Group 1-</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Chiropractic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.2.2 Age Distribution

The participants that ended up being recruited for this study were between the ages of 20 and 30 years providing a range of 10 years. The mean age was 24.57 years for the whole study population. The mean for Group 1 (Chiropractic manipulation) was 23.6 years. The minimum age for Group 1 was 20 years of age and the maximum age was 26 years. The mean for Group 2 (Soft tissue protocol) was 24.2 years. The minimum age for Group 2 was 23 years of age and the maximum age was 27 years. The mean for Group 3 (Combination) was 25.8 years. The minimum age for Group 3 was 22 years of age and the maximum age was 30 years. Please refer to figure 4.2.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Age (Years)</th>
<th>Maximum Age (Years)</th>
<th>Minimum Age (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1- Chiropractic Manipulation</td>
<td>23.6</td>
<td>26</td>
<td>20</td>
</tr>
<tr>
<td>Group 2- Soft Tissue Protocol</td>
<td>24.2</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>Group 3- Combination</td>
<td>25.8</td>
<td>30</td>
<td>22</td>
</tr>
</tbody>
</table>

4.3 SUBJECTIVE DATA

Subjective data in this study consisted of the Vernon-Mior Neck Pain and Disability Questionnaire.

4.3.1 The Vernon-Mior Neck Pain and Disability Questionnaire

Figure 4.1 illustrates the mean values of the Vernon-Mior Neck Pain and Disability Questionnaire scores between the groups on visits one and seven in percentages. Group 1
(Chiropractic manipulation) showed a mean score of 44% on the first visit and a mean of 21.8% on the seventh visit, indicating a decrease in perceived pain and discomfort. Group 2 (Soft tissue) showed a mean score of 44.8% on the first visit and a mean of 30.8% on the seventh visit, thus also indicating a decrease in perceived pain and discomfort. Group 3 (Combination) showed a mean score of 49.2% on the first visit and a mean of 26.2% on the seventh visit, thus indicating an improvement in perceived pain and discomfort.

Figure 4.1: A Bar Graph Indicating the Mean Values for the Vernon-Mior Neck Pain and Disability Index Questionnaire of all groups on the first and seventh visits

Figure 4.1 illustrates the estimated marginal means for the Vernon-Mior Neck Pain and Disability Questionnaire for Groups 1, 2 and 3 from the first and seventh visits. The results show that all three groups had a similar level of perceived pain and discomfort at the start of the trial and showed similar improvement by the 7th visit. It is evident that Group 1 (Spinal manipulation) had the greatest decrease in perceived pain and discomfort.

a) Tests for Normality and Equal Variance in the Vernon-Mior Neck Pain and Disability Questionnaire

Table 4.3: The Statistical Significance of the Shapiro-Wilk Test between the Groups

<table>
<thead>
<tr>
<th>Vernon-Mior Neck Pain and Disability Index Questionnaire (Visit 1)</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Shapiro-Wilk Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p=0.079</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vernon-Mior Neck Pain and Disability Index Questionnaire (Visit 2)</td>
<td>Group 1</td>
<td>Group 2</td>
<td>Group 3</td>
<td>p=0.000</td>
</tr>
</tbody>
</table>
The Shapiro-Wilk test for normality was performed for the Vernon-Mior Neck Pain and Disability Questionnaire to determine if data was normally distributed across the groups. The p-value was 0.000 on the final visit (p≤0.05) as seen in table 4.3. Non-parametric testing was utilised for further testing.

The p-value was less than 0.05 on the final treatment, thus the null hypothesis was not rejected as there was no differences between the groups. Therefore it can be said that data was normally distributed.

b) Intra-Group Analysis

The Wilcoxon Signed Rank Test was used to compare the Vernon-Mior Neck Pain and Disability Questionnaire values between all the groups on visit 1 and visit 7. The p-value for Group 1 (Spinal manipulation) was 0.05 indicating a statistically significant difference (p≤0.05) between the 1st and 7th visit. The p-value for Group 2 (Soft tissue) was 0.011 indicating a statistically significant (p<0.05) difference between the 1st and 7th visit. The p-value for Group 3 (Combination) was 0.05 indicating a statistically significant difference (p≤0.05) between the 1st and 7th visit. The test shows that there was a significant difference between the first and seventh visit of all three groups as p≤0.05.

c) Inter-Group Analysis

The Kruskal-Wallis test is a non-parametric test used to compare results between the groups. The test was used to determine the presence of a statistically significant difference between the 1st and 7th visit between all the groups. A p-value of 0.212 was evident on the first visit and 0.040 on the final visit thus, indicating a statistically significant change (p≤0.05) on only the final visit.

The Mann-Whitney Test was then used to compare the Vernon-Mior Neck Pain and Disability Questionnaire issued on the last day of the clinical trial between groups 1, 2 and 3. An intergroup analysis was conducted to determine if a significant difference had occurred between the groups. The intergroup analysis between group 1 and 2 revealed a p-value of 0.012, the p-value between groups 1 and 3 was 0.135 and the p value between groups 2 and 3 was 0.266.

There was a significant difference (p<0.05) between group 1 and 2 however there was no significant difference (p>0.05) between group 1 and 3 and group 2 and 3.
4.4 OBJECTIVE DATA

Objective data for this study consisted of Algometer readings taken at various intervals (Visit 1, 4 and 7) and the Craniovertebral angle measured on the first and last visit.

4.4.1 Pressure Algometer

Figure 4.2 illustrates the mean values of the pressure algometer of all three groups on the first, fourth and seventh visits, measured in kg/cm². On the first visit, Group 1 (Spinal manipulation) had a mean algometer reading of 1.42kg/cm², Group 2 (Soft Tissue) had a mean algometer reading of 1.95kg/cm² and Group 3 (Combination) had a mean algometer reading of 1.64kg/cm². On the fourth visit, Group 1 had a mean algometer reading of 2.38kg/cm², Group 2 had a mean algometer reading of 3.02kg/cm² and Group 3 had a mean algometer reading of 2.45kg/cm². On the seventh visit Group 1 had a mean algometer reading of 3.32kg/cm², Group 2 had a mean algometer reading of 4.05kg/cm² and Group 3 had a mean algometer reading of 3.53kg/cm². These results show that all groups had similar pain and discomfort levels at the beginning of the trial and showed that a significant difference had occurred by the end of the trial.

![Graph of algometer readings](image)

Figure 4.2: A Bar Graph Indicating the Mean Values for the Pressure Algometer of all the Groups on the 1st, 4th and 7th Visits

a) Tests for Normality and Equal Variance for the Pressure Algometer Measurements

The Shapiro-Wilk test for normality was performed for algometer statistics to determine if data was normally distributed across the groups. The p value for the algometer readings on the first visit was 0.001, 0.000 for the fourth visit and 0.000 for the seventh and final visit.

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The p-value for all three readings were less than 0.05 as the data was not normally distributed. Non-parametric testing was utilised for further testing. Refer to table 4.4

Table 4.4: The Statistical Significance of the Shapiro-Wilk Test for the Pressure Algometer Readings between the Groups

<table>
<thead>
<tr>
<th>Visits</th>
<th>Shapiro-Wilk Test</th>
</tr>
</thead>
</table>
| Algometer Reading on Visit 1 | Group 1  
|                         | Group 2  
|                         | Group 3  | 0.001 |
| Algometer Reading on Visit 4 | Group 1  
|                         | Group 2  
|                         | Group 3  | 0.000 |
| Algometer Reading on Visit 7 | Group 1  
|                         | Group 2  
|                         | Group 3  | 0.000 |

The p value was less than 0.05 on the final treatment, thus the null hypothesis was not rejected as there was no differences between the groups. Therefore it can be said that data was normally distributed.

b) Intra-Group Analysis of Groups 1, 2 and 3 Algometer Statistics

![Figure 4.3 Illustrates the Mean Algometer Readings of Visit 1, Visit 4 and Visit 7 for all Three Groups](image-url)
The Friedman test was used for the analysis of the algometer statistics for Groups 1, 2 and 3. Analysis was taken over three points of time (visit 1, 4 and 7) to see if a change occurred. Based on the intra-group analysis of group 1, 2 and 3; the Friedman test found that a statistically significant change \((p \leq 0.05)\) occurred between visit 1 and 7 \((p=0.000)\).

The non-parametric, Wilcoxon Signed Ranks Test was used to determine where the change occurred. The data was compared between visit 1 and 4 \((p=0.05)\), visit 1 and 7 \((p=0.05)\), and visit 4 and 7 \((p=0.05)\). The Bonferroni adjustment was applied, thus 0.05 was divided by 3 to give a stricter alpha level of 0.017. All the p-values were equal to 0.05; therefore there was no statistically significant \((p>0.17)\) improvement between treatment 1 and 4, 1 and 7 as well as 4 and 7.

c) Inter-Group Analysis of Algometer Statistics for Group 1, Group 2 and Group 3

The non-parametric Kruskal-Wallis test was used to compare algometer readings between visits 1, visit 4 and visit 7. The p value for visit 1 was 0.109, for visit 4 the p-value was 0.167 and for the 7\(^{th}\) visit the p-value was 0.173. Thus, no statistically significant \((p>0.05)\) change between groups was noted.

4.4.2 The Craniovertebral Angle

Figure 4.4 illustrates the mean values of the Craniovertebral angle scores between the groups on visits one and seven. Group 1 (chiropractic adjustments) showed a mean score of 36.1 ° on the first visit and a mean of 43.7 ° on the seventh visit, indicating an overall improvement throughout the duration of the trial. Group 2 (soft tissue) showed a mean score of 36.5 ° on the first visit and a mean of 45.6 ° on the seventh visit, thus also indicating an overall improvement. Group 3 (combination) showed a mean score of 38.8 ° on the first visit and a mean of 44.2 ° on the seventh visit, thus indicating an improvement.
a) Intra-Group Analysis of the Craniovertebral Angle

The Wilcoxon Signed Rank test was used to compare the Craniovertebral Angle values between all the groups on visit 1 and visit 7. The p-value for Group 1 was 0.08, the p-value for group 2 was 0.08 and the p-value for group three was 0.08. The test shows that there was no significant difference (p>0.05).

b) Inter-group Analysis of the Craniovertebral Angle

The Kruskal-Wallis test is a non-parametric test used to compare results between the groups. The test was used to determine the presence of a statistically significant difference between the 1st and 7th visit between all the groups. An asymp.sig value of 0.512 was evident on the 1st visit and 0.702 on the final visit thus indicating no statistically significant change (p>0.05) on visit 1 or 7.
CHAPTER 5: DISCUSSION

5.1 INTRODUCTION

This chapter discusses, in detail, the results obtained at the end of trial as presented in the previous chapter. It provides the necessary information to explain the results that were obtained by referring to the literature that was discussed in chapter two and results of previous research conducted.

The statistical and clinical significance will be discussed in terms of intra- and inter-group analysis. The results were obtained through the Vernon-Mior Neck Pain and Disability Questionnaire, pressure algometer readings and the craniovertebral angle.

5.2 DEMOGRAPHIC DATA

5.2.1 Age Distribution

The entire study consisted of 30 participants. As indicated in table 4.1 there were 10 participants within each group. The ratio of males to females in each group was 5:5 which means that there was an equal distribution between male and female participants in each group.

One of the inclusion criteria for this particular study was that all participants had to be between the ages of 18-50 years of age. The age restriction was to prevent participants who might be suffering from head and neck pain due to joint degeneration. According to Magee (2008), the incidence of joint and intervertebral joint degeneration increases significantly after the age of 45. Vecchiet (2002) states that active myofascial trigger points are most commonly found in individuals younger than 50 years of age as these are the most active years in which muscles are most likely to be overused.

All the participants of this study met the inclusion criteria and were between the ages of 18-50 years (table 4.2). In this study the mean for all of the participants was 24.57 years of age. Group 1 (Spinal manipulation) had a mean of 23.6 years, Group 2 (Soft tissue protocol) had a mean of 24.2 years and Group 3 (Combination) had a mean of 25.8 years. The maximum age in spinal manipulation group was 26 years with a minimum of 20 years, the maximum in soft tissue group was 27 years with a minimum of 23 years and the maximum of combination group was 30 years with a minimum of 22 years.

According to Stovner et al., (2007) and Simon et al., (2004), tension-type headaches are most prevalent in younger adults. It is estimated that 40% of tension-type headaches
sufferers experience their first attack by age 20, an additional 40% will experience their first attack after age 20 and 20% will experience a tension-type headache after 40 (Simon et al., 2004). The average age in this study falls within the above mentioned statistics.

No statistically significant differences were found between Group 1, 2 and 3 as \( p > 0.05 \) with regards to age. All groups are therefore comparable in terms of their age.

5.2.2 Gender Distribution

There were 30 participants recruited for this study that were divided into 3 equal groups. Each of the three groups had 10 participants consisting of 5 females and 5 males in each group. The gender distribution indicated that a total of 15 females and 15 males were used in total for this study. This indicates that there was comparable amount of participants in terms of males and females. There was no statistically significant change found between Groups 1, 2 and 3 as \( p > 0.05 \) with regards to gender.

The participants were randomly selected to create three homogenous groups; the gender distribution does not reflect the prevalence of tension-type headaches. Tension-type headaches have been found to be most prevalent in women (Stovner et al., 2007; Simon et al., 2004) with a ratio estimated at 1:1.31 (M:F). In this study the male-female ratio was controlled by specific number allocation within the groups and therefore the ratio was 1:1 (M:F).

5.3 SUBJECTIVE DATA

Subjective data used in this study consisted of the Vernon-Mior Neck Pain and Disability Index Questionnaire, which was issued to each participant on their first consultation as well as on their last consultation. The subjective data was used to verify any subjective changes within the participants’ observations regarding treatment in their pain specifically during the 4 week research study.

5.3.1 Vernon-Mior Neck Pain and Disability Index Questionnaire

a. Clinical Impression

All the groups had a decrease in neck-pain and disability from a mean Vernon-Mior Neck Pain and Disability Index Questionnaire score of 45.74% on the first visit to 26.26% on the seventh visit, indicating a 21.29% decrease. It is evident that on the first consultation the participants were experiencing a greater degree of pain compared to the seventh and final consult. The spinal manipulation group showed a mean score of 44% on the first visit and a
mean of 21.8% on the seventh visit, indicating a 50.46% decrease throughout the duration of the study. The soft tissue group showed a mean score of 44.8% on the first visit and a mean of 30.8% on the seventh visit, thus indicating a decrease of 31.25% in perceived pain and discomfort. The combination group showed a mean score of 49.2% on the first visit and a mean of 26.2% on the seventh visit, thus indicating a decrease of 46.75% in perceived pain and discomfort (refer to figure 4.1). It is evident from the results that all three groups had roughly equal levels of head and neck pain on the first visit. Whilst all three groups showed improvement from the first to the seventh visit, the spinal manipulation group showed the greatest decrease in perceived head and neck pain.

b. Intra-Group Analysis

Intra-Group analysis was performed using the Wilcoxon Signed Rank test.

The Wilcoxon Signed Rank test was used to compare the Vernon-Mior Neck Pain and Disability Questionnaire values between all the groups on visit one and visit 7. The test revealed that there was a significant difference (p≤0.05). The p-value for the spinal manipulation group was 0.05, the p-value for the soft tissue group was 0.011 and the p-value for the combination group was 0.05. This indicates that there was a statistically significant improvement (p≤0.05) in perceived pain levels in all three groups between visits 1 and 7.

c. Inter-Group Analysis

Inter-Group analysis was performed using the Kruskal-Wallis and Mann-Whitney test.

The Kruskal-Wallis test was used to determine the presence of a statistically significant difference between the first and seventh visit between all the groups. An asymp.sig value of 0.0212 was evident on the first visit and 0.040 on the final visit thus indicating a statistically significant change (p≤0.05).

The Mann-Whitney test was used to compare the Vernon-Mior Neck Pain and Disability Index Questionnaire between the groups on the first and seventh visit. The p-value between the spinal manipulation group and the soft tissue group revealed a p-value of 0.012, the p-value between the spinal manipulation group and the combination group was 0.135 and the p-value between the soft tissue group and the combination group was 0.266. There was a significant difference (p≤0.05) between Group 1 (spinal manipulation) and 2 (soft tissue) as the p-value was less than 0.05 however there was no significant difference (p>0.05) between group 1 (spinal manipulation) and 3 (combination) and group 2 (soft tissue) and 3 (combination) as the p-value was more than 0.05.
d. Outcomes of the Vernon-Mior Neck Pain and Disability Index Questionnaire

The Vernon-Mior Neck Pain and Disability Index Questionnaire showed a significant reduction in pain and disability perceived by the patient during the four week trial.

As seen in Figure 4.1, the spinal manipulation group showed a mean score of 44.4% on the first visit and a mean of 21.8% on the seventh visit, indicating an overall decrease of 50.46% throughout the duration of the trial. The soft tissue group showed a mean score of 44.8% on the first visit and a mean of 30.8% on the seventh visit, thus also indicating an overall decrease of 31.25% in perceived pain and discomfort. The combination group showed a mean score of 49.2% on the first visit and a mean of 26.3% on the seventh visit, thus indicating an overall decrease of 46.75% in perceived pain and discomfort. The results showed a significant difference in comparison between the spinal manipulative, soft tissue and combination groups. In theory the combination group should have showed the greatest improvement; however this is not the case as the chiropractic manipulation group showed the greatest improvement, followed by the combination group and finally the soft tissue group.

A reasonable explanation behind this is that chiropractic manipulations have been shown to have an effect on the hypertonicity of muscles also causing a decrease in pain (Peterson & Bergmann). Chiropractic manipulations induce a reflex response which, in turn, creates a reduction in pain, a reflex inhibition of the spastic muscles and a short term reflex activation of skeletal muscles. The chiropractic manipulation has analgesic properties as it results in the release of enkephalins and endorphins. These substances function as endogenous pain inhibitors (Peterson & Bergman, 2002). The mechanism underlying the alteration of a person’s pain threshold or pain tolerance is the manipulations ability to alter the central sensory processing of the central nervous system by removing sub-threshold mechanical and/or chemical stimuli from the paraspinal tissues. Spinal manipulative therapy causes an increase in proprioceptive input which has reflex inhibition on the transmission of pain (Kirkaldy-Willis & Bernard, 1999). These theories give reasonable explanation as to why the individuals in the spinal manipulative group had a decrease in their perceived pain.

In a study investigating the effects of different spinal manipulative techniques in the treatment of neck pain, it was found that the post chiropractic manipulation group had the highest decrease in neck pain as seen in the Vernon-Mior Neck Pain and Disability Index Pain Rating Scale (Van Schalkwyk & Parkin-Smith, 2000).

Mootz et al., (1994) conducted a study to assess the effectiveness of chiropractic management in the treatment of chronic episodic muscle tension type headache in male patients. It was established at the end of the study that mean headache frequency had a significant change from 6.4 episodes per two week period to 3.1. The duration of headaches also had a statistically significant change from 6.7 hours per episode to 3.88
hours. This was an indication that manipulative therapy was capable of significantly reducing a patient's headache as a result of muscular abnormalities (Mootz et al., 1994) as \( p < 0.05 \).

Broline et al., (1995) conducted a study to compare spinal manipulation versus the use of amitriptyline in the treatment of tension-type headaches. The results showed that spinal manipulation has an advantage in headache severity, use of non-analgesics and general health status \( (p < 0.05) \) however at the end of a 6 week treatment period the patients using amitriptyline fared slightly better than the spinal manipulation group in terms of headache pain \( (p = 0.05) \). Patients using amitriptyline reported more side effects than those in the spinal manipulation group. This is a good indication that even though spinal manipulation proved to be less effective than amitriptyline, the side effects occurring as a result of the medication could be avoided using the chiropractic manipulation. This information also provides evidence that chiropractic manipulation aids in the decrease of pain levels and coincides with the results obtained in this study.

Bove & Nilsson, (1998) conducted a trial to determine whether or not spinal manipulative therapy combined with soft tissue massage would improve outcomes for episodic tension-type headaches. The two treatment groups comprised of deep friction massage and deep friction massage with laser placebo treatment. Participants received eight treatments over the course of four weeks. Both groups improved at a similar rate during treatment and follow up periods. No important differences were reported between the groups with regards to either daily headache hours, pain intensity per headache episode, or analgesic use.

In the study conducted by Cleland, Childs, McRae, Palmer & Stowell (2004), it was established that patients who received chiropractic manipulations for neck pain were satisfied with treatment and reported an overall reduction in their pain and disability.

Deep pressure applied to trigger points produces pain that hyperstimulates inter neurons in the dorsal horn to release endorphins that block pain perception (Peterson & Bergmann, 2002). Ischemic compression delivered by applying sustained pressure for a period of a few seconds to a minute on a trigger point will ease the tension within a taut band of a muscle (Montanez-Aguilera et al., 2010). This provides an explanation as to why the soft tissue group had improvement with their levels or perceived pain.

In the study done by Sefton, Yarar, Carpenter & Berry (2011), on the effects of massage on cervical range of motion, it was discovered that an increase of blood flow occurs which results in a decrease in pain and allows healing thereby reducing the amount of pain perceived by the patient. This could explain the decrease in perceived pain reported by the participants that were in the soft tissue group.

Therefore changes that were achieved through this study could be as a result of central changes associated with descending inhibitory pathways. All three treatments administered
in the various groups had a perpetual effect thereby decreasing the amount of perceived pain and discomfort experienced by the patient.

5.4 OBJECTIVE DATA

Objective data was obtained using a pressure algometer and the craniovertebral angle. The data was used to verify any changes in the participants trigger point severity throughout the study as well as to evaluate a change in forward head posture.

5.4.1 Pressure Algometer

a. Clinical Interpretation

All groups showed an improvement regarding trigger point severity from the first to the seventh visits (refer to figure 4.3).

The spinal manipulative group had an increase in their mean algometer readings indicating a decrease in trigger point severity of $1.42\, \text{kg/cm}^2$ on the first visit to $3.32\, \text{kg/cm}^2$ on the seventh visit, indicating a 133.80% improvement. The soft tissue group had an increase in their mean algometer readings indicating a decrease in trigger point severity of $1.95\, \text{kg/cm}^2$ on the first visit to $4.05\, \text{kg/cm}^2$ on the seventh visit, showing an improvement of 107.69%. The combination group had an increase in their mean algometer readings indicating a decrease in trigger point severity of $1.64\, \text{kg/cm}^2$ on the first visit to $3.53\, \text{kg/cm}^2$ on the seventh visit, showing an improvement of 115.24%. It is evident that all groups had a decrease in trigger point severity from visits one through to seven. The spinal manipulation group had the greatest improvement with regards to pain and discomfort followed by the combination group, whilst the soft tissue group showed the least improvement.

b. Intra-Group Analysis

Intra-Group Analysis was performed using the Friedman Test and Wilcoxon Signed Ranks Test.

The Friedman test used for the pressure algometer measurements revealed a significant difference in all three groups from the first to the seventh visits (spinal manipulation group: $p=0.00$, soft tissue group: $p=0.00$ and combination group: $p=0.00$). The Wilcoxon Signed Ranks Test revealed a statistically significant difference in all three groups between the first, fourth and seventh visits (spinal manipulation group: $p=0.05$, soft tissue group: $p=0.05$ and combination group: $p=0.05$). The Bonferroni adjustment was applied, thus 0.05 was divided by 3 to give a stricter alpha level of 0.17. All the p-values were equal to 0.05;
therefore there was no statistically significant improvement ($p>0.17$) between treatments 1 and 4, 1 and 7 as well as 4 and 7.

c. Inter-Group Analysis

Inter-Group analysis was performed using the Kruskal-Wallis test.

The Kruskal-Wallis test was used to compare algometer readings between visits 1, visit 4 and visit 7. The p-value for algo 1 was 0.109, for algo 4 the p-value was 0.167 and for the 7th visit the p-value was 0.173. The Kriskal-Wallis test revealed no statistically significant difference ($p>0.05$) between the three groups.

d. Outcomes for the Pressure Algometer

An algometer is used to quantitatively assess the participants pressure pain threshold of a specific myofascial trigger point (De Las Penas et al., 2005). The pressure pain threshold in turn is defined by the minimum amount of pressure one can tolerate before pain (Ylinen et al., 2007). Simons (1998) believed that deep pressure produces pain that hyperstimulates inter neurons in the dorsal horn to release endorphins that block pain perception.

It was discussed and proposed that by stimulating joint mechanoreceptors, a regulating function will be exerted on the muscle tone of associated musculature of the involved joints (Sandoz, 1981). Esposito and Philipson (2005) explain that the manipulation may result in the stretch of surrounding musculature at the particular vertebral level being manipulated; this, in turn, will result in the activation of muscle spindles and golgi-tendon reflexes which may decrease the state of hypertonicity and remove any myofascial trigger points in the associated muscles. As a result by correcting musculature abnormalities in theory the degree and resultant symptoms of a forward head posture can and should be decreased. This provides evidence as to why the spinal manipulative group had a decrease in pain threshold as well as in the degree of forward head posture.

The applied compression delivered during ischemic compression blocks blood flow into the area, and thereby inhibits the metabolic activity which may reduce the contractile potential in the target muscle. Upon the trigger point release a resurgence of blood occurs into the area which, in turn, removes metabolites, pain and local muscle hypertonicity (Travell & Simons, 1998). Travell & Simons (1998) believed that the deep pressure applied while holding a muscle makes a contracted stretch to contracted sarcomeres associated within the muscles trigger point, which would create separation of the muscles actin-myosin heads. This may be a reasonable explanation for the continual increase in pain threshold experienced by the soft tissue and combination group throughout the duration of this study.
In the study conducted by Coronado, Gay, Bialosky, Carnaby, Bishop & George (2012), on the investigation of the effects of spinal manipulation, it was discovered that patients responded to treatment by having an increase in pain threshold that was not just local but also found to be present in distant areas. This is an indication that the effects do not just occur at a spinal level but also in the central nervous system.

In the study conducted by Bryans et al. (2011), on evidenced-based guidelines for the treatment of adults with headaches the following practice recommendation was established after completion of the trial. It was stated that spinal manipulation cannot be solely recommended for the management of patients with episodic tension-type headaches, as there was evidence that spinal manipulation received after premanipulative soft tissue therapy provided no additional benefit for patients suffering from tension-type headaches. This recommendation coincides with the results obtained through objective data of this particular study. Fernandez-De-Las-Penas, Alonso-Blanco, Cuadrado, et al., (2006b), stated that there was no rigorous evidence that manual therapies offer benefit beyond a placebo effect to patients suffering with tension-type headaches.

Espí-López et al., (2013) researched the effectiveness of two manual therapy treatments that were aimed on the suboccipital region for tension-type headaches. Eighty-four patients were treated over a four week trial, followed by one final visit a month after the study was conducted. Patients were assigned to four groups which included suboccipital soft tissue inhibition, occiput-atlas-axis global manipulation, a combination group and a control group. At the end of the trial it was established that suboccipital soft tissue inhibition is effective in reducing the impact of the patients’ headache and the functional aspect of the headache disability and in increasing craniocervical flexion. Occiput-atlas-axis global manipulation was found to have an overall impact in reducing frequency and disability of the headache and increasing the craniocervical motion in flexion and extension. The combination group was effective in reducing the impact of the patient’s headache, frequency and intensity of the headache, pericranial tenderness and in increasing craniocervical flexion and extension. This may explain why there was an overall improvement in both pain threshold and the craniovertebral angle.

Bryans et al. (2011), stated that the use of spinal manipulation as an isolated intervention for tension-type headaches remains equivocal and that more evidence is needed.

5.4.2 The Craniovertebral Angle

a. Clinical Interpretation

All groups showed an improvement regarding the degree of forward head posture from the first to the seventh visits.
The spinal manipulative group had an increase in their mean craniovertebral angle indicating a decrease in the degree of forward head posture as the angle improved from 36.1° on the first visit to 43.7° on the seventh visit, indicating an increase of 21.05%. The soft tissue group had an increase in their mean craniovertebral angle indicating a decrease in the degree of forward head posture as the angle increased from 36.5° on the first visit to 45.6° on the seventh visit, indicating an increase of 24.93%. The combination group had an increase in their mean craniovertebral angle indicating a decrease in the degree of forward head posture as the angle increased from 38.8° on the first visit to 44.2° on the seventh visit, indicating a 13.92% increase. Please refer to figure 4.4.

b. Intra-Group Analysis

Intra-Group Analysis was performed using the Wilcoxon Signed Ranks Test.

The Wilcoxon Signed Rank test was used to compare the craniovertebral angle between all the groups on visits one and visit 7. The test revealed that there was a significant difference between as the p-value was less than 0.05. The p-value for the spinal manipulation group was 0.08, the p-value for the soft tissue group was 0.08 and the p value for the combination group was 0.08. The test shows that there was no statistically significant improvement in the degree of forward head posture as the p value was more than 0.05.

c. Inter-Group Analysis

Inter-Group analysis was performed using the Kruskal-Wallis and Mann-Whitney test

The Kruskal-Wallis test was used to compare Craniovertebral angle between the three groups on visit one and visit 7. An asymp.sig value of 0.512 was evident on the first visit and 0.702 on the final visit thus indicating no statistically significant change on visit 1 or 7 as p>0.05.

d. Outcomes of the Craniovertebral Angle

Tension-type headaches are classified according to Tsuboi (2002), as pain that occurs as a result of excessive contraction of the pericranial muscles. Psychosocial factors including stress are involved in the development of these headaches. Thus, in order to treat these patients, one should consider dealing with daily stress experienced by the patient as a form of management. The improvement of the pattern of physical activities and the introduction of therapeutic exercise and drug therapy are often effective in treating the problem.
According to Gupta et al. (2013) deep cervical flexor training is the more effective than conventional isometric training in the reduction of forward head postures. The study comprised of a six month trail on 52 patients, between the ages of 20-40 years of age. The participants were divided into two groups, the first group aimed at using deep-cervical flexion training while the second group focused on conventional isometric training. Group 1 had a significant improvement (p=0.000) compared to group 2 in reduction of forward head posture. Both groups showed a significant improvement in terms of neck pain (p=0.000). This study gives a good indication as to why the soft tissue group in my study had the greatest improvement in the reduction of forward head posture.

Morningstar et al. (2003) conducted a study where a total of fifteen subjects were selected to see if chiropractic manipulative therapy had an effect on forward head posture. Seated lateral cervical radiographs were taken to evaluate the degree of forward head posture and the amount of cervical lordosis. Chiropractic manipulation was received by each patient immediately after the radiograph was taken. The results showed an overall decrease in forward head posture among all subjects. The largest reduction was 1.25 inches. The largest cervical lordosis improvement was 23 degrees while the smallest improvement was 4 degrees. The study only indicated the immediate effects of spinal manipulation but gives an indication that spinal manipulation may improve forward head posture and thus coincides with the results obtained in this particular study.

In the study conducted by Lee et al. (2013) on the effects of deep flexor muscle strengthening exercises on the neck and shoulder posture, and the strength and endurance of the deep flexor muscles of high school students, it was found that the experimental group showed statistically significant changes in the head-tilt angle, neck flexion angle, forward shoulder angle, and the results of the cranio-cervical flexion test after training (p<0.05). Hoe (2005) observed that impairment of the deep neck flexors in patients with chronic neck pain weakened the strength of static muscles which severely weakened their endurance. It was stated that for rehabilitation, patients should focus on improving the endurance of the neck muscles so that they can withstand a low-intensity load for a long time.

Diab & Moustafa (2011) found that there was a significant difference in the craniovertebral angle after ten weeks of treatment (p=0.00). Ninety-six participants with a craniovertebral angle of less than 50 degrees took part in the trial. The target group received a postural corrective exercise program in addition to ultrasound and infrared radiation. It was concluded that patients with a forward head posture should be treated using a postural corrective exercise program as may result in a decrease in pain and an improvement in the craniovertebral angle. This statement coincides with the results obtained in this study.
5.5 Conclusion

Possible explanations for the results that were obtained in this study may be that this study consisted of a short treatment period. It is possible that a significant difference may occur with a longer study duration with more frequent visits and a much larger experimental group.

Another possible reason that needs to be considered in this trial is human error between measurements of the craniovertebral angle. A thorough investigation needs to be performed to determine the best way to acquire measurements without the possibility of human error.
CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

The purpose of the study was to compare whether manipulating the relevant restricted segments of the cervical spine in conjunction with a soft tissue protocol to release hypertonic muscles and strengthen weakened muscles would be effective in treating patients with tension-type headaches as a result of a forward head posture. The study was also aimed at potentially reducing the amount of forward head posture by correcting the patient's muscular imbalances.

A total number of thirty participants were used in this study. Ten of those were placed in the group receiving chiropractic manipulative therapy; ten were placed in the group receiving the soft tissue protocol aimed at releasing hypertonic muscles and strengthening of weakened muscles and the remaining ten were placed in a combination group which received both chiropractic manipulative therapy and the soft tissue protocol. Participants were treated a total of six times. Subjective measurements were taken on the first and seventh visits and consisted of the Vernon-Mior Neck Pain and Disability Index Questionnaire. Objective measurements were taken on the first, fourth and seventh visits using the pressure algometer, while the craniovertebral angle was measured on the first and seventh visits.

After completion of this study it became evident that all three groups demonstrated significant changes on their own. The chiropractic manipulation group showed the greatest improvements with regards to subjective data, followed by the combination group and finally the soft tissue group, which consisted of releasing hypertonic muscles and strengthening weakened muscles, showing the least amount of improvement.

All groups showed improvement with regards to objective data. The chiropractic manipulation group showed the greatest improvements with regards to the algometer data, followed by the combination group, with the soft tissue group showing the least improvement. The soft tissue group showed the greatest improvement with regards to the objective data collected by measuring the craniovertebral angle, followed by the spinal manipulation group and finally the combination group showed the least improvement.

6.2 Recommendations

The following recommendations could be used to improve the outcome and statistical significance of future studies relating to this topic.
- Increase the size of the study. This would increase the applicability of the sample which, in turn, would allow for the results to be more statistically viable.

- Use one specific manipulation that focuses on correcting anterior head carriage. The manipulation should have a line of drive directed anterior to posterior, driving the specific vertebrae posteriorly. This will decrease torsional stresses placed on the vertebrae during the manipulation.

- Conduct the study on occupation specific samples. e.g.) Secretaries who sit in front of a computer for 5 hours a day. Each particular occupation has a unique set of postures and injuries (associated with these postures). Many of the injuries sustained during occupational activities are associated with overuse injuries. These types of injuries are caused when repetitive stress exceeds the physiological limits of the body's tissues (Levangie & Norkin, 2011).

- Increase the duration of the clinical trial as postural faults are persistent and will take time to correct. The trial could be extended up to six months as this would give sufficient time to see if an actual improvement occurs over time. Long term treatment could prove beneficial and make the results more statistically viable.

- A follow up consultation should take place 2 months after the trial to ensure that the participants are in fact better off and are no longer suffering from tension-type headaches as a result of a forward head posture. This will determine the long term effects of treatment.

- Incorporate the use of x-rays to be more specific with regards to measuring the degree of forward head posture. The craniovertebral angle is not specific enough as human error can occur while setting up the participant. Distance of the camera, position of the tripod and posture the participants assume while seated can account for error. According to Vrtovec et al. (2009) x-rays have been the gold standard for measuring spinal kyphosis and lordosis since the 1930s.

- By incorporating the use of a cervical range of motion device it will help the researcher determine whether or not flexion and extension have improved over the duration of the study.

- The use of a headache diary should also be included into the study. This will provide the researcher with an indication of how many and how frequently the participants suffer with tension-type headaches.
REFERENCES


Appendix A: Advertisement

Do you suffer from tension-type headaches??

If you are between the ages of 18-50 and you have answered yes to this question
You may be entitled to a free treatment

Possible areas of pain:
- upper back and neck
- base of the head
- the ears
- above the ears
- the jaw
- above the eyes

Supervised treatment is conducted at the UJ Chiropractic Day Clinic
Doornfontein Campus

Contact Patrick Newman
079 522 4034
Chiropractic Masters Student
Appendix B: Contra Indications to Cervical Spine Manipulative Therapy (Gatterman, 2004)

1) Vascular complications
   - Vertebral artery syndrome
   - Aneurysms

2) Tumours
   - Primary to the bone
   - Secondary (metastasis to the bone)

3) Bone Infections
   - Tuberculosis of the spine
   - Osteomyelitis of the spine

4) Traumatic Injuries
   - Fracture
   - Instabilities
   - Dislocation
   - Unstable spondylolisthesis

5) Arthritis
   - Ankylosing Spondylitis
   - Rheumatoid Arthritis
   - Psoriatic Arthritis
   - Reactive Arthritis
   - Osteoarthritis

6) Psychological consideration
   - Malingering
   - Hysteria
   - Pain intolerance
   - Dependant personality
   - Disability Syndromes

7) Neurological complications
   - Cervical disc lesions
   - Advancing neurological deficits
   - Space occupying lesions
INFORMATION FORM

Dear Participant,

My name is Patrick Newman, and I am completing my Master’s Degree at the University of Johannesburg. I would like to invite you to participate in my research study entitled:

“A comparative study in the treatment of tension-type headaches in individuals presenting with forward head posture”

Before agreeing to participate, it is important that you read and understand the following explanation of the purpose of the study, the study procedures, benefits, risks, discomforts, and precautions and your right to withdraw from the study at any time.

This information leaflet is to help you to decide if you would like to participate. You must understand what the research study is about before you agree to take part in this study. You may find that this form may contain words that you do not understand. If you have any questions, do not hesitate to ask me. You may also take home a copy of this form before signing the consent form to think about or discuss with family or friends before making your decision.
This intended study compares the effects of chiropractic manipulative therapy, namely chiropractic cervical spine manipulative therapy and a soft tissue protocol to aid in the treatment of tension-type headaches in individuals presenting with a forward head posture. The study is also aimed at potentially reducing the amount of forward head posture by correcting the patient’s muscular imbalances.

Procedure

The treatment procedure involves two treatment protocols: Chiropractic spinal manipulative therapy to the cervical spine. The Chiropractic manipulative therapy involves the restoration of normal joint motion. Abnormal joint motion will be detected by the researcher via motion palpation. The Chiropractic manipulative therapy is a safe, non-invasive treatment technique. The second treatment consists of a soft tissue programme which is aimed at releasing hypertonic muscles and strengthening weakened muscles. This soft tissue programme involves manual therapy and is also a safe, non-invasive treatment technique.

Should you decide to volunteer to partake in this study you will first be screened for what we call “inclusion and exclusion criteria”. The inclusion criteria for this study are symptomatic male and female patients who have an anterior head carriage, participants must be between the ages of 18 and 50 years of age (these are the individuals who are most susceptible in developing a forward head posture due to continual studying positions, work positions, sleeping positions etc) and finally participants must be suffering from tension headaches. The exclusion criteria for this study are if you have any known congenital anomalies that in turn can result in an anterior head carriage e.g. wedge vertebrae, if you are contra-indicated to cervical spine manipulative therapy, if you have a history of cervical spine surgery or if you demonstrate forward head posture but are asymptomatic (symptomless).

From here measurements will be taken with the use of a cervical spine photograph which will be used to evaluate the degree of your forward head posture. The Vermon-Mior Neck Pain and Disability questionnaire will be used for the purpose of collecting subjective data.

The research study will take place at the University of Johannesburg Chiropractic Clinic
If you want any information regarding your rights as a research participant, or concerns regarding this research study, you may contact me or my supervisor or alternatively the Chairperson of the University of Johannesburg's Academic Ethics committee which is an independent committee established to help protect the rights of research participants.

**Confidentiality**

All information obtained during the course of this study will be kept strictly confidential. Recorded data used for the statistical analysis by STATKON will not include any information that identifies you as a participant in this study. Data that may be reported in scientific journals will not include any information that identifies you as a participant in this study.

Any information uncovered regarding your results or state of health as a result of your participation in this study will be held in strict confidence. You will be informed of any finding of importance to your health or continued participation in this study but this information will not be disclosed to any third party without your written consent. The only exception to this rule will be cases of communicable diseases were a legal duty of notification of the Department of Health exists. In this case, you will be informed of my intent to disclose such information.

Should you have any concerns or queries regarding the current study, the following persons may be contacted:

- **Researcher:** Patrick Newman  
  **Telephone number:** 079 522 4034
- **Supervisor:** Dr Chris Yelverton  
  **Telephone number:** (011) 559 6218
- **Chairperson of RE**  
  **Telephone number:** (011) 559 6686
  
  **Prof Poggenpoel**

UJ Ethic's clearance number: **Rec-01-133-2014**
Appendix D: Consent Form

Date: ___________________

CONSENT FORM

Dear Participant

Before signing this consent form please take time to read the information form.

Personal doctor/specialist notification option

Please indicate below, whether you want me to notify your personal doctor or your specialist of your participation in this study:

- YES, I want you to inform my personal doctor/ specialist of my participation in this study
- NO, I do not want you to inform my personal doctor/ specialist of my participation in this study
- I do not have a personal doctor / specialist

Do you have any questions related to this study?

INFORMED CONSENT

I hereby confirm that I have been informed by the researcher, Patrick Newman, about the nature, conduct, benefits and risks of this study with the title:
"A comparative study in the treatment of tension-type headaches in individuals presenting with forward head posture"

I have also received, read and understood the information form (participant information leaflet) regarding this study.

- I am aware that the results of this study, including personal details regarding my gender, age, date of birth, and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed.
- I may, at any stage, without prejudice, withdraw my consent and participation in this study as it is on a voluntary basis.
- I have had sufficient opportunity to ask questions and (of my own free will) I declare myself prepared to participate in this study.
- The Data will be destroyed 2 years after completion of the trial and is kept in a locked room at the UJ Chiropractic Clinic.

Signed Participant

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Signed Researcher

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Signed Witnesses

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Appendix E: Photographic Consent Form

DEPARTMENT OF CHIROPRACTIC

FACULTY OF HEALTH SCIENCES

Telephone: (011) 559 6218

DATE:

To Whom It May Concern:

My name is Patrick Newman. I am a 5th year Chiropractic student, completing my Master’s degree at the University of Johannesburg. I am requesting your permission to conduct the photographic component of my research trial by taking cervical spine photographs which will be used to evaluate your forward head posture. This study has been approved by the University of Johannesburg’s higher degrees and ethics committees. The aim of my study is to compare various treatment methods for tension-type headaches in individuals presenting with forward head posture.

My intended research requires that I measure the craniovertebral angle of the cervical spine of patients who are presenting with tension-type headaches as a result of forward head posture. You are required to read an information form and to sign both consent forms in order to participate in this study.

The photograph shall be taken on the first consultation as well as on the last day of the research trial. The photographs will be processed with your consent. From here the craniovertebral angle will be measured and recorded for statistical analysis. Your identity and personal information will not be disclosed to any members of the public without your written consent. For the purpose of the study your face will be blurred out so that your identity will not be disclosed.

Researcher: Patrick Newman  Telephone number: 079 522 4034
Supervisor: Dr Chris Yelverton  Telephone number: (011) 559 6218
Signature __________________________
Appendix F: Case History

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

CASE HISTORY

Date: _______________

Patient: ____________________  File No: __________

Age: _____  Sex: _______  Occupation: _______________

Student: ____________________  Signature: ____________

Complies with Inclusion criteria of the research:

Clinic: ____________________  Signature: ____________

Examination:
Previous: UJ  Current: UJ
Other

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

Clinical Path. Lab:
Previous: UJ  Current: UJ
Other

Case status:
PTT: Conditional  Signed off: Final sign out:

Recommendations:
Students case history

1. Source of history:

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

3. Present illness:
   - Location
   - Onset
   - Duration
   - Frequency
   - Pain (character)
   - Progression
   - Aggravating factors
   - Relieving factors
   - Associated Sx's and Sg's
   - Previous occurrences
   - Past treatment and outcome
4. Other complaints:

5. Past history
   - General health status
   - Childhood illnesses
   - Adult illnesses
   - Psychiatric illnesses
   - Accidents/injuries
   - Surgery
   - Hospitalisation

6. Current health status and lifestyle
   - Allergies
   - Immunizations
   - Screening tests
   - Environmental hazards
   - Safety measures
   - Exercise and leisure
   - Sleep patterns
   - Diet
   - Current medication
   - Tobacco
   - Alcohol
   - Social drugs
7. **Family history:**
   *Immediate family:*
   - Cause of death
   - DM
   - Heart disease
   - TB
   - HBP
   - Stroke
   - Kidney disease
   - CA
   - Arthritis
   - Anaemia
   - Headaches
   - Thyroid disease
   - Epilepsy
   - Mental illness
   - Alcoholism
   - Drug addiction
   - Other

8. **Psychosocial history:**
   - Home situation
   - Daily life
   - Important experiences
   - Religious beliefs

9. **Review of systems:**
   - General
   - Skin
   - Head
Eyes
Ears
Nose/sinuses
Mouth/throat
Neck
Breasts
Respiratory
Cardiac
Gastro-intestinal
Urinary
Genital
Vascular
Musculoskeletal
Neurologic
Haematologic
Endocrine
Psychiatric
Appendix G: Physical Exam

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

(Note: only if Cervical Spine Regional is complete)

Underline abnormal findings in RED.

Date: ____________________

Patient: ____________________  File No: ______________

Clinician: ____________________  Signature: ______________

Student: ____________________  Signature: ______________

Height: ___________  Weight: ___________  Temp: ___________

Rates: Heart: ___________  Pulse: ___________  Respiration: ___________

Blood pressure:  Arms: L  R

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General Appearance:
_____________________
_____________________
_____________________
_____________________
STANDING EXAMINATION

1. Minor’s sign
2. Skin changes
3. Posture: Erect

   Adam’s

4. Ranges of motion (Thoracolumbar Spine)
   T/L spine: Flexion: 90° (fingers to floor)
   Extension: 50°
   R. lat. flex: 30° (fingers down leg)
   L. lat. flex: 30° (fingers down leg)
   Rot. to R: 35°
   Rot. to L: 35°

5. Romberg’s sign
6. Pronator drift
7. Trendelenburg’s sign
8. Gait: rhythm
    - balance
    - pendulousness
    - on toes
    - on heels
    - tandem

9. Half squat
10. Scapular winging
11. Muscle tone
12. Spasticity/Rigidity
13. Shoulder: skin symmetry
    ROM
    - glenohumeral
    - scapulo-thoracic
    - acromioclavicular
    - elbow
    - wrist
14. Chest measurement:
   - inspiration
   - expiration

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15. Visual acuity

16. Breast examination:
   Inspection:
   - skin
   - size
   - contour
   - nipples
   - arms overhead
   - hands against hips
   - leaning forward

   Palpation
   - axillary lymph nodes
   - breast incl. tail

**SEATED EXAMINATION**

1. Spinal posture
2. Head
   - hair
   - scalp
   - skull
   - face
   - skin

3. Eyes:
   Observation
   - conjunctiva
   - sclera
   - eyebrows
   - eyelids
   - lacrimal glands
   - nasolacrimal duct
   - position and alignment
   - corneas and lenses

   - corneal reflex

   - ocular movement

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   - visual fields
   - accommodation
   - Ophthalmoscopic
   - Examination
     - iris
     - pupils
     - red reflex
     - optic disc
     - vessels
     - general background
4. Ears:
   • Inspection
     - auricle
     - ear canal
     - drum
     - auditory acuity
     - Weber test
     - Rinne test

5. Nose:
   • External
   • Internal
     - septum
     - turbinates
     - olfaction

6. Sinuses (frontal & maxillary):
   - tenderness
   - transillumination

7. Mouth and pharynx:
   • lips
   • buccal mucosa
   • gums and teeth
   • roof
   • tongue
     - inspection
     - movement
     - taste
     - palpation
   • pharynx
     - CN X
     - inspection

• carotid arteries (thrills, bruit)
• Cranial Nerves
  - CN V
  - CN VII
  - CN VIII (nystagmus)
  - CN IX
  - CN XI
  - CN X11

8. Peripheral vasculature:
   • Inspection
     - skin
     - nail beds
     - pigmentation
     - hair loss
• Palpation
  - pulses:  - femoral  - dorsalis pedis
    - popliteal  - radial
    - post. Tibial  - brachial
  - lymph nodes  - epitrochlear
    - femoral (horizontal & vertical)
  - temperature (feet and legs)

• Manual compression test
• Retrograde filling (Tredelenburg) test
• Arterial insufficiency test

10. Musculoskeletal:
    (i) ROM
    • hip

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  L |  R

• knee
• ankle

(ii) leg length

• Co-ordination
  - point to point
  - dysdiachokinesia

9. TMJ
• Inspection
  - ROM
  - deviation
• Palpation
  - crepitus
  - tenderness
10. Thorax
   • Inspection
     - skin
     - shape
     - respiratory distress
     - rhythm (respiratory)
     - depth (respiratory)
     - effort (respiratory)
     - intercostals/supraclavicular retraction
   • Palpation
     - tenderness
     - masses
     - respiratory expansion
     - tactile fremitus
   • Percussion
     - lungs (posterior)
     - diaphragmatic excursion
     - kidney punch
   • Auscultation
     (i) breath sounds
     - vesicular
     - bronchial
     (ii) adventitious sounds
     - crackles (rales)
     - wheezes (rhonchi)
     - rubs
     (iii) voice sounds
     - broncophony
     - whispered pectoriloquy
     - egophony
   • Cardiovascular
     - auscultation (aortic murmurs)
     - Allen’s test

SUPINE EXAMINATION

1. JVP
2. PMI
3. Auscultation heart
   (L. lat. Recumbent)
4. respiratory excursion
5. percussion chest
   (anterior)
6. breast palpation
7. Abdominal Examination
   • Inspection
     - skin
     - umbilicus
     - contour
     - peristalsis
     - pulsations
     - hernias (umbilical/incisional)
- Auscultation
  - bowel sound
  - bruit

- Percussion
  - general
  - liver
  - spleen

- Palpation
  - superficial reflexes
  - cough
  - light
  - rebound tenderness
  - deep
  - liver
  - spleen
  - kidneys
  - aorta
  - intra-/retro-abdominal wall mass
  - shifting dullness
  - fluid wave

- Acute abdomen
  - where pain began and now
  - cough
  - tenderness
  - guarding/rigidity
  - rebound tenderness
  - roving’s sign
  - psoas sign
  - obturator sign
  - cutaneous hyperaesthesia
  - rectal exam
  - Murphy’s sign

MENTAL STATUS

(i) Appearance and behaviour
  - level of consciousness
  - posture and motor behaviour
  - dress, grooming, personal hygiene
  - facial expression
  - affect

(ii) Speed and language
  - quantity
  - rate
  - volume
  - fluency
  - aphasia (pm)

(iii) Mood

(v) Memory and attention
  - orientation (time, place, person)
  - remote memory
- recent memory
- new learning ability

(vi) Higher cognitive functions
- information and vocabulary
- (general and specialised knowledge)
- abstract thinking

### NEUROLOGICAL EXAMINATION (LUMBAR SPINE)

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Appendix H: Cervical Spine Regional Examination

RESEARCH

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

REGIONAL EXAMINATION CERVICAL SPINE

Date: ____________________________

Patient: ____________________________ File No: ____________________________

Clinician: ____________________________ Signature: ____________________________

Student: ____________________________ Signature: ____________________________

OBSERVATION

- Posture
- Size
- Swellings
- Scars
- Discolouration
- Hairline
- Bony and soft tissue contours
- Shoulder level
- Muscle spasm
- Facial expression

5. RANGE OF MOTION

- Flexion = 45° - 90°
- Extension = 55° - 70°
- L/R Rotation = 70° - 90°
- L/R Lat Flexion = 20° - 45°
ORTHOPAEDIC EXAMINATION

1. Doorbell Sign
2. Max. Cervical Compression
3. Spurling’s manoeuvre
4. Lateral Compression (Jackson’s test)
5. Kemp’s Test
6. Cervical Distraction
7. Shoulder abduction Test

PALPATION

- Lymph nodes
- Trachea
- Thyroid gland
- Pulses/thrills
- Tenderness
- Muscle Tone
- Active MF Trigger Points
  - SCM
  - Trapezius
  - Scoleni
  - Levator Scapulae
  - Posterior Cervical musculature

\( l \) = Pain free limitation
\( ll \) = Painful limitation
8. Shoulder depression Test
9. Dizziness rotation Test
10. Lhermitte’s Sign
11. O’ Donoghue Manoeuvre
12. Brachial Plexus Tension
13. Carpal tunnel syndrome:
   ▪ Tinel’s sign
   ▪ Phalen’s Test
14. TOS:
   ▪ Halstead’s test
   ▪ Adson’s test
   ▪ Eden’s (traction) test
   ▪ Hyperabduction (Wright’s) test – Pec minor
   ▪ Costoclavicular test

Remarks:
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

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| **Visit No:** |
| **Student:** |
| **Clinician:** |

**S:**

**O:**

**A:**

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Comments:
Appendix J: Questionnaire

NECK PAIN AND DISABILITY QUESTIONNAIRE (Vernon-Mior)

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

**SECTION 1 – PAIN INTENSITY**
- I have no pain at the moment.
- The pain is very mild at the moment.
- The pain is moderate at the moment.
- The pain is fairly severe at the moment.
- The pain is very severe at the moment.
- The pain is the worst imaginable at the moment.

**SECTION 2 – PERSONAL CARE**
- I can look after myself normally without causing pain.
- I can look after myself normally but it causes extra pain.
- It is painful to look after myself and I am slow and careful.
- I need some help but manage most of my personal care.
- I need help every day in most aspects of self care.
- I do not get dressed, I wash with difficulty, and I stay in bed.

**SECTION 3 – LIFTING**
- I can lift heavy weights without extra pain.
- I can lift heavy weights but it causes extra pain.
- Pain prevents me from lifting heavy weights off the floor, but I manage if they are conveniently positioned (e.g. on a table).
- Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned.
- I can only lift very light weights at the moment.
- I cannot lift or carry anything at all.

**SECTION 4 – READING**
- I can read as much as I want with no neck pain.
- I can read as much as I want with slight neck pain.
- I can read as much as I want with moderate neck pain.
- I can’t read as much as I want because of moderate neck pain.
- I can hardly read at all because of severe neck pain.
- I cannot read at all.

**SECTION 5 – HEADACHES**
- I have no headaches at all.
- I have slight headaches that come infrequently.
- I have moderate headaches that come infrequently.
- I have moderate headaches that come frequently.
- I have severe headaches that come frequently.
- I have headaches almost all of the time.

**SECTION 6 – CONCENTRATION**
- I can concentrate fully when I want with no difficulty.
- I can concentrate fully when I want with slight difficulty.
- I have a fair degree of difficulty concentrating when I want.
- I have a great deal of difficulty concentrating when I want.
- I cannot concentrate at all.

**SECTION 7 – WORK**
- I can do as much work as I want.
- I can do my usual work but no more.
- I can do most of my usual work but no more.
- I cannot do my usual work.
- I can hardly do any work at all.
- I cannot do any work at all.

**SECTION 8 – DRIVING**
- I can drive my car without any neck pain.
- I can drive my car as long as I want with slight pain in my neck.
- I can drive my car as long as I want with moderate pain in my neck.
- I can’t drive my car as long as I want because of moderate pain in my neck.
- I can hardly drive at all because of severe pain in my neck.
- I can’t drive my car at all.

**SECTION 9 – SLEEPING**
- I have no trouble sleeping.
- My sleep is slightly disturbed (less than 1 hour sleepless).
- My sleep is mildly disturbed (1-2 hours sleepless).
- My sleep is moderately disturbed (2-3 hours sleepless).
- My sleep is greatly disturbed (3-5 hours sleepless).
- My sleep is completely disturbed (5-7 hours sleepless).

**SECTION 10 – RECREATION**
- I am able to enjoy all my recreation activities with no neck pain.
- I am able to enjoy in all my recreation activities with some neck pain.
- I am able to engage in most but not all of my usual recreation activities because of neck pain.
- I am able to engage in a few of my usual recreation activities because of neck pain.
- I hardly do any recreation activities because of neck pain.
- I cannot do recreation activities at all.
# Appendix K: Score sheet

## Algometer Readings

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## Craniovertebral Angle

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<th>Initial Consultation</th>
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## Questionnaire Score

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