THE RELATIVE EFFECTIVENESS OF CERVICAL SPINE MANIPULATION ALONE, DRY NEEDLING ALONE AND CERVICAL SPINE MANIPULATION COMBINED WITH DRY NEEDLING FOR THE TREATMENT OF EPISODIC TENSION–TYPE HEADACHES.

A dissertation submitted to the Faculty of Health at the Durban University of Technology in partial compliance with the requirements for the Master's Degree in Technology: Chiropractic.

By

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I, Leslie John Watts Trollope, do hereby declare this dissertation to be a representation of my own work, both in concept and execution.

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DEDICATION

To my mom, dad and brother and the rest of my family as well as my friends that believed that I could make my dream come true.

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Firstly and most importantly, to my Lord and Saviour for giving me the strength, perseverance, belief and the ability to make such a dream come true. You were always there when I needed you most, thank you.

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ABSTRACT

Background:

Episodic Tension–type headache (ETTH), which has a high prevalence, is the most common headache. Manual therapeutic approaches towards Episodic Tension-Type Headaches (ETTHs) have not been fully explored. However, cervical spine manipulation (CSM) and dry needling are found to be successful modalities for the treatment of tension-type headache (TTH). Therefore, this study aims to determine the effectiveness of CSM alone, dry needling alone and CSM combined with dry needling in the treatment of ETTHs.

Objectives

The objectives of this study include: determining the effectiveness of CSM alone, dry needling alone and CSM combined with dry needling in terms of objective and subjective data for the treatment of ETTHs.

Method

Forty five participants suffering from ETTHs, between the ages of eighteen and fifty, were recruited through convenience sampling and were randomly allocated to one of three equal groups (15 per group). The three different groups were: (A); CSM alone, (B); dry needling alone and (C); CSM in addition to dry needling. The study took place over a period of four weeks involving six consultations. Each participant received a headache diary for the duration of the study. At the first consultation the participant received the headache diary and was monitored for one week before the treatments commenced. Thereafter, four treatments were administered over the next two weeks, depending on group allocation. Participants were also monitored with the headache diary for one week after the last treatment. The objective data for each participant consisted of cervical range of motion (CROM) and pressure–pain threshold readings, measured using a CROM goniometer and an algometer respectively. The subjective data for each participant was collected using a headache diary and a headache questionnaire/disability index. SAS version 9.1.3 was used to analyse the data. A p value of <0.05 was considered as statistically significant.

Results

A decrease in headache duration, frequency, intensity and severity and increases in CROM and algometer measurements were observed in all groups. However, no statistically significant differences were found between the three groups in terms of objective and subjective measurements although, a statistically significant improvement from consultation five to six was found in Group C in terms of headache disability.

Conclusion

CSM and dry needling, used in isolation or in combination are effective in the treatment of ETTHs although Group C did show superiority over the other groups in the long term with respect to the disability index.

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DEFINITIONS

Active Myofascial Trigger Point

A myofascial trigger point (MFTP) that weakens and inhibits a muscle from lengthening to a maximum length, causes pain, is continuously tender and, when sufficiently stimulated, causes a local twitch response of the muscle, is painful on pressure application and if pressure is applied within the individual's tolerance of pain, it can produce motor and autonomic phenomena (Travell, Simons and Simons 1999).

Adjustment

A specific type of articular manipulation that is direct, using long or short lever techniques with specific contacts that are characterized by a dynamic thrust that is controlled in direction, speed and amplitude (Gatterman 1990). More specifically, a spinal adjustment is a chiropractic manual procedure using a specific force, speed, leverage and amplitude to move a vertebral body (Stedmans, 2005).

Chiropractic

A health profession that highlights the ability of the body to heal itself in the absence of medical drugs and surgery, focusing on the function and structure within the body and how health maintenance and re-establishment is affected by this relationship (Redwood and Cleveland, 2003; Stedmans, 2005).

Dry needling

Also known as intramuscular stimulation; is an invasive procedure that involves the insertion of an acupuncture needle into the skin and muscle, more specifically into myofascial trigger points (MFTPs) to stimulate MFTPs and treat movement function deficits and neuromuscular pain (Dommerholt, Mayoral del Moral and Grobli, 2006).

Episodic tension-type headache

"A bilateral, squeezing, mild to moderate headache that lasts from 30 minutes to seven days, has no nausea and is associated with occasional photophobia and phonophobia" (International Headache Society, 2004).

Fixation

"A state where an articulation is immobilized provisionally in a position where it would normally occupy during physiological movement of the spine" (Gatterman, 1990).

Headache

"Pain that is not limited to a nerve distribution, affecting a variety of areas of the head" (Stedmans, 2005).

Local twitch response

"A contraction of a group of muscle fibers that pass through a MFTP due to stimulation of that trigger point or a trigger point within the area such as by manual palpation or needle therapies" (Travell *et al.*, 1999 and Dommerholt, 2004).

Manipulation

"A passive, specific manual force applied to the extravertebral and vertebral articulations with the aim of restoring restricted movements" (Gatterman, 1990). "It uses a passive technique where the joint it taken further than the restricted range of motion, beyond the elastic barrier without going beyond the barriers of anatomical integrity" (Redwood and Cleveland, 2003).

Myofascial trigger point

"A region in a skeletal muscle that has an increased sensitive and irritable lump felt on palpation within a tight muscular band. This region is painful when compressed and can cause referred tenderness and pain, autonomic phenomena and motor disturbances" (Haldeman, 1992; Travell *et al.,* 1999; Chaitow and Delany, 2002 and Fernández-de-las-Peñas, Campo, Carnero, and Page, 2005).

Prevalence

"The number of cases of an illness presented in a given population at a specific point in time" (Stedmans, 2005).

Subluxation

“A motion segment that has altered physiological function, movement and alignment although contact between the two joint surfaces remains intact” (Gatterman, 2005).

Tension-Type Headache

“The most common primary headache (Redwood and Cleveland, 2003:652), defined as a bilateral, mild to moderate headache described as squeezing, tightening, pressure type of pain, lasting from 30 minutes to seven days and not associated with nausea and vomiting but may be associated with photophobia or phonophobia” (Redwood and Cleveland, 2003).

A headache (ETTH and chronic TTH) resulting from anxiety or nervous tension and associated with contraction of the muscles of the scalp (Stedmans, 2005).

LIST OF ABBREVIATIONS

ETTH/s - Episodic Tension-Type Headache/s

CROM - Cervical Range of Motion

CSM - Cervical Spine Manipulation

MFTP/s - Myofascial Trigger Point/s

ROM - Range of Motion

TTH/s - Tension-Type Headache/s

CHAPTER ONE

1.1 Introduction

Headaches, regularly managed by the medical fraternity, commonly affects the adult population (Fernández-de-las-Peñas, Cuadrado, and Pareja, 2007a) with 78% of the universal population being affected (Jensen, 2003a). According to Slettbakk, Vaksdal Nilsen and Malterud (2006), a headache is commonly perceived as a nuisance, with tension-type headache (TTH) described as a distress that most of society encounter. Karakurum, Karaalin and Coskun (2001), Penter (1994) and Lenaerts (2004) have proposed dry needling and cervical spine manipulation (CSM) respectively to be common treatment modalities used for treating episodic tension-type headaches (ETTHs).

TTH, the most common primary headache (Redwood and Cleveland, 2003; Lyngberg, Rasmussen, Jorgensen and Jensen, 2005), is defined as a headache that is associated with contraction of the muscles of the scalp as a result of anxiety or nervous tension (Stedmans, 2005) and can be classified as either episodic or chronic (International Headache Society, 2004). Schwartz, Stewart and Simons, (1998) and Fernández-de-las-Peñas *et al.* (2007a) observed the prevalence of episodic tension-type headache (ETTH) to be 38%, which is more prevalent than its chronic form (2.2%), having a greater societal impact and numerous episodes of attack, with women more commonly affected than men (Schwartz *et al*., 1998; White, Resch, Chan, Norris, Modi, Patel and Ernst, 2000). ETTH is also thought to be caused by structural or functional defects in the musculoskeletal components of the neck and skull (Steiner, Lange and Voelker, 2003).

The pericranial muscles are commonly involved in ETTH (Ashina, Bendtson, Jensen, Sakai and Olesen, 1999) and may develop tender spots (Fernández-de-las-Peñas, Cuadrado, Arendt-Nielsen, Simons and Pareja, 2007b). These spots, commonly known as myofascial trigger points (MFTPs), are regions within a tight skeletal muscle band that have increased irritability and are related to increased sensitivity on palpation (Travell *et al.,* 1999; Chaitow and Delany, 2002). They are divided into two types, namely active and latent (Davidoff, 1998; Huguenin, 2004). Active MFTPs, which have a high prevalence and are a main cause of pain and dysfunction

in the musculoskeletal system, are common in the neck, upper Trapezius, shoulder, Levator Scapulae and Sternocleidomastoid muscles (Travell *et al.,* 1999) and have been implicated in causing TTH (Han and Harrison, 1997). ETTH sufferers commonly have active MFTPs in the upper Trapezius muscle (Fernández-de-las-Peñas *et al.,* 2007a). There are several treatment methods for treating MFTPs (Travell *et al.,* 1999), however dry needling has been advocated by Dommerholt (2004) and is a commonly used modality. Karakurum *et al.* (2001) and Huguenin (2004) have noted dry needling to be successful, providing long lasting relief of ETTH and muscular pain and tension respectively.

Furthermore, Graff-Radford and Newman (2002) have indicated that the joints of the cervical spine may be responsible for ETTH. It is believed that muscle spasms develop secondary to joint fixations arising from mechanical or chemical stimuli resulting in an ETTH (Gatterman, 1990). Cervical spine manipulation (CSM) has been stated to be a successful treatment modality for TTH (Gardner and Mosby, 2000; Lenaerts, 2004), with it decreasing pain intensity, duration and frequency of TTH (Penter, 1994). Curl (1994) and Green (1997) observed that CSM resulted in an increase in the cervical range of motion (ROM) of the involved segment and a reduction in pain and muscle spasm, as the spasm is reflexly relieved by facet mechanoreceptor stimulation.

Several studies have tested combination therapies such as CSM combined with soft tissue massage (Bove and Nilsson, 1998; de Busser, 2001) and CSM combined with interferential current (Prithipal, 2003) in the treatment of ETTH, showing that the combined treatments did not have a positive outcome in the treatment of ETTH. However, the therapies used in conjunction with CSM did not directly treat the MFTPs and results may have been different if the MFTPs were treated directly e.g. using a therapy such as dry needling.

Therefore, this study will assess the effectiveness of CSM combined with dry needling in the treatment of ETTH.

1.1 Aim of the study

The aim of this study is to compare the relative effectiveness of CSM alone, dry needling alone and CSM combined with dry needling in the treatment of ETTHs.

1.2 Objectives of the study

Objective One

To determine the effectiveness of CSM in terms of objective (algometer and CROM goniometer) and subjective (headache diary and headache questionnaire/disability index) data for the treatment of ETTHs.

Objective Two

To determine the effectiveness of dry needling in terms of objective (algometer and CROM goniometer) and subjective (headache diary and headache questionnaire/disability index) data for the treatment of ETTHs.

Objective Three

To determine the effectiveness of CSM combined with dry needling in terms objective (algometer and CROM goniometer) and subjective (headache diary and headache questionnaire/disability index) data for the treatment of ETTHs.

Objective Four

To compare the groups in terms of objective and subjective data.

1.3 Null Hypothesis

1.3.1 Null Hypothesis One

It was hypothesized that the group receiving CSM will show no improvement in terms of objective (algometer and CROM goniometer) and subjective (headache diary and headache questionnaire/disability index) data in the treatment of ETTHs.

1.3.2 Null Hypothesis Two

It was hypothesized that the group receiving dry needling will show no improvement in terms of objective (algometer and CROM goniometer) and subjective (headache diary and headache questionnaire/disability index) data in the treatment of ETTHs.

1.3.3 Null Hypothesis Three

It was hypothesized that the group receiving CSM combined with dry needling will show no improvement in terms of objective (algometer and CROM goniometer) and subjective (headache diary and headache questionnaire) data in the treatment of ETTHs.

1.3.4 Null Hypothesis Four

It was hypothesized that the combination treatment group in the form of CSM and dry needling would not be superior in terms of objective and subjective measurements in the relief of ETTHs as compared to either CSM or dry needling alone.

1.4 Rationale

ETTH is a common complaint (Nilsson, 1997) and can be treated by various different methods such as medicines and manual therapies. However, for those people choosing a drug free approach, this study aims to determine the effectiveness of a conservative/drug free management programme in the treatment of ETTHs.

Evidence supporting manual therapy treatment protocols for ETTH have not been fully investigated (Fernández-de-las-Peñas, Alonso-Blanco, Cuadrado, Miangolarra, Barriga, and Pareja, 2006), and therefore this study aims to add to the literature by comparing three treatment techniques.

According to Karakurum *et al.* (2001) and Mense, Simons, and Russell (2001), MFTPs are involved in TTH. MFTPs are treated in various different ways, an effective technique being dry needling (Karakurum *et al*., 2001; Huguenin, 2004). However, there is a paucity of literature investigating dry needling treatment for ETTHs.

According to Penter (1994) and Kidson (2001), CSM provides relief for ETTH symptoms. However, no studies have demonstrated the effects of CSM combined with dry needling in the treatment of ETTHs.

1.5 Conclusion

TTH is a common disorder affecting the adult population (Fernández-de-las-Peñas *et al.,* 2007a) and is thought to be caused by structural or functional defects in the muscles and joints of the neck and skull (Steiner *et al.,* 2003). Manual therapeutic approaches towards ETTH have not been fully explored (Fernández-de-las-Peñas *et al.,* 2006). However, dry needling (Karakurum *et al.,* 2001) and CSM (Gardner and Mosby, 2000; Lenaerts, 2004) are reported to be successful modalities for the management of TTH. Therefore, this study aims to determine the effectiveness of these two modalities used as a combined treatment.

Chapter Two involves a review of the literature of TTH, the anatomy of the cervical spine and muscles involved in TTH and the treatments investigated in this study. Chapter Three describes the methodology of the study, Chapter Four will present the results, Chapter Five will be a discussion of the results and Chapter Six will be the study conclusion and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

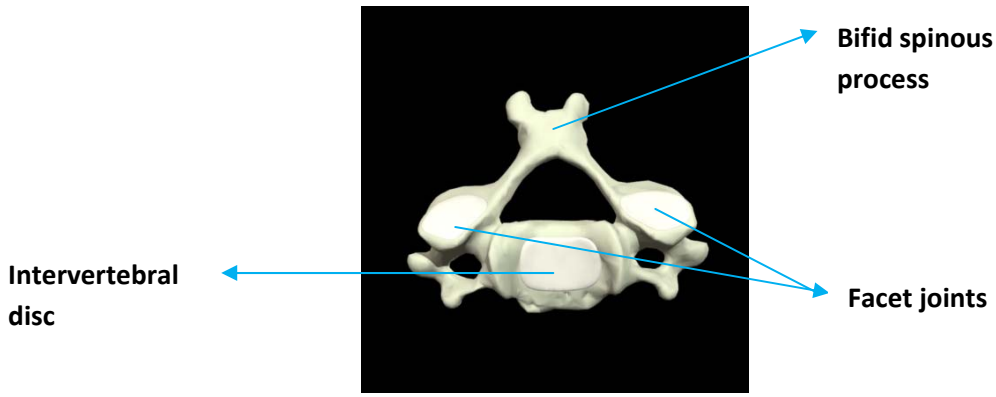
This chapter will present the current literature on tension–type headaches (TTHs) and the treatments utilized in this study. It will describe the anatomy of the cervical spine and the muscles associated with TTHs.

2.2 Tension-Type Headaches

TTHs are associated with pericranial muscle contractions, resulting from anxiety or stress (Stedmans, 2005) or a response to an external event, such as direct trauma (Gardner and Mosby, 2000), and cervical spine joint fixations (Gatterman, 1990).

2.3 Anatomy – Cervical Spine and its Structures

Typical cervical vertebral body



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According to Moore and Dalley (1999), the skeleton of the neck, found between the skull and the thorax is made up of seven small vertebral bodies, which are the smallest movable vertebra of the spine. These authors point out that the cervical spine vertebrae are divided into atypical (C1+C2) and typical (C3–C7) with the spinous processes of C3–C6 being short and bifid and C7 spinous process being characteristically long. The various parts of the cervical spine vertebrae are discussed below:

2.3.1 Intervertebral Discs

The intervertebral disc serves as an articulation between adjacent vertebral bodies, unites them and allows an entire range of movement at that motion segment. When pressure is removed, the centrally placed viscid gelatinous nucleus pulposus of the disc allows the disc to assume its normal position (Gatterman, 1990).

The discs, which provide flexibility (Chaitow and Delany, 2002) and curvatures to the vertebral column (Moore and Dalley, 1999), have shock absorbing capabilities (Moore and Dalley, 1999; Chaitow and Delany, 2002), form strong attachment sites between adjacent vertebral bodies and provide strength and weight bearing ability (Moore and Dalley, 1999).

2.3.2 Zygapophyseal Joints

The zygapophyseal joints, also known as facet joints are true diarthrodial joints of the vertebral arches that contain articular cartilage, supporting ligaments, a synovial lined lax capsule and muscles (Gatterman, 1990; Moore and Dalley, 1999). They allow gliding movements between adjacent vertebral bodies and in the cervical spine they also bear weight together with the intervertebral discs (Moore and Dalley, 1999).

2.3.3 Uncovertebral Joints/Joints of Luschka

These joints are found at the posterolateral and lateral borders of the intervertebral discs, between the uncinate processes of C3-C6 vertebral bodies and the vertebral bodies above them. Some literature states that these joints are synovial joints while other literature states that they are degenerative spaces in the discs filled with extracellular fluid. Spur formations from these joints may cause neck pain (Travell *et al.,* 1999).

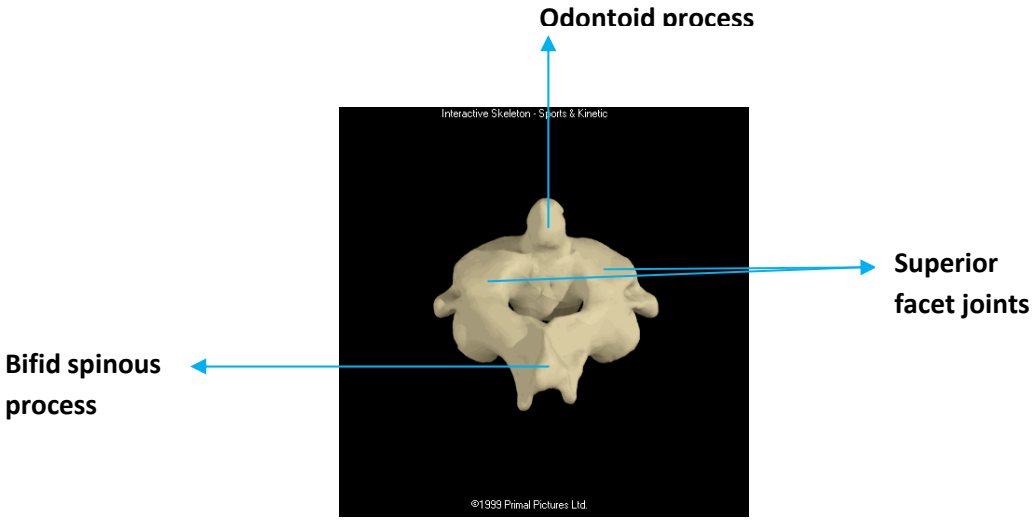
2.3.4 Craniovertebral Joints

There are two craniovertebral joints, firstly the atlanto-occipital joint between C1 (atlas) and the occipit and secondly, the atlanto-axial joint between the C1 and C2 (axis) (Moore and Dalley, 1999).

The kidney shaped atlas, C1, is the widest cervical vertebrae and its concave superior articular facet joints receive the occipital condyles of the skull. The axis, C2, is the strongest cervical vertebrae as it supports the weight of the skull. The axis has an odontoid process, and is held in place by the transverse ligament thus preventing horizontal displacement of the atlas (Moore and Dalley, 1999).

The atlanto-occipital joints allow neck flexion, extension and sideway leaning of the head. The main movement is flexion with some rotation and lateral bending (Moore and Dalley, 1999).

The atlantoaxial joints consist of one medial and two lateral joints. The medial pivot joint, refers to the odontoid process of C2 and the anterior arch of C1. The lateral gliding-type synovial joints refer to the joints between the inferior facet joints of C1 and the superior facet joints of C2. Rotation at all three joints is the main movement with excessive rotation being prohibited by the alar ligaments (Moore and Dalley, 1999).



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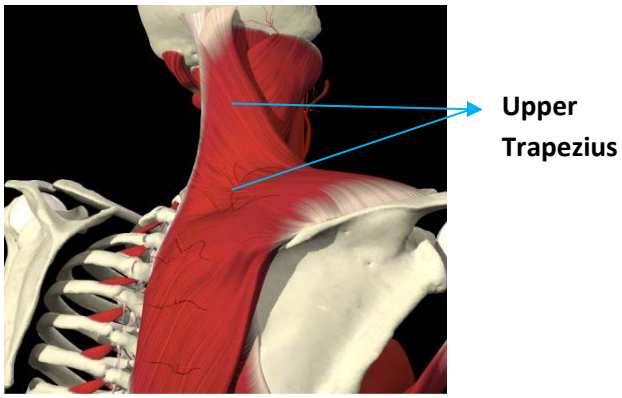
2.4 Anatomy – The Muscles

The upper Trapezius and Posterior Cervical muscles are pericranial muscles containing myofascial trigger points (MFTPs) most commonly found in tension-type headache (TTH) sufferers (Travell *et al.,* 1999).



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2.4.1 Upper Trapezius

Superiorly, the upper Trapezius muscle, which receives its innervations from the accessory nerve, originates from the middle third of the superior nuchal line and in the midline from the nuchal ligament. The fibers pass down laterally and insert on the lateral third of the clavicle (Travell *et al.,* 1999; Chaitow and Delany, 2002).

2.4.2 Posterior Cervical region

The Posterior Cervical musculature consists of the Semispinalis Capitis, Longissimus Capitis, Semispinalis Cervicis, Multifidi and Rotators (Travell *et al.,* 1999; Chaitow and Delany, 2002).

The Semispinalis Capitis attaches above in between the superior and inferior nuchal lines at the occiput and below to the articular processes of the C4-C6 tranverse processes. The Longissimus Capitis attaches above to the skull, alongside the posterior margin of the mastoid process and below to the articular processes of the inferior three or four cervical vertebral bodies (Travell *et al.,* 1999). The Semispinalis Cervicis attaches above to the second to fifth spinous processes and below to the first to fifth transverse processes (Travell *et al.,* 1999; Chaitow and Delany, 2002).

The Multifidi attach above to the C2 spinous process and below to the C4-C7 articular processes and the rotatores begin at C2 and pass inferiorly attaching to vertebrae of the same or every second level (Travell *et al.,* 1999).

Semispinalis Capitis receives its innervation from the first four or five cervical spinal nerves. The Semispinalis Cervicis is supplied by the 3rd to 6th cervical spinal nerves and the deep Posterior Cervical muscles together with the Longissimus Capitis is innervated by branches of the posterior primary divisions of the cervical spinal nerves (Travell *et al.,* 1999).

2.5 Classification and Definition of Tension-Type Headaches

The two main classifications of TTH are either episodic or chronic (International Headache Society, 2004). Episodic tension-type headaches (ETTHs) are characterized as pressing/bilateral headaches (White *et al.,* 2000) and defined by the International Headache Society (2004) as occurring from one to 15 days per month for a minimum of three months, with each episode lasting from 30 minutes to seven days. ETTHs are further sub-divided into frequent and infrequent types (International Headache Society, 2004; Buchgreitz, Lyngberg, Bendtsen and Jensen, 2006), with the frequent type causing significant disability and the infrequent type having minimal effects on individuals (International Headache Society, 2004). Schmidt-Hansen, Svensson, Bendtsen, Graven-Nielsen and Bach (2007) define chronic TTH as headaches occurring more than 15 days a month.

2.6 Prevalence

More than a third of the adult population suffers from TTH (Redwood and Cleveland, 2003) with the one year prevalence of episodic tension-type headache (ETTH) being 38% (Schwartz *et al*., 1998; White *et al.,* 2000; Fernández-de-las-Peñas *et al.* (2007a). There is a higher prevalence of ETTH in women than in men (Schwartz *et al*., 1998; Gardner and Mosby, 2000; White *et al.,* 2000; Jensen, 2003a) of all ethnic groups, ages and levels of education (Schwartz *et al*., 1998). The age of onset of TTH is variable (Jamison, 1991), with there being a peak in ETTH in the fourth decade (30-39 years) (White *et al*., 2000). According to Jensen (2003a), the onset most commonly occurs between 25 and 30 years of age.

According to the International Headache Society (2004), ETTHs cause significant disability. White *et al.* (2000) found that 8% of individuals suffering from ETTHs took a leave of absence from work due to their headaches with an average of nine days leave annually, with a total of 44% of individuals stating that their work ability was reduced by five days annually. Schwartz *et al*. (1998) found that 8.3% of individuals with ETTH reported lost days at work with 43,6% of sufferers having reduced efficiency of their work ability. According to Nestoriuc, Martin, Retief and Andrasik (2008), individuals suffering from a headache encounter deteriorating conditions at home and work.

A large percentage of ETTH sufferers experience adverse effects on family relationships (89%), friends (70%) with 80% reporting ETTH to affect exercise (Redwood and Cleveland, 2003).

2.7 Associated Signs and Symptoms

A common sign found in individuals suffering from ETTH is tenderness of the pericranial muscles (Mork, Ashina, Bendtsen, Olesen and Jensen, 2004). Pericranial tenderness is noted on days when individuals experience the headache as well as on headache-free days (Buchgreitz *et al.,* 2006). According to Ashina *et al.* (1999), the more painful the pericranial muscles are, the higher the frequency and intensity of the headache. This is supported by Anttila, Metsahonkala, Mikkelsson, Aromaa, Kautiainen, Salminen, Viander, Jappila and Sillanpaa (2002); Jensen (2003b); Mork *et al.* (2004) and Buchgreitz *et al.* (2006).

Other common symptoms include a variety of psychological problems, anxiety, irritability and difficulty concentrating which can further affect the home and work environment (Gardner and Mosby, 2000). Muscles commonly involved include the upper Trapezius, Posterior Cervical, Suboccipital and Sternocleidomastoid muscles (Travell *et al.,* 1999).

2.8 Diagnosis

The diagnosis of TTH can be difficult due to its varied presentation (Jensen, 2003a). According to Jensen and Stovener (2008), ETTH have a high accuracy of diagnosis only if the criteria as specified by the International Classification of Headache disorders (2004) are followed:

- Occurring from one to 15 headache days per month for a minimum three months
- Lasting from 30 minutes to seven days per episode
- Without nausea or vomiting
- With a minimum of two of the follow characteristics:

1. bilateral location
2. tightening quality
3. mild or moderate in intensity
4. not made worse by activities of daily living such as walking or climbing stairs

However, Boon, Colledge and Walker (2006) state that ETTHs may continue for weeks to months at a time with Gatterman (1990) and Steiner *et al.* (2003) stating that ETTHs last at most a couple of hours often with low frequency of attacks. Jensen (2003a) states that ETTHs can differ in frequency and duration from short headaches with discomfort to long episodes that can disable a patient.

Boon *et al.* (2006) describes the pain associated with TTH to be a pressing, tight, band-like sensation surrounding the head or at the top of the head, being widespread over the head with it starting in the occipital area and moving forward towards the frontal area. Similar descriptions have been used by Gatterman (1990), Jamison (1991), Gardner and Mosby (2000), Karakurum *et al.* (2001), Graff-Radford and Newman (2002), Beers, Fletcher, Jones, Porter, Berkwits and Kaplan (2003) and Steiner *et al.* (2003).

The severity of ETTH often ranges from mild to moderate (Gardner and Mosby, 2000:163; White *et al.,* 2000) with an average pain intensity of 4,98 on a 10 point scale (Schwartz *et al.,* 1998) and occurring in episodes that are short and inconsistent in duration (Jensen, 2003a). The pain is described as heavy and tense (Gardner and Mosby, 2000), dull and non-throbbing and is associated with muscle stiffness (Gatterman, 1990), with 66% of ETTH sufferers having muscle disorder (Anttila *et al.,* 2002). Redwood and Cleveland (2003) state that moderate or extremely painful headaches are reported by at least 50% of TTH sufferers.

Furthermore, the pain associated with TTH is not serious early in the day but becomes severe and intense as the day progresses (Jamison, 1991; Boon *et al.,* 2006). Beers *et al.* (2003) state that TTHs can begin a few hours after awaking but does not often wake the person from sleep.

TTHs are perpetuated by stress and relieved by relaxation (Travell *et al.,* 1999), with no aggravation by lights, sounds, smells and exercise (Beers *et al.,* 2003). Gatterman (1990) states TTHs to be perpetuated by stress, depression and

emotional conflict and relieved with sleep or rest. Jamison (1991) reports common aggravating factors to be anxiety, stress, cold draft and a common relieving factor to be alcohol consumption. The symptoms continue if the patient is anxious about the headache leading to a belief of a severe underlying sickness (Boon *et al.,* 2006), with these patients commonly being depressed and anxious (Jamison, 1991).

According to Fernández-de-las-Peñas *et al.* (2006), TTH has a negative effect on social behaviour. Jensen (2003a) indicates TTH to have the highest impact socioeconomically compared to other headaches where migraine sufferers reported more absenteeism. According to Mork *et al.* (2004) and Nestoriuc *et al.* (2008), TTHs (episodic and chronic) commonly affect the economically active class of people resulting in significant social and economic costs.

2.9 Aetiology of Tension-Type Headaches

The pathogenesis of TTH is not fully understood (Steiner *et al.,* 2003; International Headache Society, 2004; Fernández-de-las-Peñas *et al.,* 2006a; Ashina, Stallknecht, Bendtsen, Pedersen, Schifter, Galbo and Olesen, 2003 and Fernández-de-las-Peñas, Falla, Arendt-Nielsen, and Farina, 2008). There are a variety of theories implicating its pathogenesis such as psychological stress factors (Gardner and Mosby 2000; Jensen, 2003b; Boon *et al.,* 2006; Terolli, Abrignani, Castellini, Lambru and Manzoni, 2008), continuous contraction of the pericranial and cervical muscles (Travell *et al.,* 1999; Gardner and Mosby, 2000) and structural or functional defects in the musculoskeletal components of the neck and skull (Steiner *et al.,* 2003).

2.9.1 Psychological

Psychological stresses such as anxiety and emotional factors have been found to be a major precipitating factor to TTH development (Jensen, 2003b; Boon *et al.,* 2006). Terolli *et al.* (2008) supports this by stating that risk factors for TTH development include psychological and emotional instability with mental strain, nervous tension and stress being common causes for its development.

2.9.2 Musculoskeletal Components

- **Muscles**

According to Mork *et al.* (2004), the development of TTH is largely due to myofascial factors. Referred pain from neck, shoulder and head muscles results in a TTH (Fernández-de-las-Peñas *et al.,* 2007a; Fumal and Schoenen, 2008). This referred pain occurs when the muscles are stretched or when pressure is placed on the MFTPs (Fumal and Schoenen, 2008). Jensen (2003b) states that individuals with TTH are shown to have increased tension on palpation of the shoulder and pericranial muscles. MFTPs provide an understanding to TTH symptoms (Schmidt-Hansen *et al.,* 2007), with TTH sufferers having increased pain and stiffness of the pericranial musculature (Christensen, Bendtsen, Ashina and Jensen, 2005; Fernández-de-las-Peñas *et al.,* 2007a).

Pain receptors from the pericranial MFTPs are responsible for the development of TTH (Ashina *et al.,* 1999). Contraction of the cranial and neck muscles is believed to cause TTH as a result of nerve compression and biochemical waste production that stimulates pain with referral of pain into the head (Gardner and Mosby 2000). Gatterman (1990) reports TTH to be caused by muscular injuries, spasm or inflammation to muscles of the skull. This muscle contraction, for longer than a couple of minutes, is thought to block blood vessels, causing ischemia and pain which refers to the neck, scalp and frontal areas (Jamison, 1991).

- **Joints**

In addition to the muscles being an aetiological factor, the joints can also cause the pain in a TTH (Graff-Radford and Newman, 2002). Gardner and Mosby (2000) state that the cervical spine is implicated as a cause for TTH development. According to Gatterman (1990), mechanical or chemical stimuli resulting from the joint pain may irritate the pain receptors within the facet joints resulting in muscle spasms which may develop secondary to joint fixations resulting in TTH. Gatterman (1990) further stated that muscle spasms respond positively to cervical spinal manipulation (CSM) of the joint fixation. According to Graff-Radford and Newman (2002) the occipital part of the head and the neck passing inferiorly, receives its innervations from the second to seventh cervical spinal nerves. The union of the trigeminal nucleus and the first to

third spinal nerves in the upper cervical spine in the presence of a cervical joint fixation, results in a TTH (Graff-Radford and Newman, 2002).

Penter (1994) reported that 90% of TTH sufferers had cervical spine fixations, mostly at C2 – C3 vertebral levels. Jansen (1998), who found no statistically significant difference between two groups, found cervical spine fixations in TTH sufferers with 93.9% of the experiment group and 94.1% of the control having cervical spine fixations. According to Muller (1999), 97.5% of TTH sufferers had at least one cervical spine fixation.

2.10 Differential Diagnosis

TTH differential diagnosis as specified by Jensen (2003a) includes:

- Post-traumatic headache
- Brain tumour
- Hypertension
- Stroke
- Migraine
- Cluster headache
- Temporal arthritis
- Headache overuse of medication
- Headache from alcohol
- Glaucoma
- Depression
- Hypoglycemia

2.11 Common Treatments for TTH

TTH treatment varies between medical and non-medical practices with 34% of sufferers using non-medical approaches and 5-8% seeking help specifically from chiropractors and physiotherapists (Redwood and Cleveland, 2003). A wide variety of treatments are available that claim to prevent and terminate a TTH including medicines (painkillers, anti-depressants, muscle relaxants and non-steroidal anti-

inflammatory medications), physiotherapy, MFTP therapy, massage therapy, acupuncture, ice, spinal manipulation, relaxation procedures as well as changes in lifestyle (Gatterman, 1990; Gardner and Mosby 2000). The two treatment approaches used in this study target MFTPs and joint dysfunction and will be discussed below.

2.12 Myofascial trigger points (MFTPs)

2.12.1 Introduction

MFTPs are classified either as active or latent depending on their pain referral pattern (Huguenin, 2004; Rickards, 2006). Active MFTPs cause autonomic and motor dysfunctions such as decreased range of motion (ROM) and muscle stiffness with local and/or referred pain patterns (Shah and Gilliams, 2008) when palpated (Haldeman, 1992; Travell *et al.,* 1999; Chaitow and Delany, 2002 and Fernández-de-las-Peñas, Campo, Carnero and Page, 2005) and are commonly found in the upper Trapezius muscle in ETTH sufferers (Fernández-de-las-Peñas *et al.,* 2007a). A MFTP is a spot that has increased irritability, is painful on compression and is associated with a rigid band of skeletal muscle (Fernández-de-las-Peñas *et al.,* 2005). MFTPs are commonly encountered in the clinical environment and are responsible for limited functioning of daily activities (Huguenin, 2004). They may even result in severe pain that can be disabling (Davidoff, 1998).

2.12.2 Prevalence

People between the ages of 31–50 most commonly suffer from active MFTPs. This age group is similar to TTH peak age of onset (Travell *et al.,*1999) and these MFTPs are most common and increase into middle age and decrease after this due to a decrease in activity levels. MFTPs are seen in both genders however, they are more commonly found in women (Han and Harrison, 1997).

Jansen (1998) stated that TTH sufferers have the most number of active MFTPs in the Posterior Cervical muscles as opposed to the Suboccipital, Trapezius and Sternocleidomastoid. A total of 61.7% of the sufferers had active MFTPs in the

Posterior Cervicals trigger point one (TrP1), 62.7% at TrP2 and 66.6% TrP3. In a study done by Muller (1999), 97.5% of the TTH sufferers were found to have at least one MFTP in one of the four muscles examined, compared to 82% of the asymptomatic subjects. His study concluded that most of the MFTPs occurred in the Suboccipital and Posterior Cervical muscles and that TTH may be associated with these muscles.

2.12.3 Diagnosis

MFTPs that are active are accountable for symptoms such as weakness, referred pain, parasthesia, which are elicited on compression of the MFTP, as well as the pain complaint that the patient is experiencing (Huguenin, 2004). Tough, White, Cummings, Richards and Campbell, (2009) state that referred pain and tenderness are produced on compression of the MFTP.

The degree of referred pain and its intensity depends on how irritated the MFTP is (Travell *et al.,* 1999), with active MFTPs causing impulsive pain (Shah and Gilliams, 2008). Active MFTPs produce pain on compression (Travell *et al.,* 1999; Rickards, 2006), as well as disrupt motor functioning (Travell *et al.,* 1999; Shah and Gilliams, 2008). Other common MFTP symptoms include stiffness and tenderness in the muscle and muscle fatigue (Davidoff, 1998). Individuals with MFTPs often complain of a deep, dull prolonged ache in a group of muscles or in the muscle where the MFTP is located, with the intensity of the pain ranging from moderate to severe to extremely severe (Davidoff, 1998). Individuals may also have sensory problems (Travell *et al.,* 1999; Huguenin, 2004), motor and autonomic dysfunctions and difficulty in sleeping (Travell *et al.,* 1999), associated with weakness, fatigue (Han and Harrison, 1997) and decreased ROM (Rickards, 2006; Shah and Gilliams, 2008). Kaya, Kamanli, Ardicoglu, Ozgocmen, Ozkurt-Zengin and Bayik (2009) observed cervical ROM to be decreased with active MFTPs. Similarly, Davidoff (1998) and Travell *et al.* (1999) state that the muscles that harbour MFTPs have limited ROM and are inflexible.

2.12.4 Aetiology of MFTPs

MFTPs develop from disturbances in posture, disease processes, sporting or occupational injury, muscular imbalances (Huguenin, 2004) as well as overloading the muscle (Huguenin, 2004; Fernández-de-las-Peñas *et al.,* 2005; Tough *et al.*, 2009). Hans and Harrison, (1997) indicate development to be due to disturbances in sleep, vitamin deficiencies, joint disorders and lack of exercise. According to Hong (2006) and Travell *et al.* (1999), MFTPs develop as a result of joint dysfunction such as that of the facet joints. According to Ruiz-Sáez, Fernández-de-las-Peñas, Blanco, Martı´nez-Segura and Garcı´a-León (2007) dysfunctions in the cervical facet joints can result in the development of MFTPs.

Development may also be due to the muscle being placed in a shortened position, contraction whilst in this position, compression of nerves, direct trauma and fatigue and indirectly by diseases of the visceral organs, other MFTPs and arthritis (Travell *et al.,* 1999).

Psychological factors are known to contribute to the development of MFTPs (Travell *et al.,* 1999) and TTH development (Travell *et al.,* 1999). Shah and Gilliams (2008) state emotional stress to be a contributing factor to active MFTP development. The activity of MFTPs as well as TTH increases with psychological stress (Travell *et al.,* 1999). Anxiety may result in muscle tension where the muscles are in constant contraction, overloading the muscle and resulting in MFTP's development and TTH development (Travell *et al.,* 1999).

2.12.5 Common Myofascial Trigger Points in the Cervical Region

2.12.5.1 Upper Trapezius

Two MFTPs are found in the upper Trapezius muscle, namely trigger point 1 (TrP1) and 2 (TrP2). TrP1 involves the upright fibers attaching to the clavicle and is found in the midportion of the anterior Trapezius border. Pain from TrP1 may extend to the occiput and when referring together with other muscles such as the Suboccipital muscles, a TTH can develop (Travell *et al.,* 1999). TrP2 is found lateral and below TrP1 in the center of the horizontal upper Trapezius fibers (Travell *et al.,* 1999).

2.12.5.2 Posterior Cervical muscles

Three MFTPs are found in the Semispinalis Capitis muscle. TrP1 is found at the musculotendinous junction at the skull base, up to two centimeters from the midline of the neck. TrP2 is found in the upper third of the muscle, just above C1. Trigger point 3 (TrP3) is found in the middle third of the muscle lateral to C3-C4 spinous processes (Travell *et al.,* 1999).

Trigger points (TrPs) in the Longissimus Capitis are found lateral to the Trapezuis muscle and behind the Sternocleidomastoid muscle, from the C2 spinous process to where the C3-C4 spinous processes intersect. TrPs in the Semispinalis Cervicis are found up to two centimeters lateral to C4-C5 spinous processes. TrPs in the Multifidi are found between a spinous process and a lower transverse process starting at C3-C4 and moving downwards. Rotator muscle involvement is recognized by deep tenderness by palpation lateral to the spinous processes (Travell *et al.,* 1999).

2.12.6 Treatment of MFTPs

The effectiveness of treatment approaches for MFTPs is not fully recognized even though many different methods have been stated in the literature (Esenyel, Aldemir, Gursoy, Esenyel, Demir and Durmusoglu, 2007). Travell *et al.* (1999) stated that there are several methods used to relieve tension associated with MFTPs and ultimately the pain (Travell *et al.,* 1999), namely spinal manipulation (Hong, 2006), stretching (Graff-Radford and Newman, 2002; Huguenin, 2004), ultrasound, laser, transcutaneous electrical nerve stimulation, local anaesthestic (Huguenin, 2004), as well as spray and stretch (Travell *et al.,* 1999; Graff-Radford and Newman, 2002), MFTP pressure release (Travell *et al.,* 1999) and deep stroking massage (Travell *et al.,* 1999; Rickards, 2006).

Dry needling has been advocated as a treatment of choice in MFTPs (Dommerholt, 2004; Kamanli, Kaya, Ardicoglu, Ozgocmen, Ozkurt Zengin and Bayik, 2005) and appears to be an effective treatment modality (Jones, 1994; Cummings and white, 2001). According to Huguenin (2004), dry needling is more commonly used in the treatment of MFTPs and has been demonstrated as a modality offering long lasting pain relief. This is supported by White *et al.* (2000) and Hong, (2006), who observed dry needling to be effective in the treatment of MFTPs.

Hong (2006) who observed cervical spine manipulation (CSM) to be a common treatment used for treating MFTPs, stated that MFTPs and facet nociceptors are connected in the spinal cord. Therefore, CSM has a positive effect by means of a spinal cord reflex mechanism. Active MFTPs can respond positively if facet joint dysfunction is restored. Hence, this study aims to determine the effectiveness of CSM together with dry needling in the treatment of ETTH.

2.12.6.1 Dry Needling

Dry needling uses an acupuncture needle insertion into a MFTP that reproduces the patient's pain and symptoms, causes a local twitch response followed by pain relief, and relaxes the tension in the muscle (Huguenin, 2004). The local twitch response, which is painful, is a reflex contraction of the involved muscle following needling of the MFTP (Dommerholt, 2004). These local twitch responses are confirmation of MFTP localization (Chaitow and Delany, 2002), resulting in immediate pain relief (Huguenin, 2004; Hong, 2006).

Dry needling effectiveness is achieved by direct stimulation or mechanical disruption by the needle which decreases or ceases the pain (Han and Harrison, 1997). According to Shah and Gilliams (2008), dry needling disrupts the MFTP causing remodeling of the connective tissue. Dommerholt (2004) observed dry needling to cause instant pain relief in 87% of sites that were needled and stated the pain relief to be achieved by mechanically stimulating the MFTP with a dry needle which blocks painful input from the MFTP via activation of the gate control system. According to Travell *et al.* (1999) MFTP penetration using the "fanning technique" is highly effective MFTP inactivation.

Karakurum *et al*. (2001) (n = 30) conducted a placebo-controlled, randomized study, on individuals suffering from ETTH, in which the treatment group received intramuscular trigger point needle insertions and the placebo group received subcutaneous insertions. In the treatment group, the neck ROM and tenderness scores improved significantly with no significant improvement in the placebo group. However, the frequency and intensity of the headache improved within both groups but the improvement was insignificant. Similarly, a study by Galer and Kitahara (1995) (n = 19), investigating the effectiveness of intramuscular dry needling in

different types of headaches, including five participants with TTH, found four of the five participants to have improvement in headache frequency and intensity.

Hong (2006) states that treating muscle tightness can increase ROM. It is reported that after needling a MFTP, the threshold to pain increased significantly (Travell *et al.,* 1999). Kamanli *et al.* (2005) (n = 10) found the pain pressure threshold of MFTPs to improved significantly (p <0.05) following dry needling of the cervical, shoulder and upper back muscles.

However, a common drawback of dry needling is post-needle soreness, being most painful two days after treatment and relieved with the use of heat packs and stretches (Huguenin, 2004).

2.12.6.1.1 Dry Needling Contraindications

- Individuals taking anticoagulation therapy
- Individuals taking aspirin within 3 days of receiving dry needling
- Individuals who fear dry needling (Travell *et al.,* 1999).

2.13 Cervical Spine Manipulation (CSM)

CSM, which improves malignment, function and movement, is a treatment directed to a joint subluxation. This is a lesion of the facet joints that is less than a dislocation, described as two joint surfaces that are partially together in which the motion segment has a changed physiological function, movement and alignment (Gatterman, 2005).

TTH caused by a joint subluxation in the cervical spine reacts positively to CSM (Jamison, 1991). According to Redwood and Cleveland (2003), CSM with soft tissue therapy is a common treatment approach for headaches with 5 to 10% of sufferers approaching a chiropractor with a main complaint of a headache (Redwood and Cleveland, 2003). According to Gardner and Mosby (2000), TTH prevention and termination is satisfactorily achieved with chiropractic therapy. Graff-Radford and Newman (2002) stated that manual treatments for TTH are not complete until the

cervical spine has been examined for cervical joint subluxations. Lenaerts (2004) supports this by reporting CSM to be a successful intervention for TTH, decreasing duration and intensity of the headache.

CSM is commonly used as a treatment modality that resolves facet joint subluxations as well as muscle guarding (Gibbons and Tehan 2001). A study by Pikula (1999) (n = 36) on CSM in ipsilateral neck pain found an increase in cervical ROM and decrease in pain. Similarly, a study by Whittingham and Nilsson (2001) (*n* = 105), investigating the outcome of CSM on cervical ROM, concluded that CSM increased active cervical ROM significantly ($p < 0.0006$). Similar results were found by Filipkowski (2006) who in a case study on a 45 year old female suffering from headaches and neck pain found CSM to result in an increase in pain pressure threshold in the cervico–thoracic muscles. According to Astin and Ernst (2002), CSM is a treatment used for individuals suffering from a TTH. In TTH sufferers, joint subluxations commonly occur at the C0-C1 and 90% of sufferers have joint subluxations at C2-C3.

Penter (1994) (n = 30) conducted a randomised control trial on adults suffering from TTH comparing CSM to soft tissue massage of the cervical and thoracic muscles. Both groups had decreased pain intensity, duration and frequency of the headache. Kidson (2001) (n = 60) found that CSM decreases the intensity of ETTH faster than that of acetylsaclicylic acid and indicated that further research is warranted on more efficient therapeutic approaches. Bove and Nilsson (1998) (n = 75) conducted a randomized controlled clinical trial on adults suffering from ETTH and found headache duration to decrease with CSM.

2.13.1 Manipulative Indications

Manipulative indications as outlined by Gibbons and Tehan (2001) include:

- Joint fixation,
- Motion restriction,
- Restore bony alignment,
- Entrapment of meniscoids,
- Somatic dysfunction with loss of motion,

- Acute joint locking,
- Hypomobility,
- Relaxation of muscles by reflex mechanisms,
- Pain modulation, and
- Adhesions.

Gatterman (1990) stated that the indication for manipulation is “a joint lock, block or fixation that is described as a reversible mechanical derangement of the facet joint which causes a restriction in normal movement.”

2.13.2 Effects of manipulation

According to Gatterman (2005), the effectiveness of manipulation is thought to work according to several different theories:

a) Mechanical

This includes correction of joint alignment and joint movement dysfunction. It is also thought that the manipulative procedure will relieve pain in the presence of an entrapped synovial membrane, which causes restricted joint movement, by the separation of the joint surfaces.

b) Soft tissue

This effect includes changes in the strength and tone of the supporting muscles and dynamics of the connective tissue. It is believed that immobilization results in a loss of extensibility of the connective tissue which is reversed by manipulation, allowing free movement. Hypertonicity of segmental muscles is released with manipulative procedures.

c) Neurological

This includes a reduction in pain by the restoration of normal joint movement, inhibiting the joint pain receptors. A common cause of joint dysfunction is incorrect neuromotor patterns caused by muscle imbalances; therefore correction of the joint dysfunction allows normal muscle and nerve control.

2.13.3 Manipulative contraindications

Contraindications as outlined by Gatterman (1990) include:

- metabolic disorders (osteoporosis, osteomalacia and clotting disorders),
- vertebral-basilar artery insufficiency,
- atherosclerosis of major vessels,
- aneurysms,
- tumours (lung, thyroid, breast and bone),
- bone infections (tuberculosis, osteomyelitis),
- traumatic injuries (instability, fractures, severe sprains and strains),
- arthritis (rheumatoid and psoriatic arthritis), and
- neurological complications.

2.14 Literature on Combination studies in the management of ETTH

Bove and Nilsson (1998) (n = 75) conducted a randomized controlled clinical trial on adults suffering from ETTH comparing a combination of soft tissue massage of the Trapezius muscle and CSM (treatment group) to soft tissue massage of the Trapezius muscle and placebo laser to the upper cervical region (control group). No difference was observed between the two groups. Similarly, a study by de Busser (2001) (n = 30) compared the relative effectiveness of soft tissue massage alone to cervico-thoracic manipulation combined with soft tissue massage in the management of ETTH in children. There was no significant difference between the two groups, although a decrease in the frequency and intensity of ETTH was observed within both groups.

Similarly, Prithipal (2003) (n = 60) comparing the effectiveness of CSM, interferential current (IFC) and a combination of CSM with IFC found no significant difference between the three groups although a decrease in TTH frequency, duration and intensity in all groups was noted. In these studies the effect of spinal manipulation combined with another therapy was observed. However, the therapies were not applied directly to MFTPs and results may have been different if the MFTPs were treated directly such as the insertion of dry needles. To this researchers knowledge no studies have been done observing the use of dry needling combined with CSM for the treatment of ETTH and this is further supported by Fernández de las Peñas *et al.* (2006a) who reported that manual therapeutic approaches towards ETTH are not fully investigated.

2.15 Conclusion

According to White *et al.* (2000), no isolated treatment has been found to work specifically for ETTH. Furthermore, manual therapeutic approaches, which are not fully explored (Fernández de las Peñas *et al.,* 2006a), are often used to treat ETTHs but little data is available to determine the effectiveness of these approaches (Bove and Nilsson, 1998).

Lenaerts (2004) advocates CSM to be successful for TTH. Dry needling is a commonly used modality (Dommerholt, 2004) found to be an efficient treatment in MFTPs (Han and Harrison, 1997), with dry needling of MFTPs found to be effective in TTH sufferers (Karakurum *et al.,* 2001). However, these have not been combined in the treatment of ETTH.

Therefore, this study aims to determine what effect CSM and dry needling will have on the course of an ETTH.

CHAPTER THREE: METHODOLOGY

3.1 Design:

The study was designed as a quantitative, single blinded clinical trial that was given ethics clearance (ethics clearance number – 034/09) (Appendix H) through the Faculty of Health Sciences Research and Ethics Committee. This commonly aligns itself with the Declaration of Helsinki, 1975 (Johnson, 2005).

3.2 Sample:

A total of 45 participants were recruited from the greater Durban area.

3.3 Patient Recruitment:

Participants were recruited through convenience sampling by advertisements in newspapers, word-of-mouth and pamphlets (Appendix A).

Those people that responded to the advertisements contacted the researcher where they were screened with the following questions:

(1.) How old are you?
(2.) Describe the character of your headache.
(3.) Describe the exact location of the headache.
(4.) How many times a month do you experience the headache/s?

The participants had to be between 18 and 50 years of age and complaining of a tightening, pressure band like sensation surrounding the head, being widespread over the head starting in the occipital area and moving towards the frontal area (Boon *et al.,* 2006). The headache must occur more than one but less than 15 headache days per month for three months and last from 30 minutes to seven days per episode (International Headache Society, 2004).

If the participant met the above criteria, an appointment was made for the participant at the DUT Chiropractic Day Clinic. Each participant received a Letter

of Information and Informed Consent (Appendix B) giving a detailed explanation of what the research entailed and what was expected from them. The letter in addition to verbal information also informed them that they were free to withdraw at any time.

The participant then had a case history (Appendix C), physical (Appendix D) and cervical regional exam (Appendix E) done to determine the inclusion and exclusion criteria:

3.4 Inclusion Criteria:

1. All participants had to be between the ages of 18 and 50, including males and females of all ethnic groups. The peak prevalence of episodic tension-type headache (ETTH) was found in the fourth decade of life in both males and females according to Schwartz *et al*. (1998).

2. According to the International Headache Society (2004), ETTH was diagnosed as:
   - Occurring between one and 15 headache days per month for three months,
   - Lasting from 30 minutes to seven days per episode,
   - Not associated with nausea or vomiting, and
   - With a minimum of two of the follow characteristics:
     1. bilateral location,
     2. tightening quality,
     3. mild or moderate in intensity, and
     4. not made worse by activities of daily living such as walking or climbing stairs.

3. The criteria for active myofascial trigger points (MFTPs) as outlined by (Travell *et al.,* 1999) included:

   - restriction of full muscle lengthening,
   - painful to touch,
   - referred pain on compression,

- produces a local twitch response when stimulated, and
- produces autonomic and motor phenomena when compressed.

According to Fernández-de-las-Peñas *et al.* (2007a) the average number of MFTPs in people suffering with ETTH is 3.7 (1.9 being active), therefore a minimum of two MFTPs were selected to be eligible for the study. The Posterior Cervical (at trigger point location 1) and upper Trapezius muscles were needled

4. All participants needed to have cervical spine dysfunction in at least one area from C1-4 (de Busser, 2001). In their studies, Penter (1994), Jansen (1998) and Muller (1999) found cervical spine dysfunctions in TTH sufferers.

3.5 Exclusion Criteria

1. Participants were excluded from the study if they were diagnosed with the following contraindications to manipulation:

   - metabolic disorders (osteoporosis, osteomalacia and clotting disorders),
   - vertebral-basilar artery insufficiency,
   - atherosclerosis of major vessels,
   - aneurysms,
   - tumours (lung, thyroid, breast and bone),
   - bone infections (tuberculosis, osteomyelitis),
   - traumatic injuries (instability, fractures, severe sprains and sprains),
   - arthritis (Rheumatoid and psoriatic arthritis) , and
   - neurological complications (Gatterman, 1990).

2. Contraindications to dry needling included, but were not limited to:

- Individuals taking anticoagulation therapy or suffering from haemophilia
- Individuals taking aspirin within 3 days of receiving dry needling
- Individuals who fear dry needling (Travell *et al.,* 1999).

3. Those participants taking any form of scheduled medicines (schedule three and upwards) for their headaches. However, those taking any over-the-counter medication, (schedule two and less) for their headaches (e.g. Panado™ or Grandpa™) were allowed to participate in the study.

3.6 Research Procedure

Once the suitability of the participant was determined they were then randomly allocated to one of three groups by means of a random allocation chart. This is where the computer randomly allocates participants one to 45 to either Groups A, B or C. Group A received CSM, Group B received dry needling and Group C received CSM in addition to dry needling.

The study was conducted over a period of four weeks including an initial week of monitoring. Each participant was required to attend six consultations, four of which included treatments administered over a two week period.

Consultation One:

Participants received a headache diary (Appendix F) and were asked to enter the details of their headaches from this day for the duration of the research until the last consultation. It was explained to the patient that should they need to take any over-the-counter medication that they may do so only after one hour of their headache starting. A subjective measurement in the form of a headache questionnaire/disability index (Appendix G) was filled out at this consultation and the objective measurements in the form of Cervical Range of Motion (CROM) using a CROM goniometer and pain pressure threshold readings using an Algometer were taken.

Consultation Two:

This took place one week after consultation one. No subjective measurements (headache questionnaire/disability index and headache diary) were taken however, objective measurements were taken prior to the treatment. The intervention was administered dependent on group allocation – treatment one. Each participant was reminded to continue filling the headache diary.

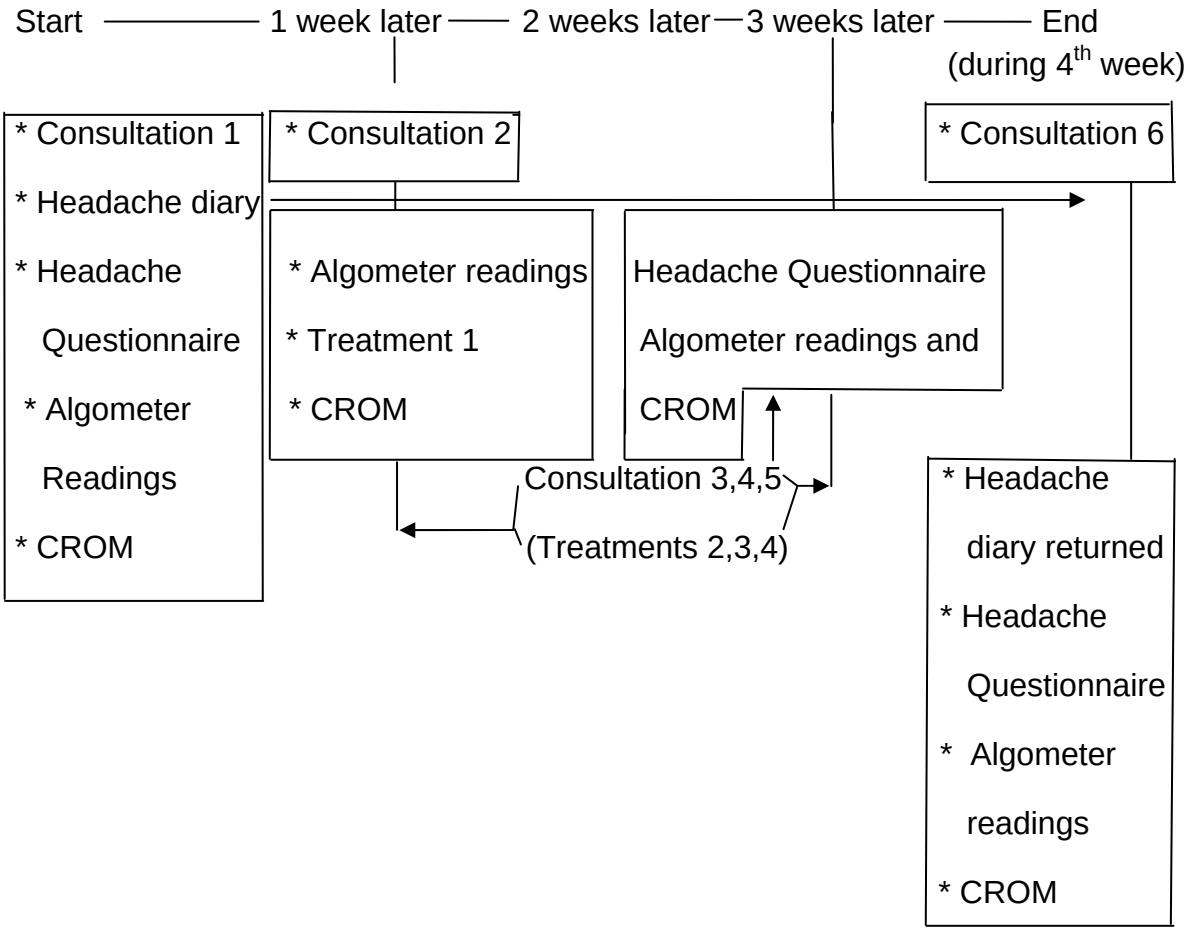
Consultation Three, Four & Five:

Were done within two weeks from consultation two, in order to administer treatments two, three and four respectively, with a minimum of at least one day in between each treatment. No readings were taken at consultations three and four but at consultation five the objective measurements and headache questionnaire/disability index were taken prior to treatment four. Each participant was reminded to continue filling in the headache diary.

Consultation six:

This took place during the fourth week from consultation one where no treatment was administered and the following was collected:

1) Headache diary was filled in and returned
2) A third headache questionnaire was completed
3) Objective measurements were taken again



3.7 Interventions:

3.7.1 Cervical Spine Manipulation (CSM)

CSM was administered to those participants in Groups A and C according to the techniques as outlined by Bergmann and Peterson (2002). Motion palpation and spinal manipulative techniques were carried out in the entire cervical spine with at least one manipulative technique performed from C1 – 4.

3.7.2 Dry needling

Dry needling in the form of sterile disposable acupuncture needles were administered on those participants in Groups B and C. The needles were opened in front of the participant and used for penetration into the trigger points using the "fanning technique" for effective myofascial trigger point inactivation (Travell *et al.,* 1999). The skin was cleaned with alcohol prior to any needle penetration to minimize infection occurring. Once the treatment was over, the needles were disposed of into a sharps container.

3.8 Blinding

Data was collected using a single blinded method. Single blinding is where a research assistant, namely a fellow chiropractic masters student, was prevented from knowing information, such as participant group allocation, that may lead to bias results whilst recording objective data readings (algometer, CROM goniometer). It was achieved with the research assistant collecting objective data measurements from each participant without the assistant knowing which group the participant was allocated to.

3.9 Measurement Tools:

Participants were monitored and assessed in the form of objective (Algometer and CROM goniometer) and subjective (headache diary and headache questionnaire/disability index) data.

3.9.1 Objective Data

3.9.1.1 Algometer

The Algometer (Push-Pull force gauge, Wagner Instruments, P.O. Box 1217, Greenwich, CT 06836 U.S.A) is an objective measurement tool used to assess each participant's pressure-pain thresholds. It is a pressure gauge that was placed on each MFTP at baseline measurements (first consultation), before the first treatment (second consultation), before the fourth treatment (fifth consultation) and at the six and final consultation, with pressure progressively applied until the participant's threshold for pain was met. This value was then recorded. However, the most tender MFTP in each participant was recorded and was monitored throughout the study. A minimum of two and a maximum of four myofascial trigger points (MFTPs) were recorded, for each participant, with the same MFTPs measured at each treatment.

Fischer (1986) stated pressure threshold measurements with an algometer to have good reliability and reproducibility. This is supported by Potter, McCarthy and Oldham (2006) who in their study found the algometer to be reliable and valid in measuring a patient's pressure pain threshold to determine myofascial tenderness scores in response to myofascial treatments.

3.9.1.2 CROM Goniometer

The CROM Goniometer (3600 Labore road, suite 6, St Paul, MN 55110-41144) is a tool that was placed on the participants nasal bridge and ears and fastened with valcro straps to back of the participants head. It was used to measure the active CROM: flexion, extension, right and left rotation, right and left lateral flexion with each movement occurring until the participant can move no more or if pain

prevents a movement. Good posture was ensured while the patient was seated on a chair prior to the readings. Readings were taken at baseline measurements (first consultation), before the first treatment (second consultation), before the fourth treatment (fifth consultation) and at the six and final consultation,

According to Youdas, Carey and Garret (1991), when compared to two other goniometers, the CROM showed a higher level of reliability and they reported good inter- and intra-examiner reliability with the procedure not affecting the patient's condition. Tousignant, Duclos and Laflecche (2002) in their study reported CROM to have good validity with respect to measuring flexion, extension, right and left rotation and right and left lateral flexion.

3.9.2 Subjective Data

3.9.2.1 Headache Diary

The headache diary (de Busser, 2001) (Appendix F) was a subjective measurement tool used throughout the research programme (one week prior to the first treatment, during and one week after the treatment period) to follow the course of the headache such as the characteristics of each attack (intensity, frequency and duration) as the participant was subjected to the various treatments, monitoring each patients response to the treatments.

The researcher explained to each participant how to complete the diary which they were requested to take home. It allowed each participant to monitor the duration of each attack by means of half hour interval blocks, to describe the headache severity by means of selecting mild or moderate or fairly severe or severe and select a facial description from an available range of faces [A (no headache) to I (most intense headache)] to describe the intensity of the headache they were experiencing.

The headache diary was used successfully by de Busser (2001) and Rasmussen, Jensen, Schroll and Olesen (1992), finding the headache diary to be accurate. Tassorelli, Sances, Allena, Ghiotto, Bendtsen, Olesen, Nappi and Jensen (2008), indicated that in their pilot study, the members showed a high compliance with the headache diary.

3.9.2.2 Headache Questionnaire/Disability Index

The headache questionnaire/disability index (Yeomans, 2000) (Yeomans, 2000) is a subjective measurement tool that each participant was required to complete at baseline measurements (first consultation), before the fourth treatment (fifth consultation) and at the sixth and final consultation. It provided emotional and functional questions of daily life, answered with a “YES”, “SOMETIMES” or “NO”, allowing each participants disability to be monitored in response to the treatments they receive. It also provides two questions relating to the headache frequency and severity.

Blizzard, Grimmer and Dwyer (2000), in their study reported the headache questionnaire to be valid, stating headache questionnaires to be used successfully in determining the disability of headaches.

3.10 Statistical analysis

Data was analysed using version 9.1.3 of SAS (SAS, North Carolina, USA). A *p* value <0.05 was considered to be statistically significant. Intra-group analysis was achieved using repeated measures ANOVA with the within-subjects effect of time. A significant time effect indicated that there was a significant change over time within the particular treatment group. Profile plots were used to assess the direction of the effect as well as trends. Inter-group analysis was achieved using repeated measures ANOVA with both within subjects effects of time, as well as between subjects effects of treatment group, and the time treatment group interaction effect. Bonferroni adjusted post hoc tests were carried out to perform all pair wise comparisons of groups. Profile plots were generated to assess the direction and trend of the effect (Grobler, 2010).

Baseline comparisons were carried out using Wilcoxon’s rank sum and Fischer’s exact tests. The repeated measures data in the headache questionnaire was analysed using mixed models which takes into account the correlation between repeated measures on the same patient over time. The ordinal repeated data in the headache questionnaire was analysed with the GENMOD procedure in SAS (Grobler, 2010).

CHAPTER FOUR: RESULTS

4.1 Introduction

The following chapter presents the results obtained from the statistical analysis of the objective and subjective data that was collected during the study. The demographic, inter-group and intra-group data are presented in the form of tables and figures.

4.2 List of Abbreviations

Group A: cervical spine manipulation (CSM) alone
Group B: dry needling alone
Group C: CSM combined with dry needling
CROM: Cervical Range of Motion
Kg's: Kilograms
Min: Minimum
Max: Maximum
MFTP/s: Myofascial Trigger Point/s
n: Number of participants
p: p - value
ROM: Range of Motion
Std: Standard deviation

4.3 Demographics

4.3.1 Gender

Table 4.1 illustrates that more females participated in the study, with a female:male ratio of 2:1 with no statistically significant (p = 0.3611) difference between the three groups.

Table 4.1: Gender distribution between groups

	n	**Female**		**Male**	
		n	***%***	***n***	***%***
Group A	15	10	66.7	5	33.3
Group B	15	8	53.3	7	46.7
Group C	15	12	80	3	20
Total	45	30		15	

*Fischer's exact test (p = 0.3611)

4.3.2 Ethnicity

There was no statistically significant (p = 0. 9375) difference between the groups in terms of ethnic distribution as represented in Table 4.2.

Table 4.2: Ethnic distribution between groups

	n	**African**		**Indian**		**Caucasian**		**Coloured**	
		n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Group A	15	2	13.3	6	40	6	40	1	6.7
Group B	15	5	33.3	5	33.3	4	26.7	1	6.7
Group C	15	3	20	7	46.6	4	26.7	1	6.7
Total	45	10		18		14		3	

*Fischer's exact test (p = 0.9375)

4.3.3 Age

Table 4.3 represents the mean ages of the participants. No statistically significant (p = 0.6598) difference was noted between the three groups.

Table 4.3: Age distribution between groups

		Age		
	n	**Min**	**Max**	**Mean**
Group A	15	21	45	31.3
Group B	15	20	46	29.7
Group C	15	18	49	32.5
Total	45			

Wilcoxon's rank sum test (p = 0.6598)

4.4. Baseline measurements

4.4.1 Objective Measurements

4.4.1.1 CROM

At baseline as illustrated in Table 4.4, no statistically significant (p <0.05) differences were noted between the three groups for mean flexion, extension, left and right lateral flexion and left and right rotation.

Table 4.4: Baseline measurements for mean flexion, extension, left and right Lateral flexion, left and right rotation ROM

	Group A	Group B	Group C	*p* – value
Flexion				0.1725
Mean	46.13	52.93	48.13	
Median	48	56	50	
Std	11.17	8.78	10.35	
Extension				0.6803
Mean	67.20	62.53	66.13	
Median	68	62	70	
Std	12.30	13.62	13.72	
Left Lateral Flexion				0.9084
Mean	43.07	42.53	42.27	
Median	42	42	42	
Std	8.71	8.40	6.92	
Right Lateral Flexion				0.0838
Mean	42.40	36	40.53	
Median	42	38	42	
Std	7.72	5.81	8.57	

	Group A	Group B	Group C	*p* - value
Left Rotation				0.4130
Mean	57.47	61.60	60.67	
Median	58	62.00	64	
Std	10.94	11.57	12.41	
Right Rotation				0.6640
Mean	59.60	60.07	62.53	
Median	62	60	68	
Std	11.86	11.16	11.07	

Wilcoxon's rank sum test

4.4.1.2 Algometer

At baseline, as illustrated in Table 4.5, no statistically significant (p = 0.8271) differences were observed for the mean most tender MFTPs between the three groups.

Table 4.5: Mean baseline measurements for the most tender MFTPs

	Group A	Group B	Group C
Consultation 1			
Mean	1.73	1.69	1.41
Median	1.40	1.60	1.40
Std	0.85	1.30	0.75

Wilcoxon's rank sum test (p = 0.8271)

4.4.2 Subjective Measurements

4.4.2.1 Headache Questionnaire/Disability Index

4.4.2.1.1 Headache Frequency - Question 1: I have a headache:

Table 4.6 illustrates no statistically significant (p = 1.000) difference at baseline for headache frequency between the three groups.

Table 4.6: Baseline measurements for headache frequency

Headache Frequency	Group A (*n*)	Group B (*n*)	Group C (*n*)
1 per month	0	0	1
More than 1 but less than 4 per month	3	2	2
More than one per week	12	13	12

Fisher's exact test (p = 1.000)

4.4.2.1.2 Headache Severity - Question 2: I describe my headache as:

At baseline, as represented in Table 4.7, no statistically significant (p = 0.3938) differences were noted for headache intensity between the three groups.

Table 4.7: Baseline measurements headache intensity

Headache Severity	Group A (*n*)	Group B (*n*)	Group C (*n*)
Mild	0	1	1
Moderate	7	10	6
Severe	8	4	8

Fisher's exact test (p = 0.3938)

4.4.2.1.3 Disability Index

No statistically significant (p = 0.5324) differences were noted at baseline for mean headache disability index between the three groups, as represented in Table 4.8.

Table 4.8: Mean baseline measurements for headache disability index

Disability Index	Group A	Group B	Group C
Mean	50.53	50.40	60.27
Median	52	50	60
Std	22.85	22.17	24.54

Wilcoxon's rank sum test (p = 0.5324)

4.4.2.2 Headache Diary

- **Duration**

Table 4.9 illustrates no statistically significant (p = 0.6764) difference at baseline for headache duration between the three groups.

Table 4.9: Mean baseline measurements for headache duration

	Group A	Group B	Group C
Mean	3.7	4.1	5.4
Median	3.5	3	4.5
Std	3.1	5	3.9

Wilcoxon's rank sum test (p = 0.6764)

- **Intensity**

At baseline, as represented in Table 4.10, no statistically significant (p = 0.8039) differences were noted for headache intensity between the three groups.

Table 4.10: Baseline measurements for headache intensity

Intensity	Group A	Group B	Group C
A	0	0	0
B	0	0	1
C	3	3	2
D	2	3	2
E	4	1	5
F	1	3	2
G	1	2	1
H	0	0	0
I	0	0	0
None	4	3	2
High (E, F, G, H, I)	6	6	8
Low (N0, A, B, C, D)	9	9	7

Fisher's exact test (p = 0.8039)

- **Severity**

No statistically significant (p = 0.8605) differences were noted at baseline for headache severity between the three groups, as represented in Table 4.11.

Table 4.11: Baseline measurements for headache severity

Severity	Group A (*n*)	Group B (*n*)	Group C (*n*)
Mild	3	3	5
Moderate	7	6	5
Fairly severe	1	3	3
None	4	3	2

Fisher's exact test (p = 0.8605)

4.5 Conclusion

At baseline there were no statistically significant (p <0.05) differences noted between the three groups in terms of objective and subjective measurements.

4.6 Objective One: To Determine the Effectiveness of Cervical Spine Manipulation in Terms of Objective and Subjective Data for the Treatment of ETTH

4.6.1 Objective Measurements

4.6.1.1 Group A – CSM alone

4.6.1.1.1 CROM Goniometer

- **Flexion**

Figure 4.1 illustrates that there was a statistically significant (p = 0.0003) change mean flexion ROM over time.

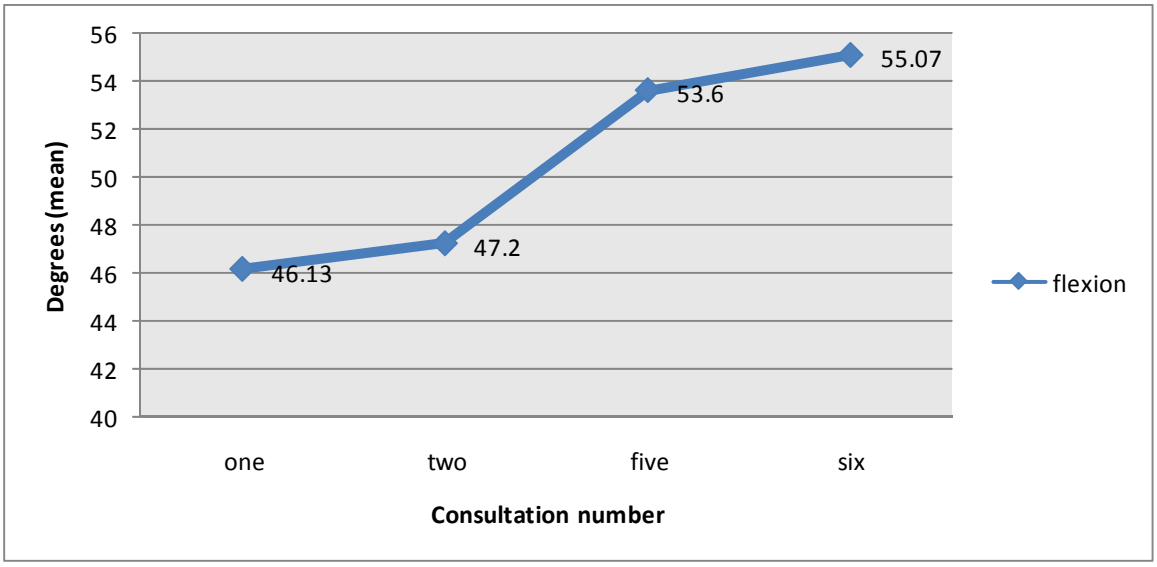


Figure 4.1: Mean flexion ROM over time in Group A

- **Extension**

Figure 4.2 represents a statistically significant (p = 0.0018) change in mean extension ROM over time.

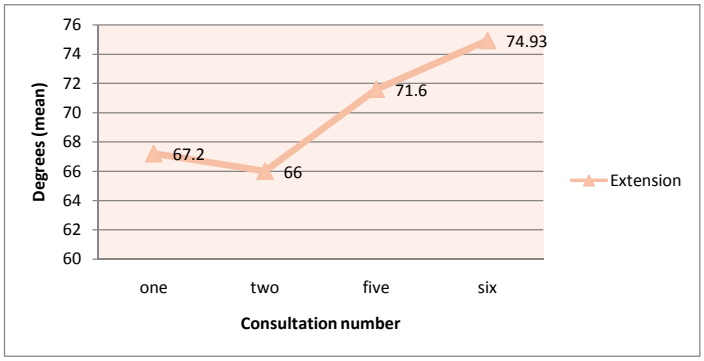


Figure 4.2: Mean extension ROM over time in Group A

- **Left Lateral Flexion**

Figure 4.3 illustrates a highly statistically significant (p <0.0001) change in left lateral flexion ROM over time.

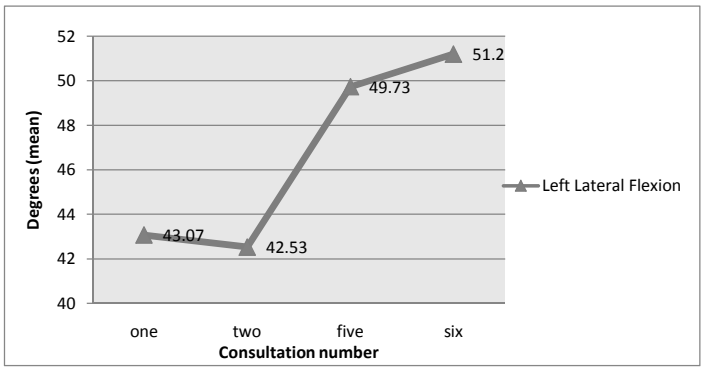


Figure 4.3: Mean left lateral flexion ROM over time in Group A

- **Right Lateral Flexion**

A highly statistically significant (p <0.0001) change in the mean right lateral flexion ROM over time was noted, as illustrated in Figure 4.4.

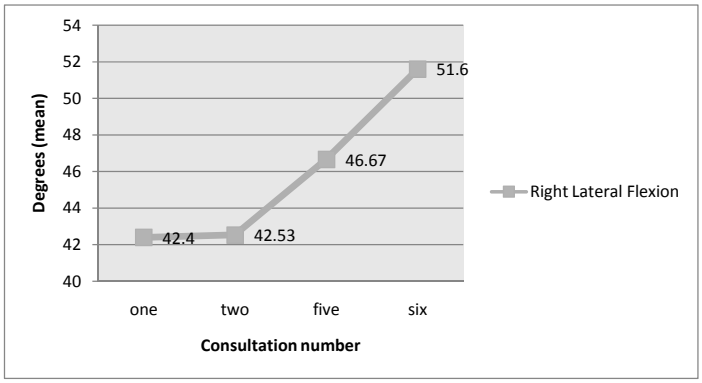


Figure 4.4: Mean right lateral flexion ROM over time in Group A

- **Left Rotation**

Figure 4.5 illustrates a highly statistically significant (p <0.001) change in the mean left rotation ROM over time.

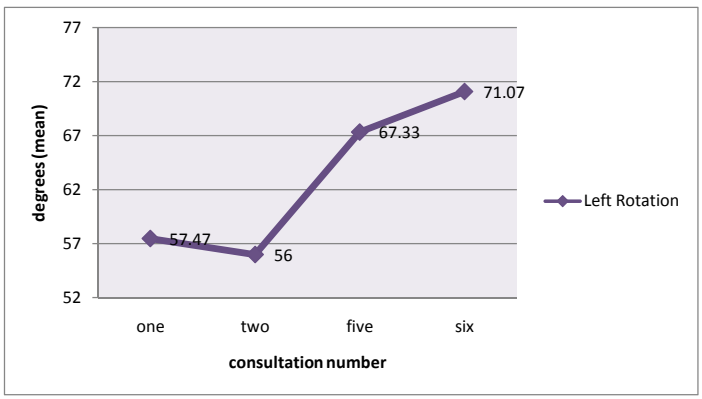


Figure 4.5: Mean left rotation ROM over time in Group A

- **Right Rotation**

A highly statistically significant (p <0.0001) change in mean right rotation ROM over time was observed, as represented in Figure 4.6.

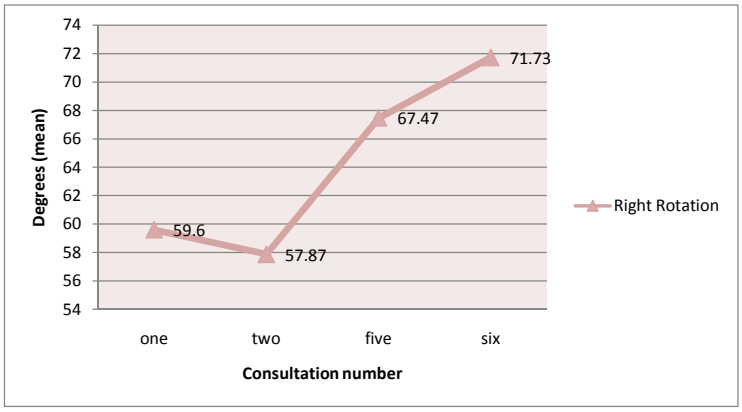


Figure 4.6: Mean right rotation ROM over time in Group A

4.6.1.1.2 Algometer

A highly statistically significant (p <0.0001) increase in the mean most tender MFTPs over time was observed, as represented in Figure 4.7.

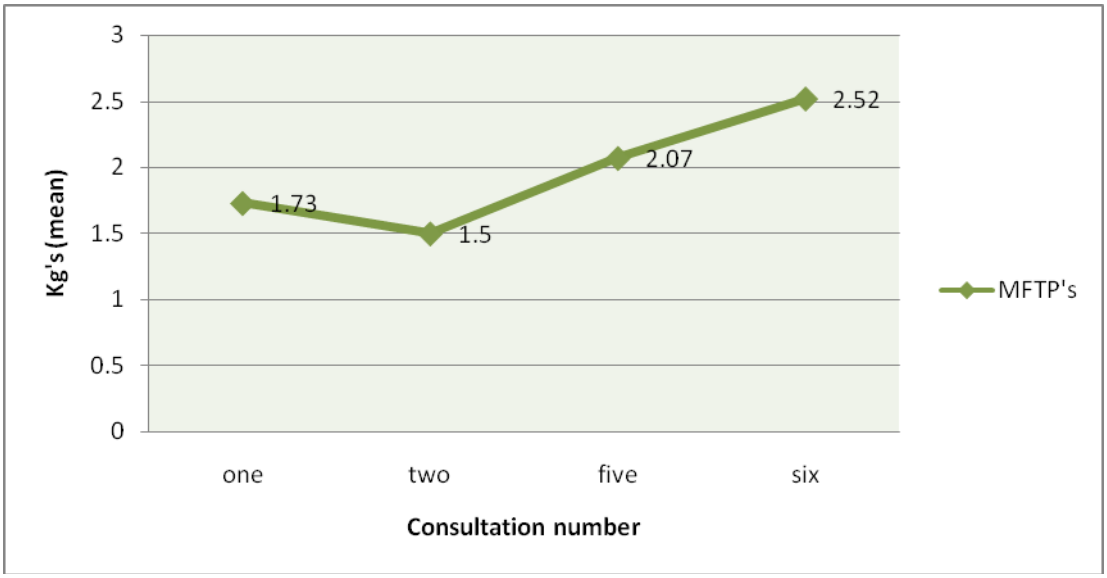


Figure 4.7: Mean score for the most tender MFTPs over time in Group A

4.6.2 Subjective Measurements

4.6.2.1 Headache Questionnaire/Disability Index

4.6.2.1.1 Headache Frequency – Question 1: I have a headache:

Table 4.12 illustrates a statistically significant improvement (p = 0.0301) in the frequency of headaches over time in Group A. No statistically significant (p = 0.1281) improvement was observed from consultation 1 to 5, however a statistically significant (p = 0.0098) improvement was observed from consultation 1 to 6.

Table 4.12: Changes in headache frequency from consultations one to six in Group A

	Group A (*n*)	**p - value**
Consultation 1		0.0301
1 per month	0	
More than 1 but less than 4 per month	3	
More than one per week	12	
Consultation 5		
1 per month	1	
More than 1 but less than 4 per month	7	
More than one per week	7	
Consultation 6		
1 per month	3	
More than 1 but less than 4 per month	8	
More than one per week	4	
Frequency of headaches decreased from Consultation 1 to 5	5	0.1281
Frequency of headaches decreased from Consultation 1 to 6	9	0.0098

Fisher's exact test (p = 0.0301)

4.6.2.1.2 Headache Severity – Question 2: I describe my headache as:

Table 4.13 illustrates that there was a highly statistically significant (p <0.0001) improvement in the intensity of headaches over time in Group A. Statistically significant improvements were noted from consultation 1 to 5 (p <0.001) and from consultation 1 to 6 (p <0.0001).

Table 4.13: Changes in headache intensity from consultation one to six in Group A

	Group A (*n*)	**p –value**
Consultation 1		<0.0001
Mild	0	
Moderate	7	
Severe	8	
Consultation 5		
Mild	9	
Moderate	5	
Severe	1	
Consultation 6		
Mild	11	
Moderate	2	
Severe	2	
Severity of headaches decreased from Consultation 1 to 5	12	<0.001
Severity of headaches decreased from Consultation 1 to 6	12	<0.0001

Fischer's exact test (p = <0.0001)

4.6.2.1.3 Disability Index

Figure 4.8 illustrates a highly statistically significant (p <0.0001) decrease in the mean disability index score over time for the CSM group (Group A).

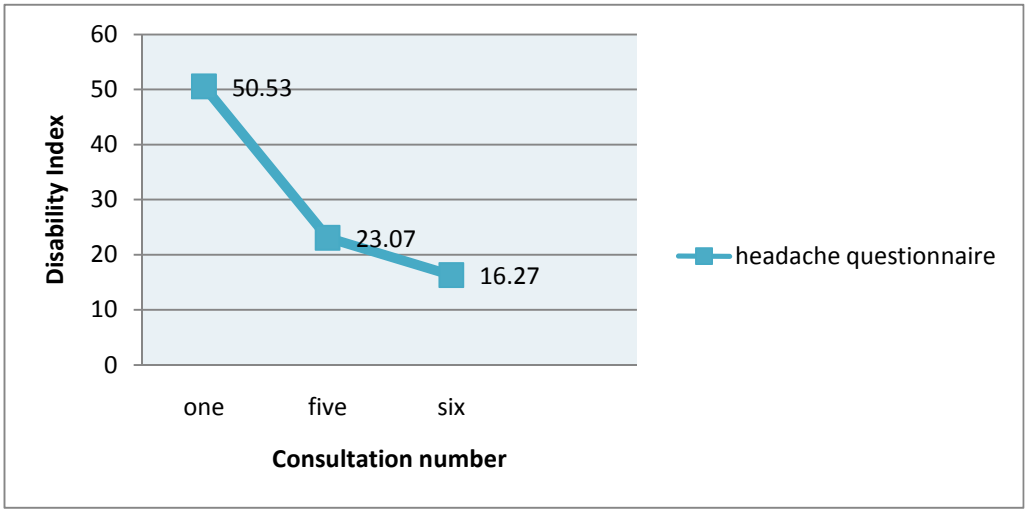


Figure 4.8: Mean disability change for Group A over time

4.6.2.2 Headache Diary

- **Duration**

Figure 4.9 illustrates a statistically significant (p <0.0001) decrease in the duration of the headaches over time in the CSM group (Group A).

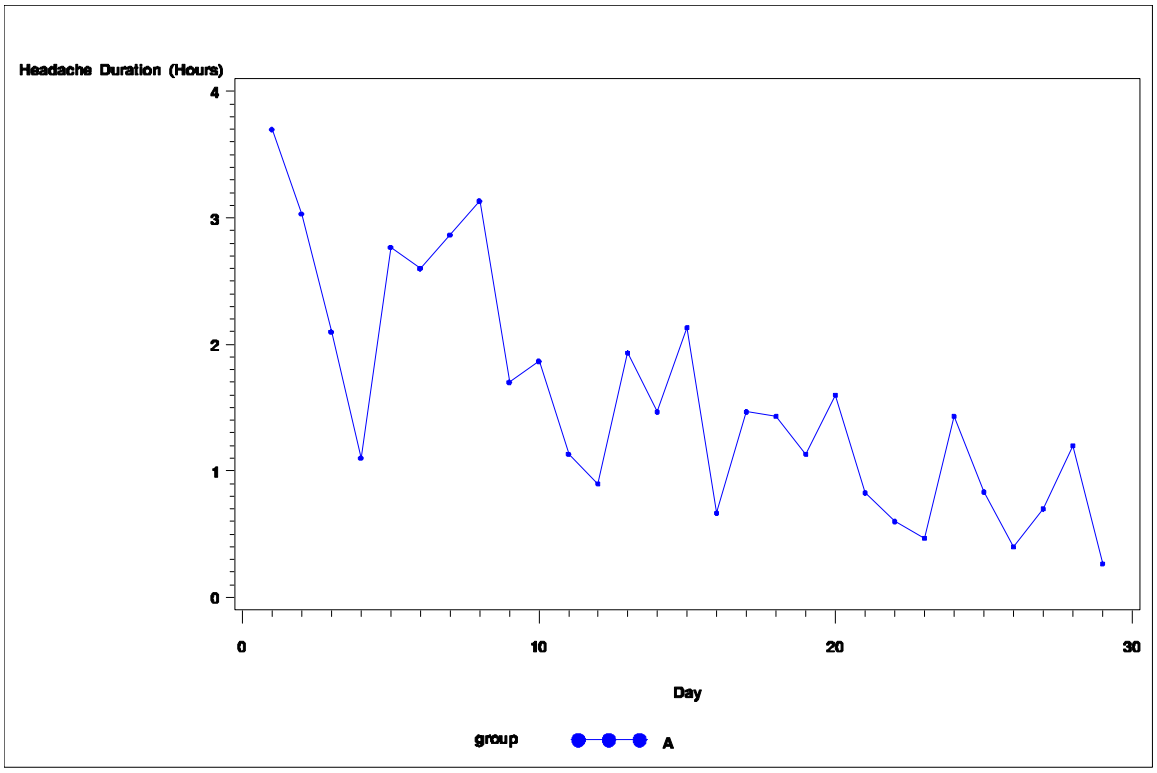


Figure 4.9: Duration of headache change over time in Group A

- **Intensity**

Figure 4.10 illustrates a statistically significant (p <0.0001) decrease in the headache intensity over the four week study period for the CSM group (Group A).

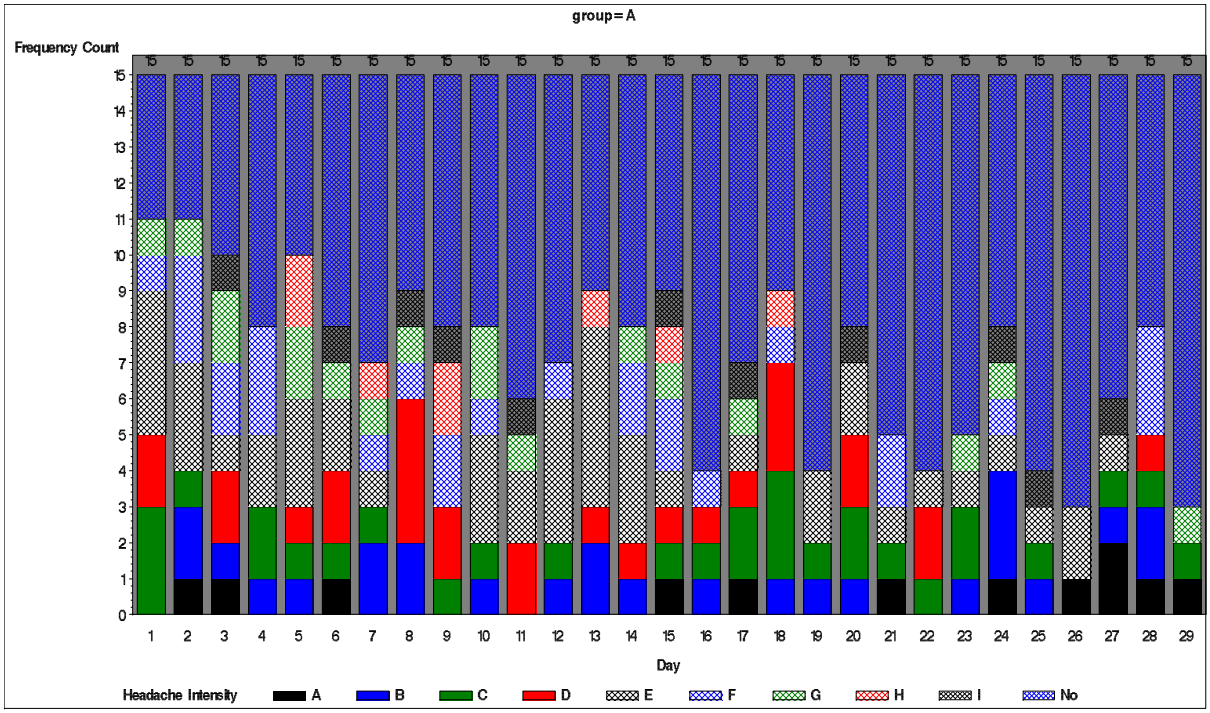


Figure 4.10: Change in headache intensity within Group A

- **Severity**

Figure 4.11 illustrates a statistically significant (p <0.0001) decrease in the headache severity over the four week study period for the CSM group (Group A).

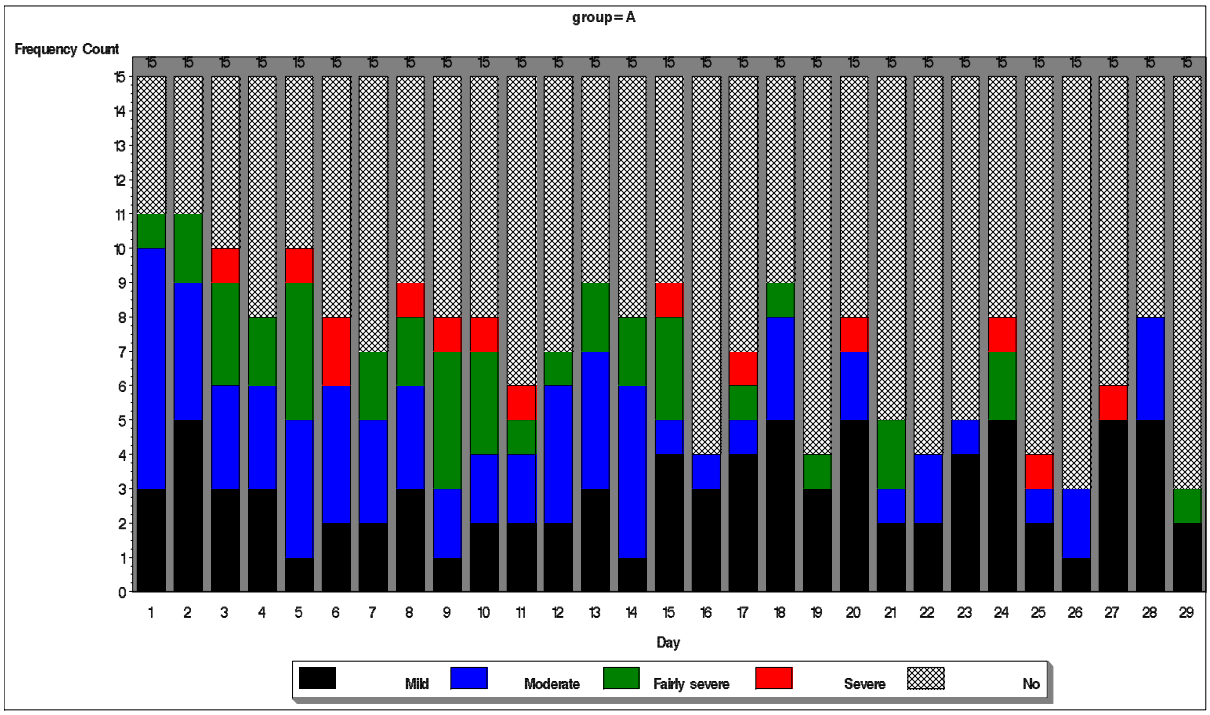


Figure 4.11: Change in headache severity within Group A

4.7 Objective Two: To Determine the Effectiveness of Dry Needling in Terms of Objective and Subjective Data for the Treatment of ETTH.

4.7.1 Objective Measurements

4.7.1.1 Group B – Dry needling alone

4.7.1.1.1 CROM Goniometer

- **Flexion**

Figure 4.12 illustrates that there was a highly statistically significant (p = 0.0002) change in the mean flexion ROM over time.

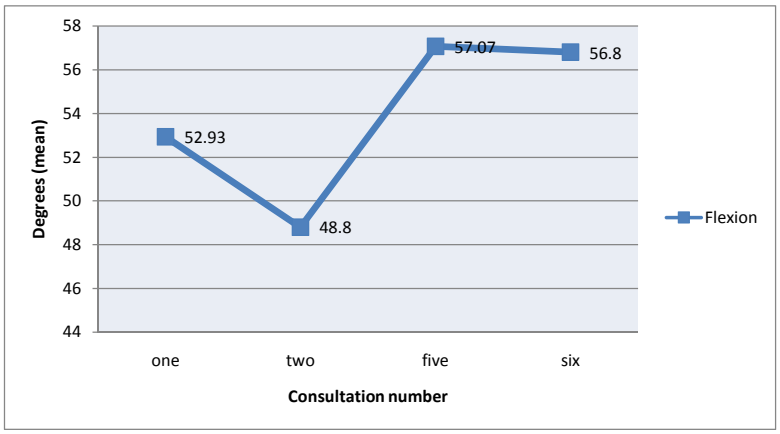


Figure 4.12: Mean change in flexion ROM over time in Group B

- **Extension**

Figure 4.13 illustrates a statistically significant (p = 0.0266) change in the mean extension ROM over time.

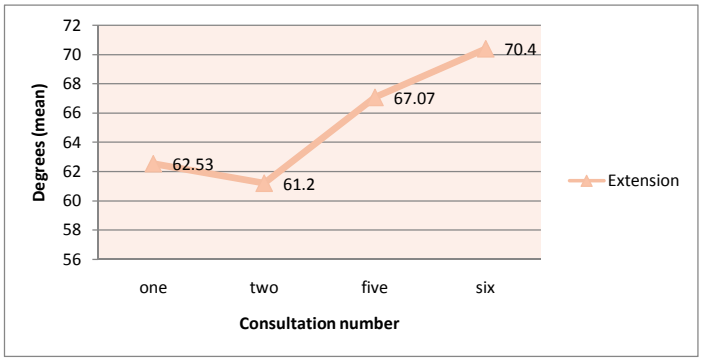


Figure 4.13: Mean change in extension ROM over time in Group B

- **Left Lateral Flexion**

Figure 4.14 illustrates a statistically significant (p = 0.0019) change in left lateral flexion ROM over time.

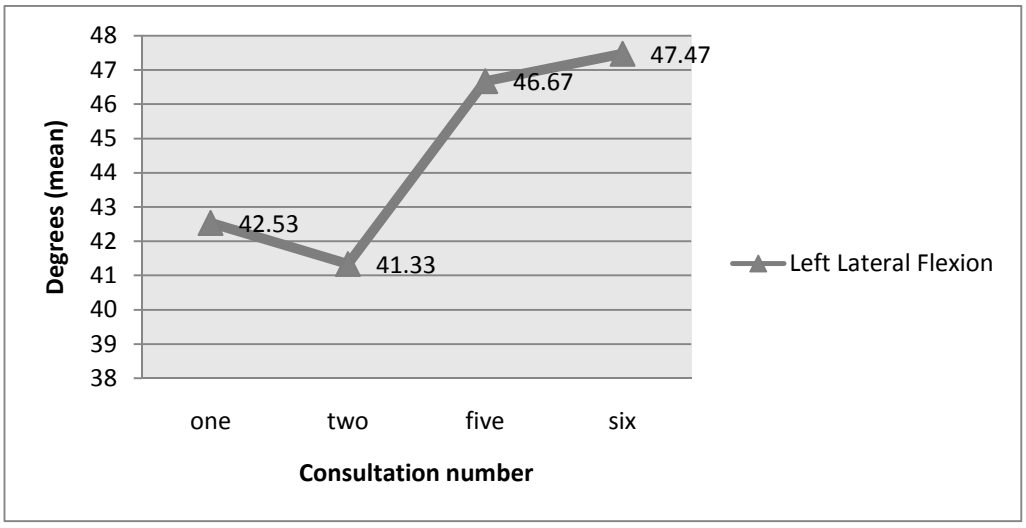


Figure 4.14: Mean change in left lateral flexion over time in Group B

- **Right Lateral Flexion**

A highly statistically significant (p <0.0001) change was noted in the mean right lateral flexion ROM over time as illustrated in Figure 4.15.

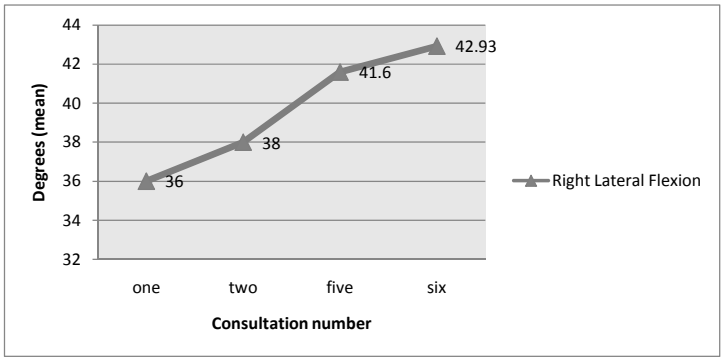


Figure 4.15: Mean change in right lateral flexion ROM over time in Group B

- **Left Rotation**

Figure 4.16 represents a statistically significant (p = 0.0009) change in the mean left rotation ROM over time.

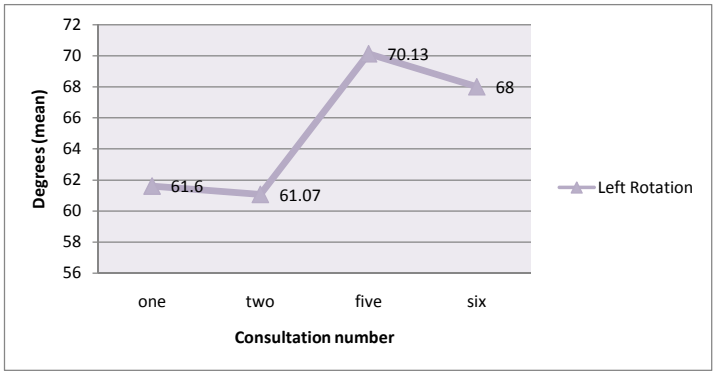


Figure 4.16: Mean change in left rotation ROM over time in Group B

- **Right Rotation**

A highly significant (p <0.0001) change was noted in the mean right rotation ROM over time as represented in Figure 4.17.

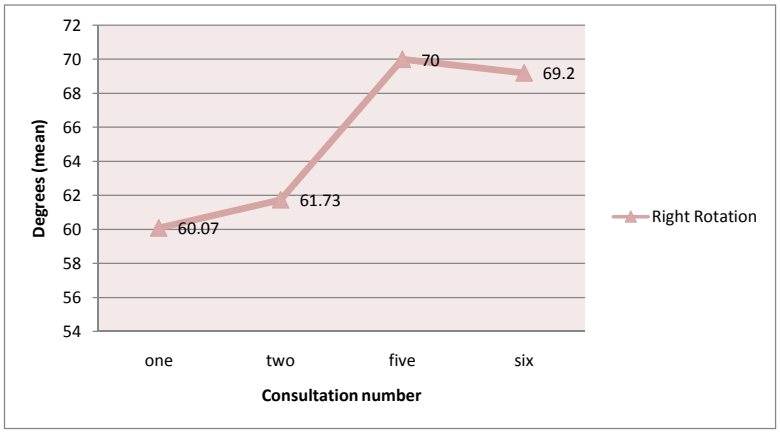


Figure 4.17: Mean change in right rotation ROM over time in Group B

4.7.1.1.2 Algometer

Figure 4.18 represents a highly statistically significant (p <0.0001) increase for the mean most tender MFTPs score over time.

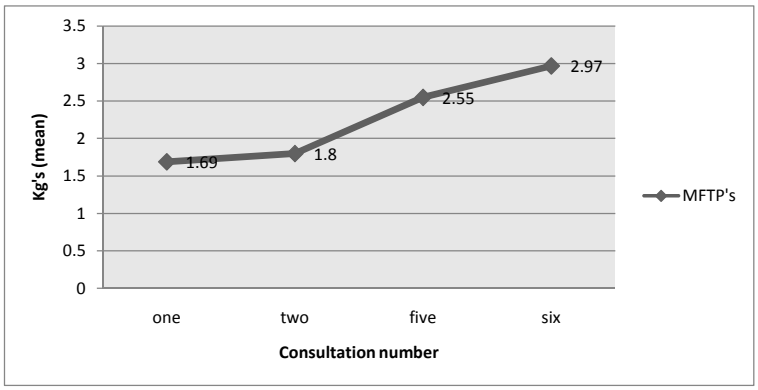


Figure 4.18: Change in mean most tender MFTPs over time in Group B

4.7.2 Subjective Measurements

4.7.2.1 Headache Questionnaire/Disability Index

4.7.2.1.1 Headache Frequency – Question 1: I have a headache:

Table 4.14 illustrates no statistically significant change (p = 0.0642) in the frequency of headaches over time in Group B. No statistically significant (p = 0.1086) change was observed from consultation 1 to 5, however a statistically significant (p = 0.0209) change was observed from consultation 1 to 6.

Table 4.14: Changes in headache frequency from consultations one to six in Group B

	Group B (*n*)	**p - value**
Consultation 1		0.0642
1 per month	0	
More than 1 but less than 4 per month	2	
More than one per week	13	
Consultation 5		
1 per month	1	
More than 1 but less than 4 per month	6	
More than one per week	8	
Consultation 6		
1 per month	1	
More than 1 but less than 4 per month	8	
More than one per week	6	
Frequency of headaches decreased from consultation 1 to 5	6	0.1086
Frequency of headaches decreased from consultation 1 to 6	8	0.0209

Fischer's exact test (p = 0.0642)

4.7.2.1.2 Headache Severity – Question 2: I describe my headache as:

Table 4.15 illustrates a highly statistically significant change (p <0.0001) in the severity of headaches over time in Group B. Statistically significant changes were noted from consultation 1 to 5 (p = 0.0019) and from consultation 1 to 6 (p <0.0001).

Table 4.15: Changes in headache severity from consultation one to six in Group B

	Group B (*n*)	**p - value**
Consultation 1		<0.0001
Mild	1	
Moderate	10	
Severe	4	
Consultation 5		
Mild	9	
Moderate	6	
Severe	0	
Consultation 6		
Mild	12	
Moderate	3	
Severe	0	
Severity of headaches decreased from Consultation 1 to 5	11	0.0019
Severity of headaches decreased from Consultation 1 to 6	12	<0.0001

Fischer's exact test (p <0.0001)

4.7.2.1.3 Disability Index

Figure 4.19 represents a highly statistically significant (p <0.0001) improvement in the mean disability index score over time.

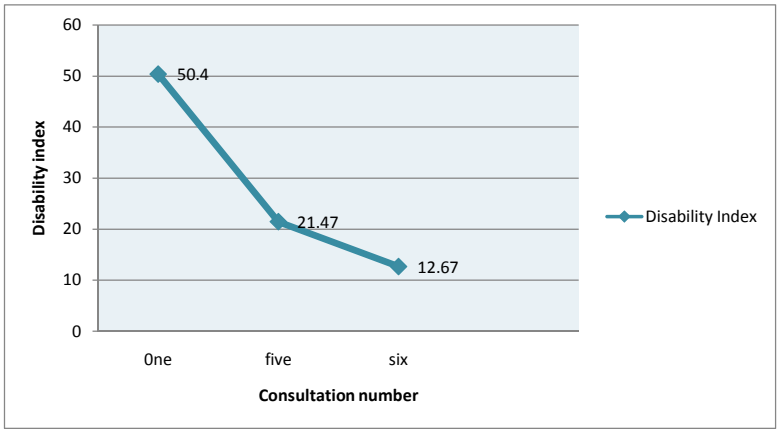


Figure 4.19: Change in mean disability index over time in Group B

4.7.2.2 Headache Diary

- **Duration**

Figure 4.20 represents a statistically significant (p = 0.0014) decrease in the duration of the headaches over time in the dry needling group.

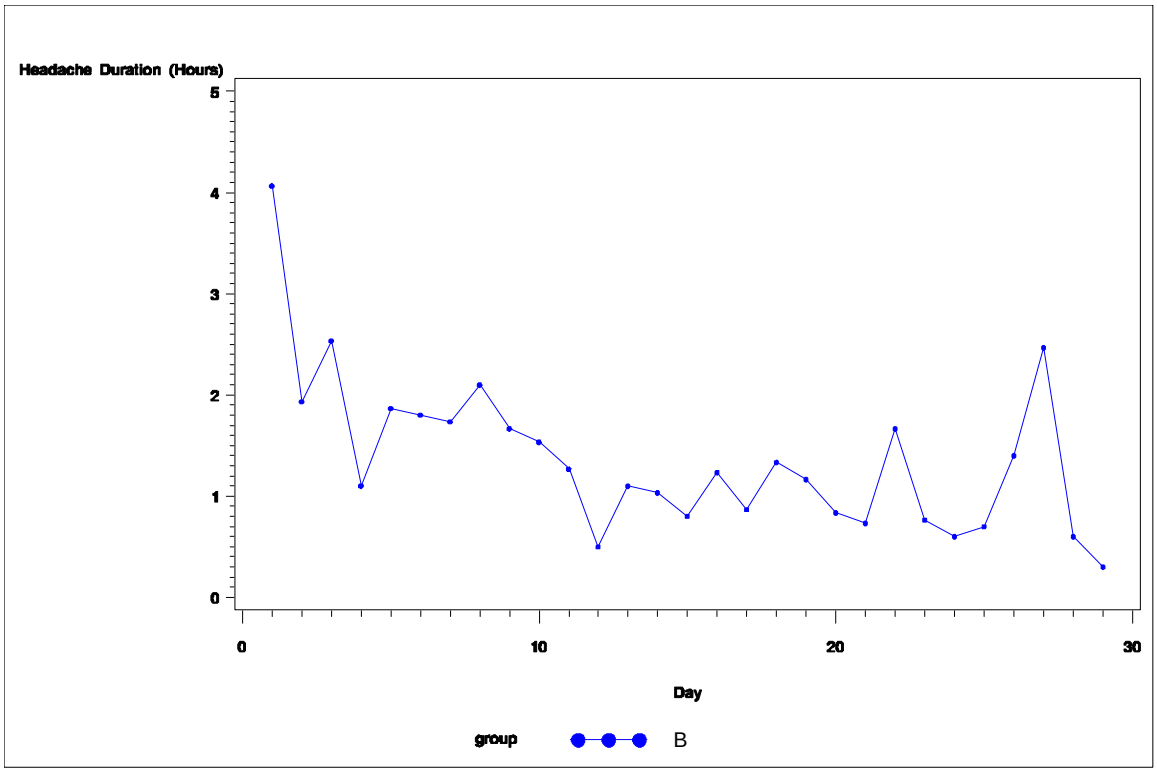


Figure 4.20: Duration of headache change over time in Group B

- **Intensity**

Figure 4.21 illustrates a highly statistically significant (p <0.0001) decrease in the headache intensity over the four week study period for Group B.

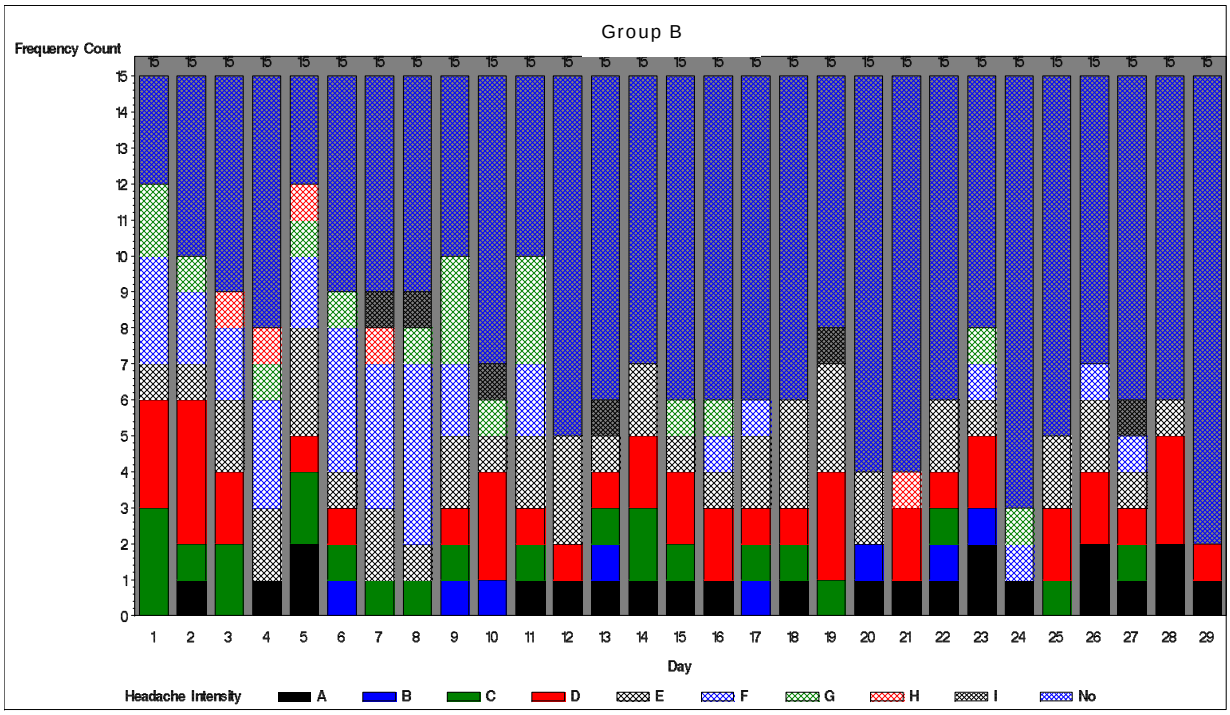


Figure 4.21: Decrease in headache intensity over time in Group B.

- **Severity**

Figure 4.22 illustrates a highly statistically significant (p <0.0001) decrease in the headache severity over the four week study period for Group B.

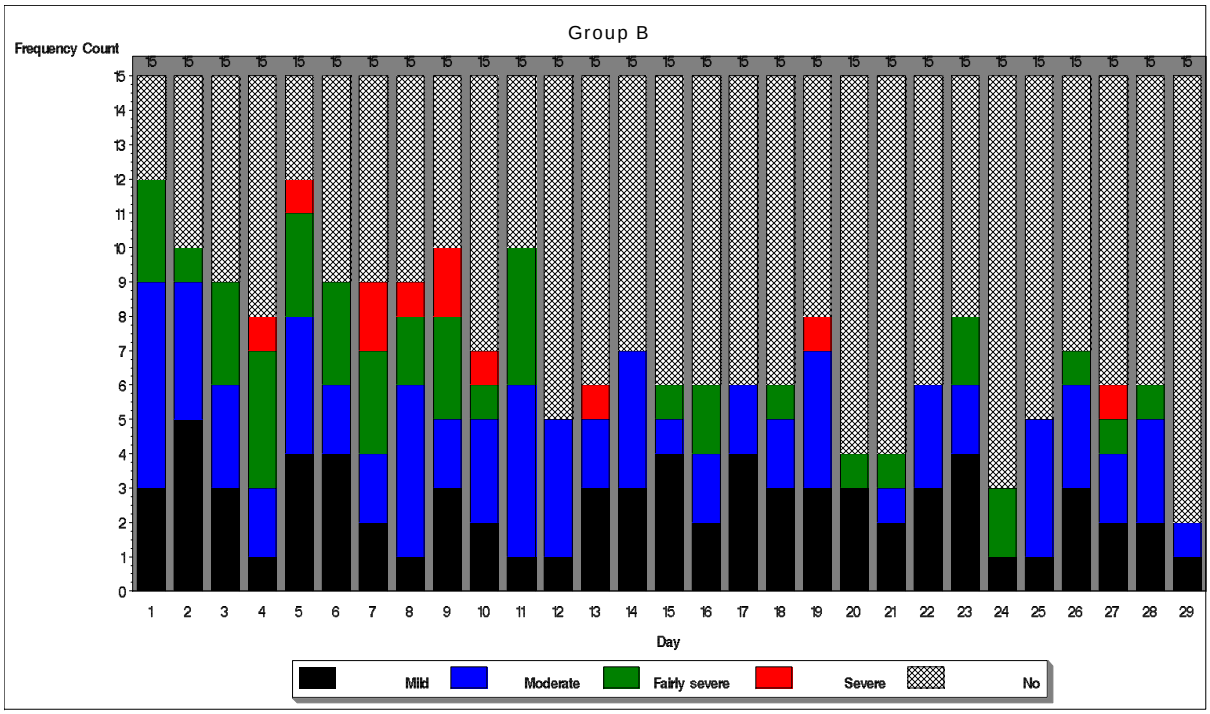


Figure 4.22: Changes in headache severity over time in Group B.

4.8 Objective Three: To Determine the Effectiveness of Cervical Spine Manipulation Combined with Dry Needling in Terms of Objective and Subjective Data for the Treatment of ETTH

4.8.1 Objective Measurements

4.8.1.1 Group C – CSM combined with dry needling

4.8.1.1.1 CROM Goniometer

- **Flexion**

Figure 4.23 represents a statistically significant (p = 0.0086) change in the mean flexion ROM over time.

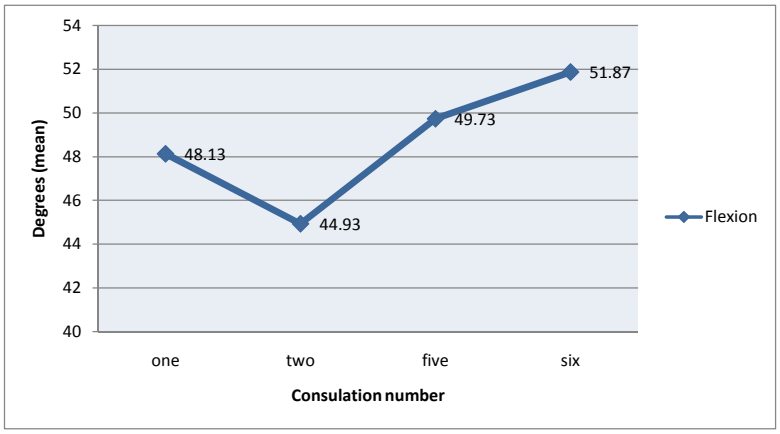


Figure 4.23: Mean change in flexion ROM over time in Group C

- **Extension**

Figure 4.24 illustrates that there was no statistically significant (p = 0.0894) change in the mean extension ROM over time.

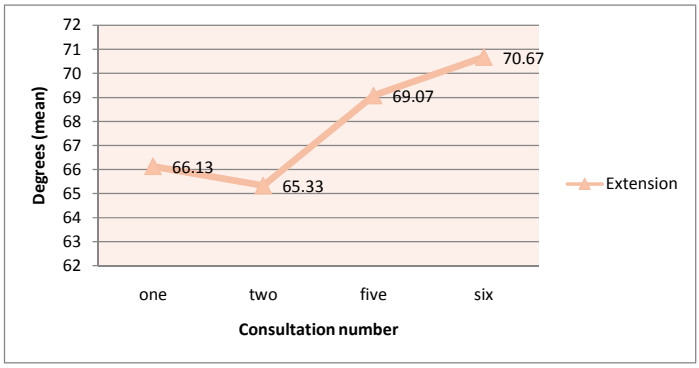


Figure 4.24: Mean change in extension ROM over time in Group C

- **Left Lateral Flexion**

Figure 4.25 represents a statistically significant (p = 0.0215) change in mean left lateral flexion ROM over time.

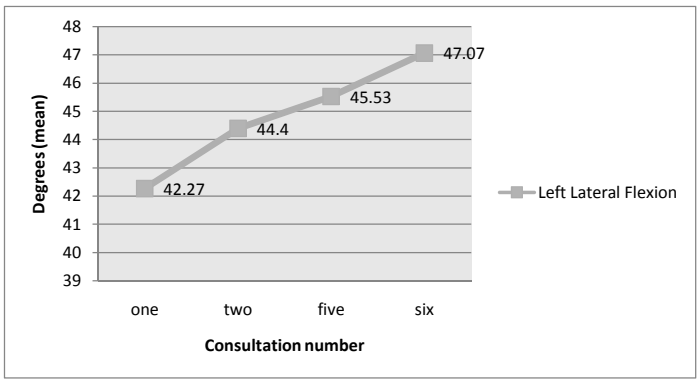


Figure 4.25: Mean left lateral flexion ROM over time in Group C

- **Right Lateral Flexion**

No statistically significant (p = 0.1288) change was noted in mean right lateral flexion ROM over time as illustrated in Figure 4.26.

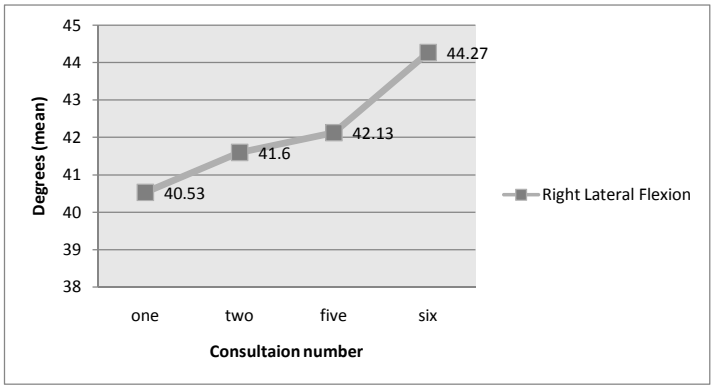


Figure 4 26: Mean right lateral flexion ROM over time in Group C

- **Left Rotation**

Figure 4.27 illustrates a statistically significant (p = 0.0005) change in the mean left rotation over time.

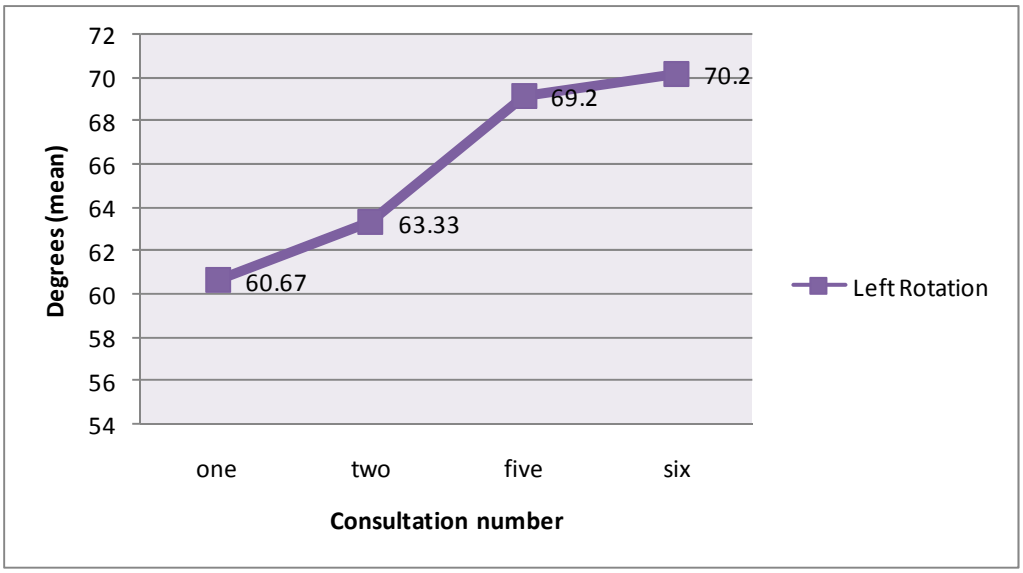


Figure 4.27: Mean change in left rotation ROM over time in Group C

- **Right Rotation**

No statistically significant (p = 0.2957) change was noted in the mean right rotation ROM over time as represented in Figure 4.28.

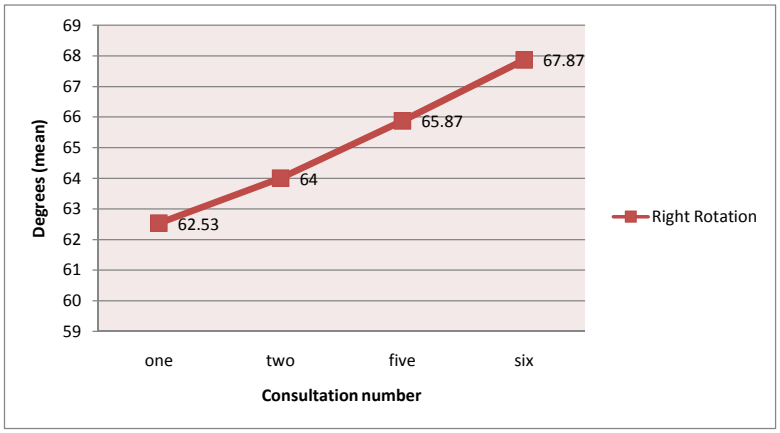


Figure 4.28: Mean change in right rotation ROM over time in Group C

4.8.1.1.2 Algometer

Figure 4.29 illustrates a highly statistically significant (p <0.0001) increase in the mean score for the most tender MFTPs over time.

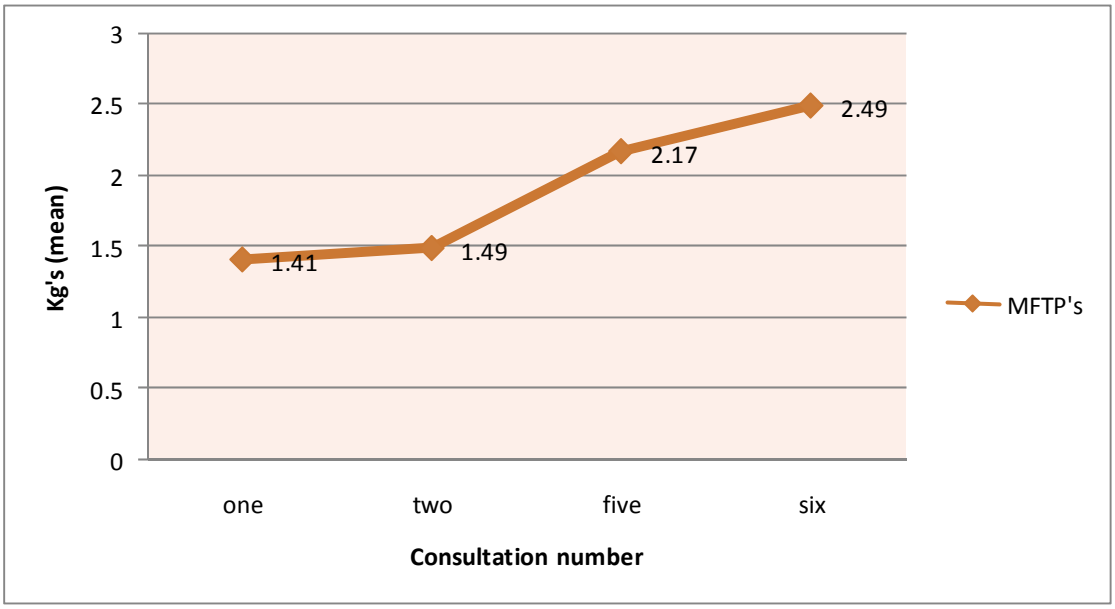


Figure 4.29: Mean score for the most tender MFTPs over time in Group C

4.8.2 Subjective Measurements

4.8.2.1 Headache Questionnaire/Disability Index

4.8.2.1.1 Headache Frequency – Question 1: I have a headache:

Table 4.16 represents a statistically significant change (p = 0.0030) in the frequency of headaches over time in Group C. No statistically significant (p = 0.3057) change was observed from consultation 1 to 5, however, a highly statistically significant (p <0.0001) change was observed from consultation 1 to 6.

Table 4.16: Changes in headache frequency from consultations one to six in Group C

	Group C (*n*)	**p – value**
Consultation 1		0.0030
1 per month	1	
More than 1 but less than 4 per month	2	
More than one per week	12	
Consultation 5		
1 per month	1	
More than 1 but less than 4 per month	6	
More than one per week	8	
Consultation 6		
1 per month	5	
More than 1 but less than 4 per month	8	
More than one per week	2	
Frequency of headaches decreased from consultation 1 to 5	5	0.3057
Frequency of headaches decreased from Consultation 1 to 6	12	<0.0001

Fischer's exact test (p = 0.0030)

4.8.2.1.2 Headache Severity – Question 2: I describe my headache as:

Table 4.17 represents a highly statistically significant change (p <0.0001) in the severity of headaches over time in Group C. Highly statistically significant (p <0.0001) changes were noted from consultation 1 to 5 and from 1 to 6.

Table 4.17: Changes in headache severity from consultations one to six in Group C

	Group C (*n*)	**p – value**
Consultation 1		<0.0001
Mild	1	
Moderate	6	
Severe	8	
Consultation 5		
Mild	10	
Moderate	5	
Severe	0	
Consultation 6		
Mild	12	
Moderate	3	
Severe	0	
Severity of headaches decreased from Consultation 1 to 5	13	<0.0001
Severity of headaches decreased from Consultation 1 to 6	13	

Fischer's exact test (p = <0.0001)

4.8.2.1.3 Disability Index

Figure 4.30 represents a highly statistically significant (p <0.0001) decrease in the mean disability index over time in Group C.

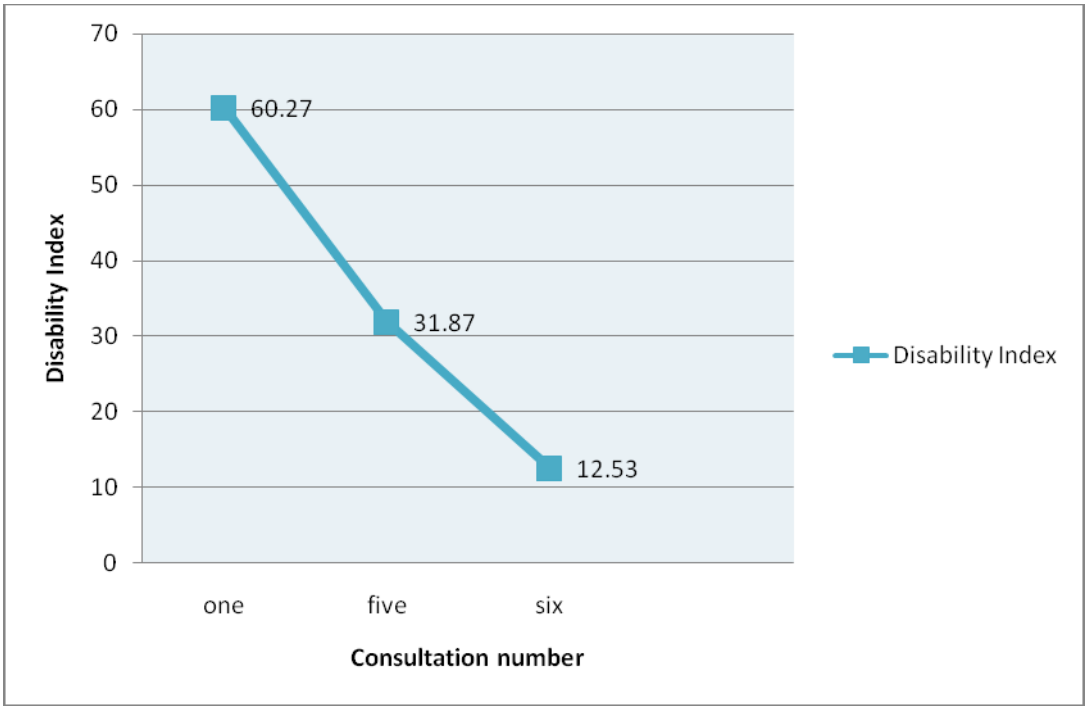


Figure 4.30: Mean change in the disability index over time in Group C

4.8.2.2 Headache Diary

- **Duration**

Figure 4.31 illustrates a statistically significant (p = 0.0119) decrease in the duration of the headaches over time in the combination group (Group C).

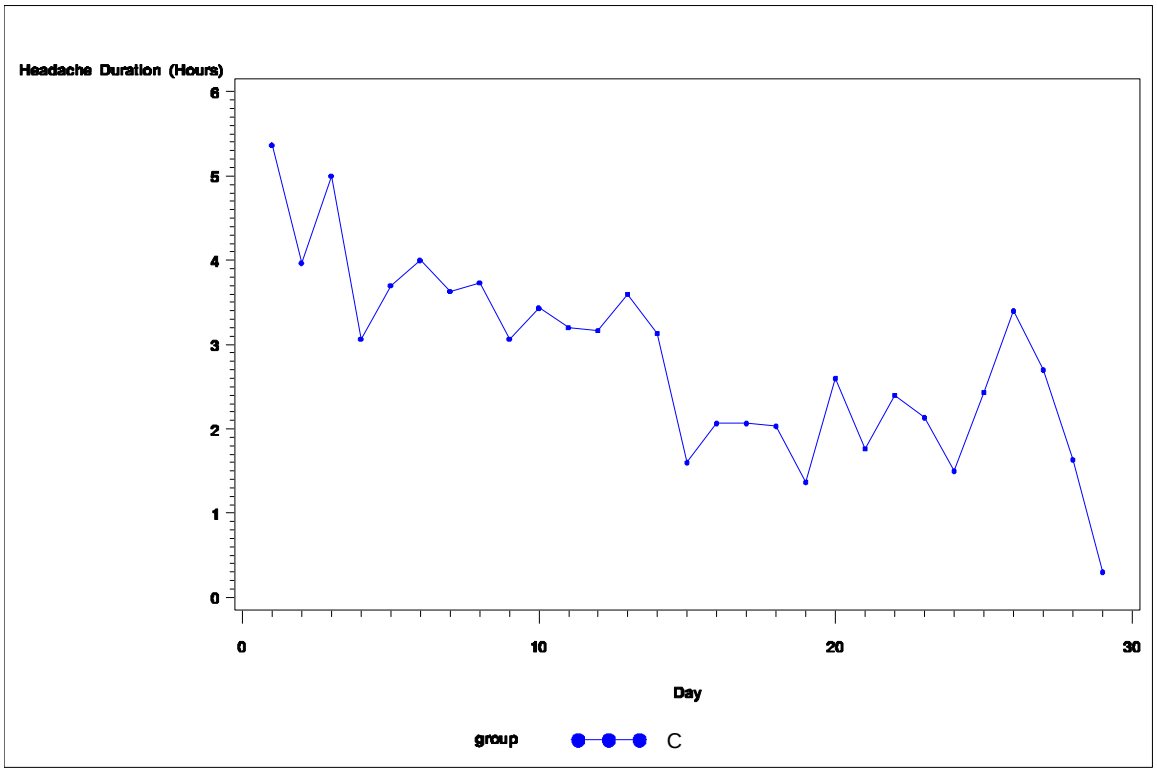


Figure 4.31: Duration of headache change over time in Group C

- **Intensity**

Figure 4.32 represents a highly statistically significant (p <0.0001) decrease in the headache intensity over the four week study period for Group C.

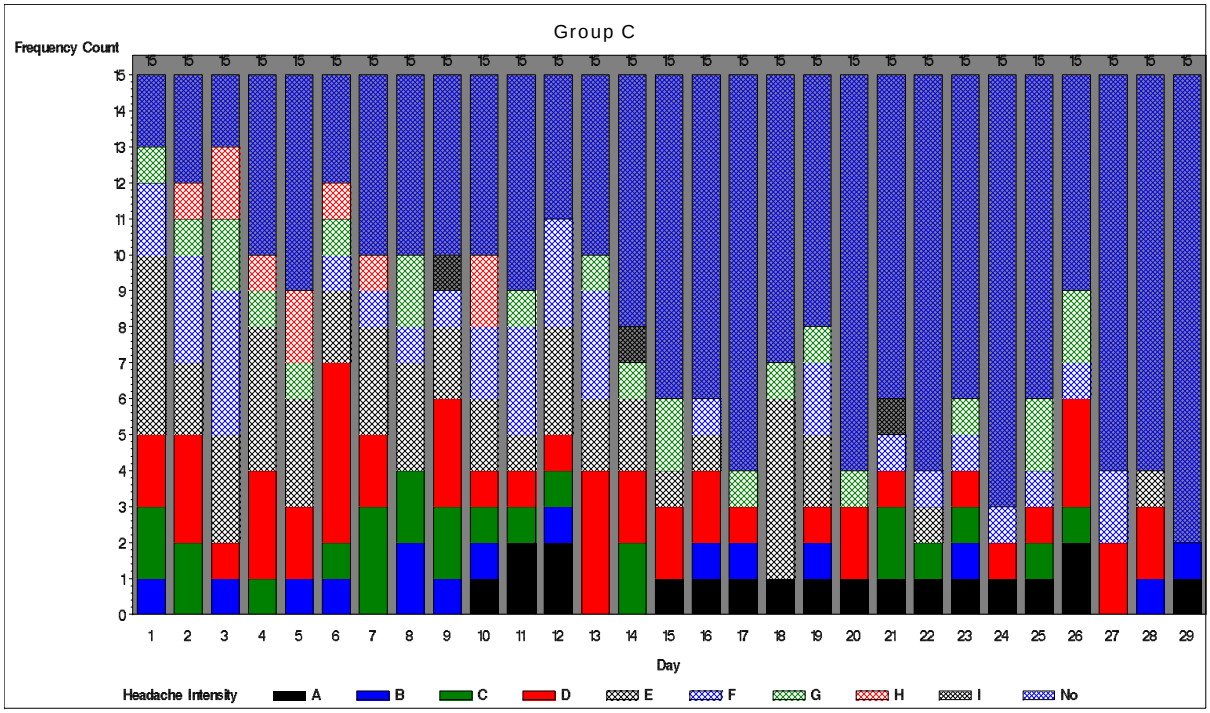


Figure 4.32: Changes in headache intensity over time in Group C

- **Severity**

Figure 4.33 illustrates a highly statistically significant (p <0.0001) decrease in the headache severity over the four week study period for the combination group (Group C).

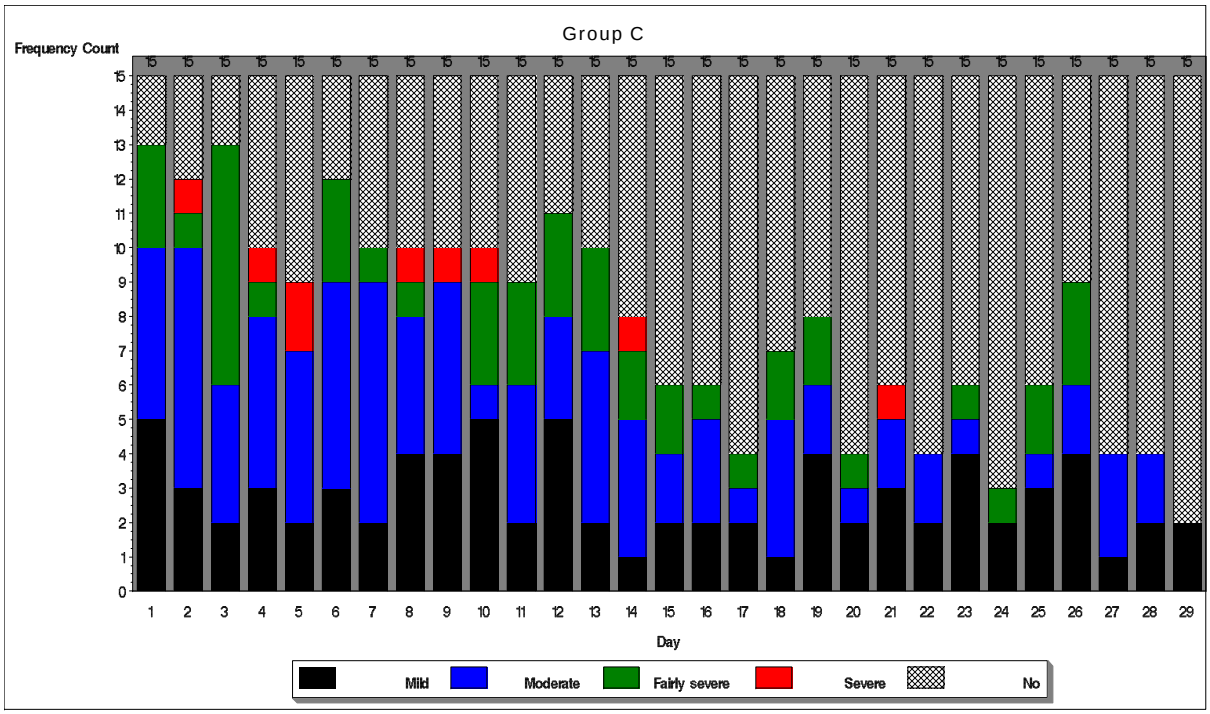


Figure 4.33: Changes in headache severity over time in Group C

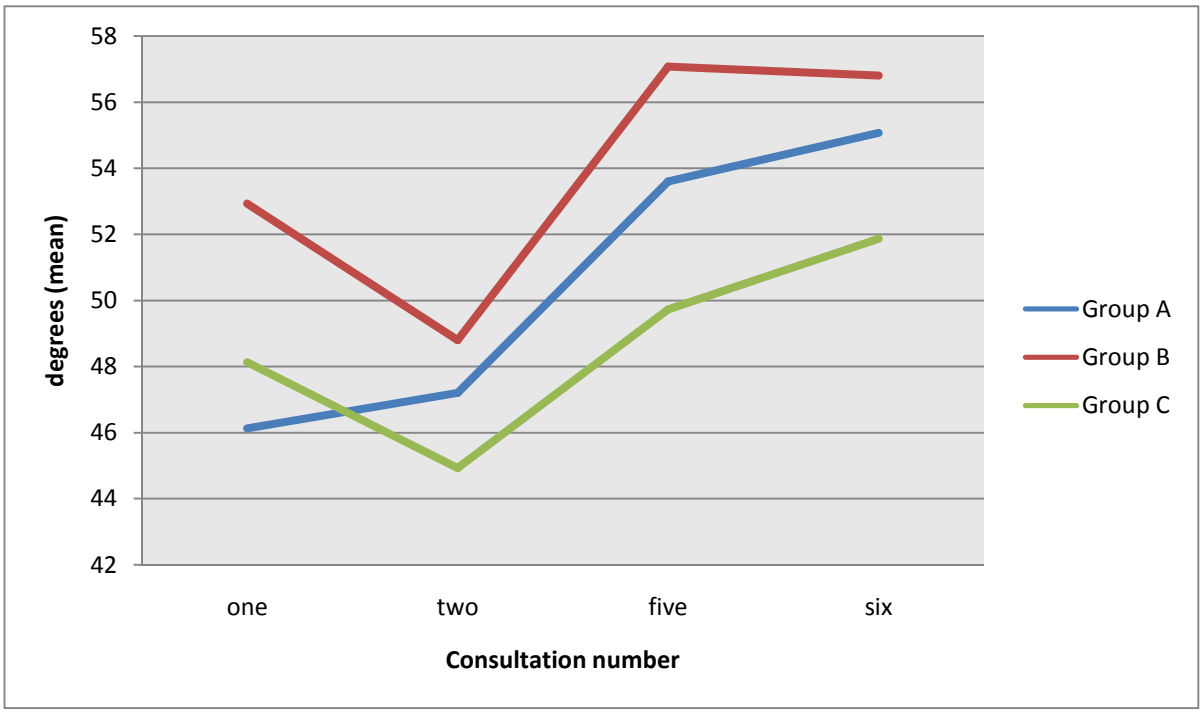
4.9 Objective Four: To Compare the Groups in Terms of Objective and Subjective Data

4.9.1 Objective Measurements

4.9.1.1 CROM Goniometer

- **Flexion**

Figure 4.34 illustrates no statistically significant difference in mean flexion ROM between the three groups from baseline to consultation two (p = 0.4571), baseline to consultation five (p = 0.0726), baseline to consultation six (p = 0.3640) and from consultation five to six (p = 0.6391).

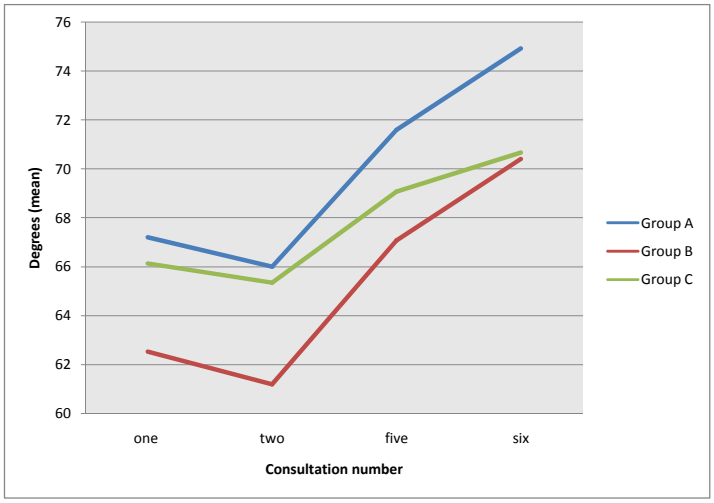


Time by group effect p= 0.2502

Figure 4.34: Mean flexion ROM over time between Groups A, B and C

- **Extension**

Figure 4.35 illustrates no statistically significant difference in the mean extension ROM between the three groups from baseline to consultation two (p = 0.8018), baseline to consultation five (p = 0.7597), baseline to consultation six (p = 0.4904) and from consultation five to six (p = 0.6307).



Time by group effect p = 0.9435

Figure 4.35: Mean extension ROM over time between Groups A, B and C

- **Left Lateral Flexion**

No statistically significant difference was noted in mean left lateral flexion ROM between the three groups from baseline to consultation two (p = 0.3923), baseline to consultation five (p = 0.2303), baseline to consultation six (p = 0.1955) and from consultation five to six (p = 0.8799) as illustrated in Figure 4.36.

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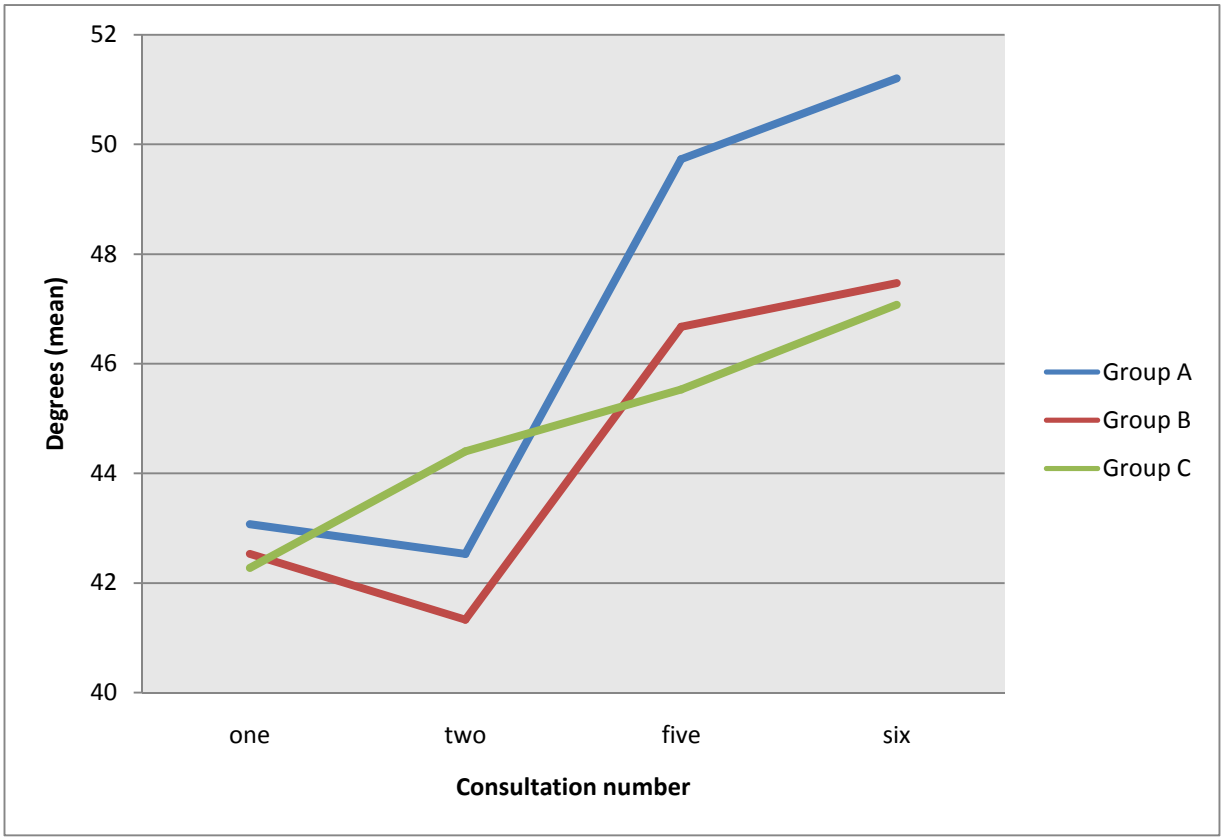
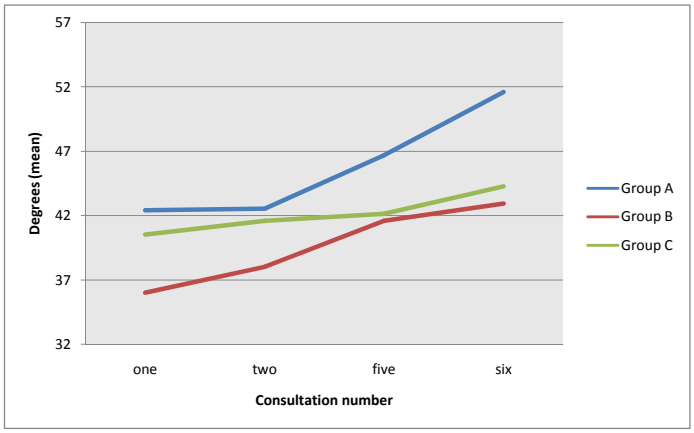


Time by group effect p = 0.2360

Figure 4.36: Change in mean left lateral flexion over time between Groups A, B and C

- **Right Lateral Flexion**

Figure 4.37 illustrates no statistically significant difference in mean right lateral flexion ROM between the three groups from baseline to consultation two (p = 0.9503), baseline to consultation five (p = 0.1860), baseline to consultation six (p = 0.1348) and from consultation five to six (p = 0.2439). The Bonferroni post hoc test showed that at consultation six, Group A was statistically significantly different to Groups B and C, indicating that Group A showed a greater improvement in right lateral flexion (Table 4.18).



Time by group effect p = 0.0812

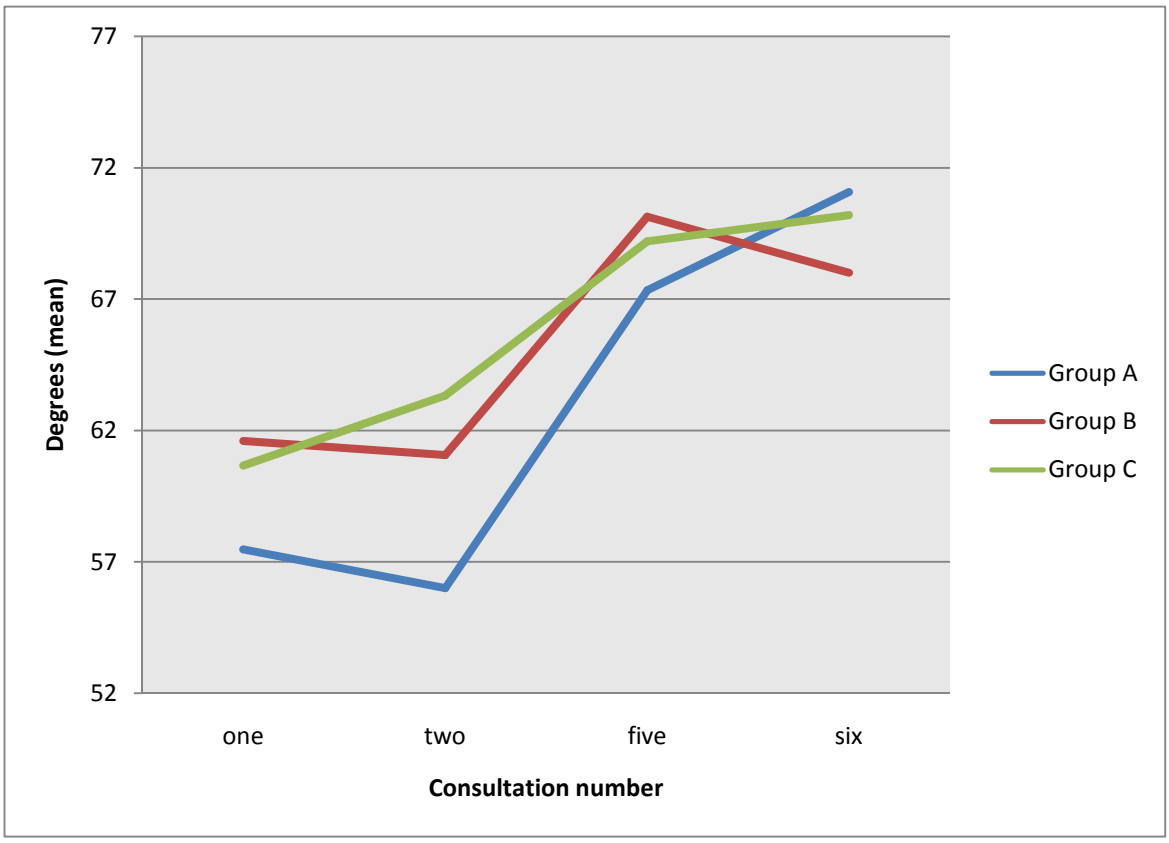
Figure 4.37: Mean right lateral flexion ROM over time between Groups A, B and C

Table 4.18: Mean right lateral flexion ROM at consultation six between Groups A, B and C

Group	Mean	*N*
A	51.60	15
B	42.93	15
C	44.27	15

- **Left Rotation**

Figure 4.38 represents no statistically significant difference in mean left rotation ROM between the three groups from baseline to consultation two (p = 0.1443), baseline to consultation five (p = 0.8806), baseline to consultation six (p = 0.2540) and from consultation five to six (p = 0.0624).

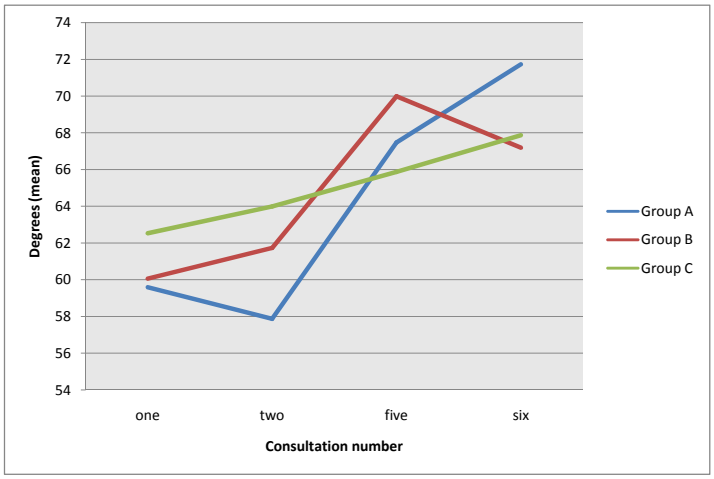


Time by group effect p = 0.0353

Figure 4.38: Change in mean left rotation over time between Groups A, B and C

- **Right Rotation**

No statistically significant difference was noted in mean right rotation ROM between the three groups from baseline to consultation two (p = 0.1163), baseline to consultation five (p = 0.2522), baseline to consultation six (p = 0.2122) and from consultation five to six (p = 0.1542) as represented in Figure 4.39.

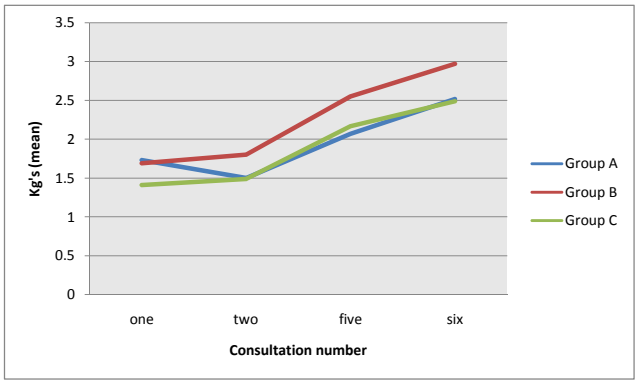


Time by group effect p = 0.0630

Figure 4.39: Mean right rotation ROM over time between Groups A, B and C

4.9.1.2 Algometer

Figure 4.40 illustrates no statistically significant difference in the mean tenderness scores of the most tender MFTPs between the three groups from baseline to consultation two (p = 0.1783) and baseline to consultation five (p = 0.0717), baseline to consultation six (p = 0.3021) and from consultation five to six (p = 0.9485).



Time by group effect p = 0.3978

Figure 4.40: Mean change in the most tender MFTP's over time between Groups A, B and C

4.9.2 Subjective Measurements

4.9.2.1 Headache Questionnaire/Disability Index

4.9.2.1.1 Headache Frequency – Question 1: I have a headache:

Table 4.19 illustrates no statistically significant difference in the frequency of headaches between the three groups at consultation one (p = 1.000), consultation five (p = 1.000), consultation six (p = 0.3307), from consultation one to five (p = 1.000) and from consultation one to six (p = 0.3872).

Table 4.19: Change in headache frequency from consultation one to six between Groups A, B and C

	Group A (*n*)	**Group B (*n*)**	**Group C (*n*)**	**p-value**
Consultation 1				1.000
1 per month	0	0	1	
More than 1 but less than 4 per month	3	2	2	
More than one per week	12	13	12	
Consultation 5				1.000
1 per month	1	1	1	
More than 1 but less than 4 per month	7	6	6	
More than one per week	7	8	8	
Consultation 6				0.3307
1 per month	3	1	5	
More than 1 but less than 4 per month	8	8	8	
More than one per week	4	6	2	

	Group A (*n*)	Group B (*n*)	Group C (*n*)	p-value
Frequency of headaches decreased from Consultation 1 to 5	5	6	5	1.000
Frequency of headaches decreased from Consultation 1 to 6	9	8	12	0.3872

4.9.2.1.2 Headache Severity – Question 2: I describe my headache as:

Table 4.20, represents no statistically significant difference at consultation one (p = 0.3938), consultation five (p = 1.000), consultation six (p = 0.6498), from consultation one to five (p = 0.8937) and from consultation one to six (p = 1.000) in the headache severity between the three groups.

Table 4.20: Change in headache severity from consultations one to six between Groups A, B and C

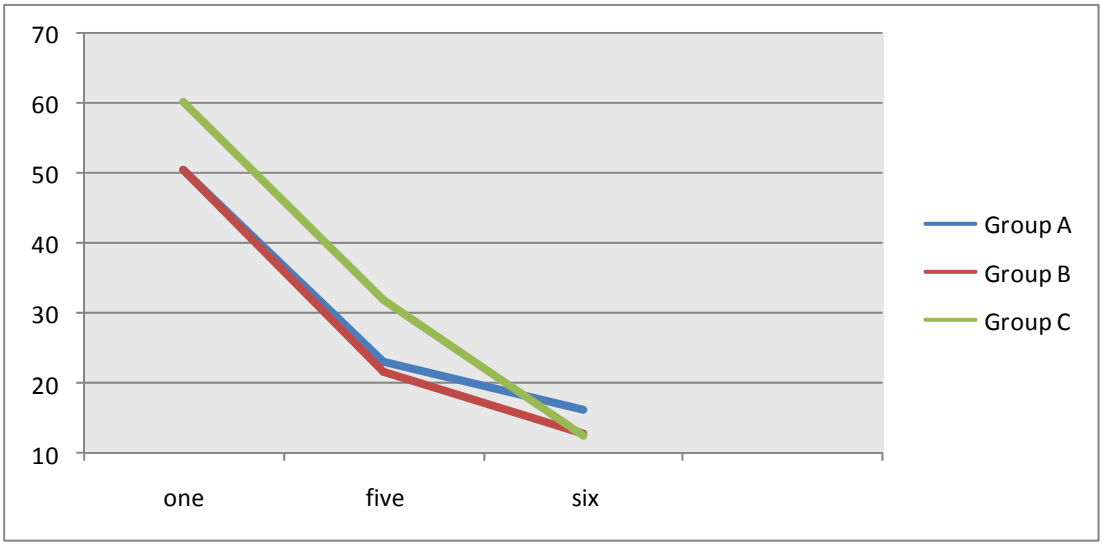
	Group A (*n*)	Group B (*n*)	Group C (*n*)	p-value
Consultation 1				0.3938
Mild	0	1	1	
Moderate	7	10	6	
Severe	8	4	8	
Consultation 5				1.000
Mild	9	9	10	
Moderate	5	6	5	
Severe	1	0	0	
Consultation 6				0.6498
Mild	11	12	12	
Moderate	2	3	3	
Severe	2	0	0	

	Group A (*n*)	Group B (*n*)	Group C (*n*)	p-value
Severity of headaches decreased from Consultation 1 to 5	12	11	13	0.8937
Severity of headaches decreased from Consultation 1 to 6	12	12	13	1.000

4.9.2.1.3 Disability Index

Figure 4.41 illustrates no statistically significant difference in the mean disability index between the three groups from baseline to consultation five (p =0.6796) and baseline to consultation six (p = 0.4599), however, a significant change was noted from consultation five to six (p = 0.0351).

The Bonferroni post hoc test revealed that Group C was statistically significantly different from Groups A and B, indicating that Group C showed superior improvement in headache disability (Table 4.21).



Time by group effect p = 0738

Figure 4.41: Change in mean disability index over time for Group A, B and C

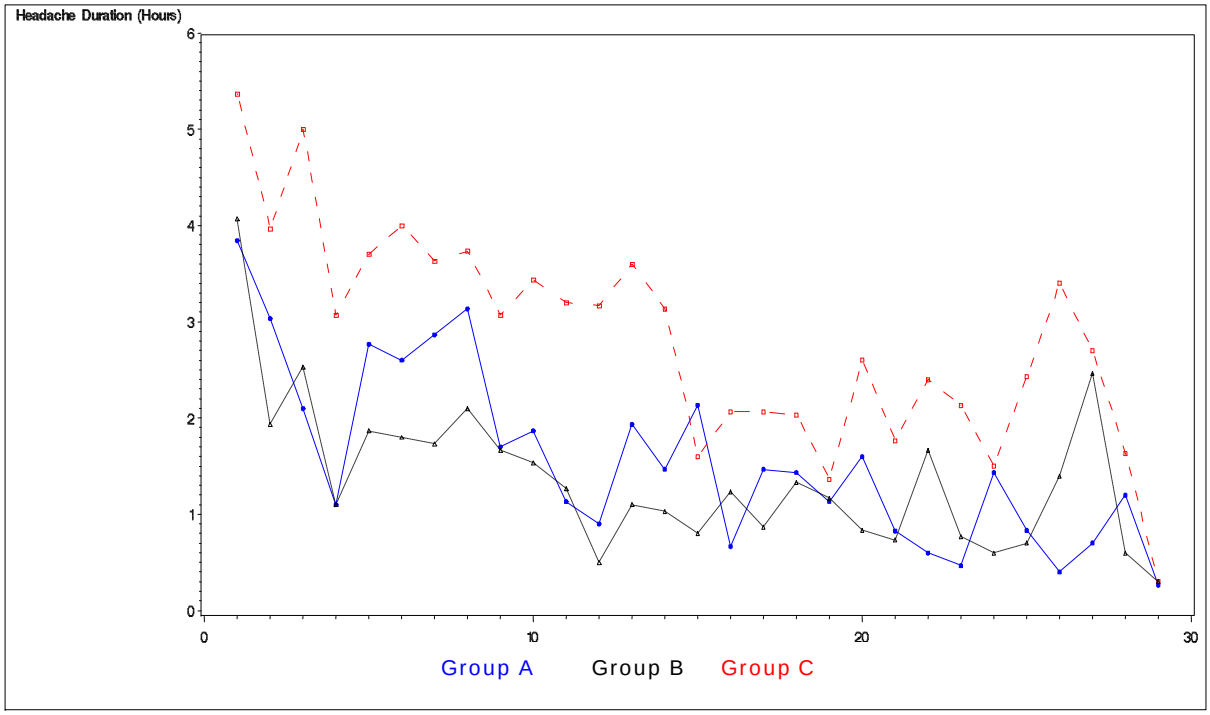
Table 4.21: Change in mean disability index score from consultation 5 to 6 between Groups A, B and C

Group	Mean	*n*
A	-6.80	15
B	-8.80	15
C	-19.33	15

4.9.2.2 Headache Diary

- **Duration**

Figure 4.42 represents no statistically significant (p = 0.1738) difference in terms of headache duration between the groups over the study.

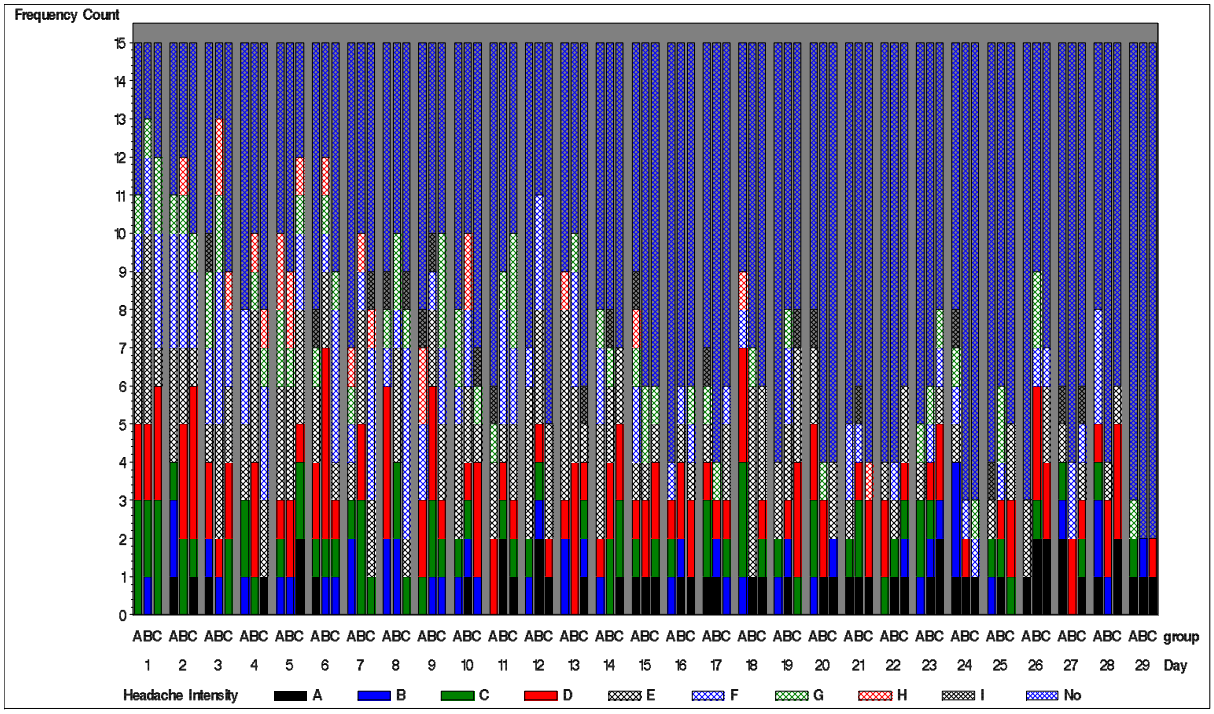


Time by group effect p = 0.1738

Figure 4.42: Duration of headache change over time in Groups A, B and C

- **Intensity**

Figure 4.43 illustrates no statistically significant (p = 0.6980) difference in terms of headache intensity between the groups over the intervention period.

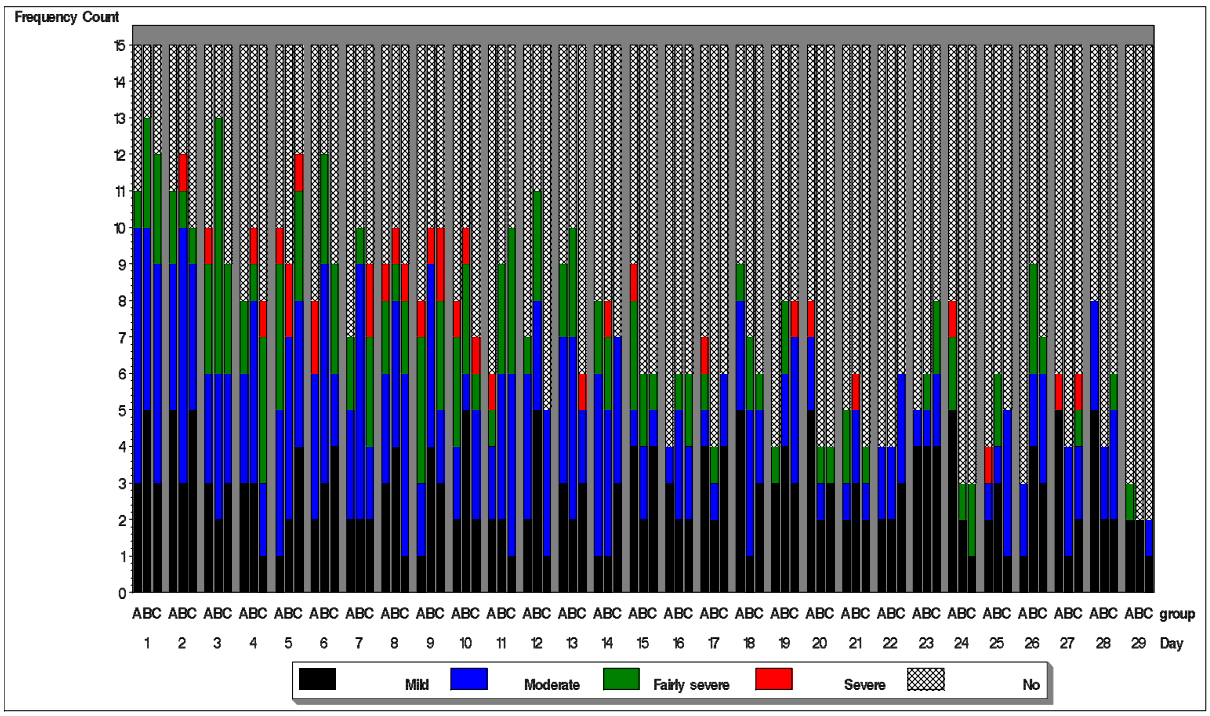


Time by group effect p = 0.6980

Figure 4.43: Intensity of headache change over time in Groups A, B and C

- **Severity**

All groups had a decrease in headache severity over the intervention period as represented in Figure 4.44. No statistically significant (p = 0.3479) difference was noted between the groups.



Time by group effect p = 0.3479

Figure 4.44: Changes in headache severity over time in Groups A, B and C

4.10 Conclusion

At baseline, all three groups were comparable in respect of the objective and subjective findings. Similarly, each group revealed statistically significant improvements in terms of the objective and subjective measurements over the duration of the study. When the three groups were compared, there were no statistically significant differences noted between the groups except for a statistically significant improvement on right lateral flexion in Group A at consultation six and a statistically significant improved disability scores from consultation five to six for Group C.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter involves a discussion of the results presented in Chapter Four.

5.2 Demographics

5.2.1 Gender

Table 4.1 illustrated no statistically significant difference (p = 0.3611) in gender distribution between the three groups. The total sample size consisted of 45 participants of which 30 (66.6%) were female and 15 (33.3%) were male. This is in keeping with literature where Schwartz *et al*. (1998); Gardner and Mosby, (2000); White *et al.* (2000) and Jensen, (2003a) observed episodic tension-type headache (ETTH) to have a higher prevalence in women than in men regardless of their age, level of education or ethnicity (Schwartz *et al*., 1998).

5.2.2 Ethnicity

In total, there were 18 Indian, 14 Caucasian, 10 African and 3 Coloured participants that took part in the study with no statistically significant difference (p = 0.9375) in ethnic group distribution between the three groups (Table 4.2). The majority of the participants in this study were Indian. Similarly, the majority of participants in a study carried out by Prithipal (2001) (n = 60) on ETTH were Indian. However, Schwartz *et al*. (1998) observed a higher prevalence in White individuals. A possible reason for this could be that there is a very large Indian population residing in the in the greater Durban area (Krugel, 2010).

5.2.3 Age

As illustrated in Table 4.3, similar age distributions were observed between the three groups (p = 0.6598) with the mean age between the three groups being 31. This concurs with Kidson (2001) (n = 60) who found the mean age in ETTH sufferers to be 31.3. The mean age in this study falls within the peak range of 30 – 39 as stated by Schwartz *et al.* (1998) in his study on the epidemiology of TTH.

5.2.4 Conclusion

There were no statistically significant differences observed between the three groups in respect to the demographics of gender, ethnicity and age. Therefore, the impact of these demographics on the results of the study have been insignificant.

5.3 Objective One: To Determine the Effectiveness of Cervical Spine Manipulation in Terms of Objective and Subjective Data for the Treatment of ETTH

5.3.1 Group A – CSM alone

5.3.1.1 CROM measurements and Algometer readings

Group A illustrated a statistically significant (p <0.05) improvement in all cervical range of motion (CROM) (Figures 4.1 to 4.6) and algometer readings for the most tender myofascial trigger points (MFTPs) (Figure 4.7) over the duration of the study.

Discussion:

In terms of CROM, the results of this group are consistent with Whittingham and Nilsson (2001) (n = 105) and Pikula (1999) (n = 36) who observed statistically significant increases in cervical range of motion after cervical spinal manipulation (CSM). According to Gatterman (2005), manipulative procedures correct abnormal joint movement, alignment, muscle imbalances, relieve pain caused by inhibiting the joint pain receptors and also relieve pain in the presence of a trapped synovial membrane by correcting joint movement restrictions and allowing free movement by relaxing hypertonic muscles. All these things in turn will aid in improved ROM which are consistent with the results obtained in this group.

The increase in myofascial trigger point (MFTP) pain pressure threshold (algometer scores) is supported by Hong (2006) who stated that MFTPs and facet nociceptors are connected in the spinal cord. He proposed that when facet joint dysfunction was restored by spinal manipulation, a spinal cord reflex mechanism released the spasm associated with MFTPs. Similarly, Travell *et al.* (1999); Hong (2006) and Ruiz-Sáez *et al.* (2007) proposed joint dysfunction to increase MFTP development and that

correcting the joint dysfunction decreases MFTPs. The results of this study concur with Ruiz-Sáez *et al.* (2007) (n = 72) who investigated the effects of CSM on MFTPs in the upper Trapezius and observed there to be an increase in the pain pressure threshold following CSM. Similar results were found by Filipkowski (2006) who in a case study on a 45 year old female suffering from headaches and neck pain observed CSM to result in an increased tolerance to pain pressure threshold in the cervico–thoracic muscles.

5.3.1.2 Headache Questionnaire/Disability Index and Headache Diary

Group A showed a highly statistically significant (p <0.0001) improvement in headache disability index scores (Figure 4.8), frequency (p = 0.0301) and severity (p <0.0001) of the headache over the study period (Tables 4.12 and 4.13). It was observed that more participants reported a decrease in headache severity to that of frequency.

In terms of the headache diary, Figures 4.9 – 4.11 represent a statistically significant (p <0.0001) decrease in the duration, intensity and severity of the headache for the participants in this group over the study period.

Discussion:

Penter (1994) (n = 30) observed there to be a statistically significant (p <0.05) improvement in the disability index score following CSM in TTH (tension-type headache) sufferers. de Busser (2001) (n = 30) used a headache questionnaire but it was issued to participants at the initial consultation to determine a baseline for their headache and not during the intervention periods, so no conclusive evidence about the patient disability could be made in response to treatment. However, to this researcher's knowledge, no further study has investigated the headache questionnaire/ disability index score in response to CSM over the course of a study therefore a paucity of literature exists against which to compare.

Penter (1994) (n = 30) found a statistically significant decrease in TTH intensity, duration and frequency with CSM. However, Bove and Nilsson (1998) (n = 75) observed CSM to have no significant positive effect on headache intensity, duration and frequency, although a decrease in duration was found. Kidson (2001) (n = 60)

found that CSM decreased the intensity of ETTH. Furthermore, the results of this study concur with Lenaerts (2004) who cited CSM to be a favorable treatment modality for TTH.

5.4 Objective Two: To Determine the Effectiveness of Dry Needling in Terms of Objective and Subjective Data for the Treatment of ETTH.

5.4.1 Group B – Dry needling alone

5.4.1.1 CROM measurements and Algometer readings

Group B showed statistically significant (p <0.05) improvements in all CROM (Figures 4.12 to 4.17) and algometer readings for the most tender MFTPs (Figure 4.18) over the duration of the study.

Discussion:

Karakurum *et al*. (2001) (n = 30); Kamanli *et al.* (2005) (n = 10); Rickards (2006); Shah and Gilliams (2008) and Kaya *et al.* (2009) found that CROM measurements improved after dry needling. Hong (2006) stated that releasing muscle tension increases cervical ROM, the muscle tension most effectively being released by intramuscular dry needling (Huguenin, 2004; Kamanli *et al.* 2005), resulting in increased cervical ROM (Kamanli *et al.,* 2005).

In terms of pain pressure threshold, similar statistically significant results were observed by Karakurum *et al*. (2001) after intramuscular dry needling of MFTP in individuals suffering from ETTH and Kamanli *et al.* (2005) who used dry needling as a treatment method for MFTPs of the cervical, shoulder and upper back muscles. Travell *et al.* (1999) and Huguenin (2004) indicated dry needling for the relief of pain and improved pain threshold of a MFTP. Dommerholt (2004) stated that this pain relief is achieved by mechanically stimulating the MFTP with a dry needle which blocks painful input from the MFTP via activation of the gate control system.

5.4.1.2 Headache Questionnaire/Disability Index and Headache Diary

Group B showed highly statistically significant decreases in severity (Table 4.15) and headache questionnaire disability (Figure 4.19) over the duration of the study with headache frequency showing a difference from consultation one to six. The headache diary analysis (Figures 4.20 – 4.22) revealed that duration, intensity and severity of the headache all decreased statistically significantly over the course of the intervention.

Discussion:

The findings in this group are in keeping with Karakurum *et al*. (2001) where there was a statistically significant improvement in the headache disability following intramuscular dry needling. Karakurum *et al*. (2001) also observed that the headache frequency and intensity improved significantly with dry needling as observed with the headache diary. Similarly, a study by Galer and Kitahara (1995) (n = 19), investigating the effectiveness of intramuscular dry needling in tension-type headaches (TTH) (n = 5) found four of the five participants to have improvement in headache frequency and intensity. In the current study, TTH frequency and intensity has statistically significant decreases from consultations one to six which is in keeping with Huguenins (2004) study that dry needling resulted in long lasting pain relief.

5.5 Objective Three: To Determine the Effectiveness of Cervical Spine Manipulation Combined with Dry Needling in Terms of Objective and Subjective Data for the Treatment of ETTH.

5.5.1 Group C – CSM combined with dry needling

5.5.1.1 CROM measurements and Algometer readings

The CROM measurements revealed statistically significant (p <0.05) increases in all ROM except extension, right lateral flexion and right rotation. The algometer readings showed a highly statistically significant (p <0.0001) increase over the course of the intervention.

Discussion:

To this researcher's knowledge, no study has investigated the combination of spinal manipulative therapy and dry needling in the treatment of TTH. Therefore there was a paucity of literature with which to compare the CROM results. However, Whittingham and Nilsson (2001) and Pikula (1999) observed that CROM increased in patient suffering with TTH after CSM. Similarly, Karakurum *et al*. (2001); Kamanli *et al.* (2005); Rickards (2006); Shah and Gilliams (2008) and Kaya *et al.* (2009) observed that CROM measurements improved after dry needling. Therefore, this study shows that when both treatments were administered simultaneously there was an improvement in CROM measurements. However, the combination group did not improve in all ROM, only in flexion, left lateral flexion and left rotation. This is an unaccounted anomaly as dry needling of the MFTP's and CSM was administered bilaterally in the majority of patients.

The results of this study concur with de busser (2001) (n = 30) where an increase in pain pressure threshold measurements were noted following CSM combined with cervico-thoracic massage in the management of ETTH. Similarly, Prithipal (2003) (n = 60) observed an increase in pain pressure threshold following the use of interferential current combined with CSM in the management of ETTH. Both these studies utilized a muscle relaxation technique combined with spinal manipulative therapy indicating that the combination treatment approach resulted in a favourable outcome.

5.5.1.2 Headache Questionnaire/Disability Index and Headache Diary

Group C showed statistically significant decreases in the headache questionnaire in terms of disability, frequency and severity. In terms of the headache diary, statistically significant changes were noted in duration, intensity and severity of the headache over the duration of the study.

Discussion:

Similar results were noted by Penter (1994) (n = 30), Bove and Nilsson (1998) (n = 75), de Busser (2001) (n = 30) and Prithipal (2003) (n = 60) in their studies using CSM in combination with a soft tissue technique where headache duration,

frequency and severity decreased due to the combination therapy administered. It appears as if the combination treatments in these studies produced similar results to the combination treatment in the current study in terms of TTH management where the combination groups were not found to be statistically superior to the isolated treatments. This would be supported by the literature where spinal manipulative therapy (Gatterman, 1990; Jamison, 1991; Gardner and Mosby, 2000; Lenaerts, 2004) as well as dry needling techniques (Galer and Kitahara, 1995 and Karakurum *et al.* 2001) were observed to be effective in TTH management.

5.6 Objective Four: To Compare the Groups in Terms of Objective and Subjective Data

5.6.1 Groups A, B and C

5.6.1.1 CROM measurements and Algometer readings

No statistically significant (p <0.05) changes were observed for cervical range of motion (ROM) between the three groups except at consultation six where the group receiving CSM alone showed a statistically significant improvement over the other groups. Algometer readings between the three groups showed no statistically significant differences.

Discussion:

In this study, at consultation six, the group receiving CSM showed a statistically significant improvement in right lateral flexion compared to the other two groups indicating that manipulation alone may have superior long term benefits compared to dry needling alone or a combination of the two in improved ROM findings over a one week period. However, this result was isolated to right lateral flexion and was not seen on other ROM and may be an anomaly. According to Karakurum *et al*. (2001), cervical ROM increases after dry needling and according to Pikula (1999), Whittingham and Nilsson (2001), CSM increases cervical ROM. Therefore, all three treatments were effective in increasing CROM.

In comparing the mean algometer readings over time, all three groups improved significantly, however, no statistically significant differences were noted between the groups advocating the benefits of the interventions in isolation and in combination for ETTH. Similarly, de Busser (2001) (n = 30) and Prithipal (2003) (n = 60) observed no statistically significant difference between the treatment groups although a decrease in MFTP tenderness was noted.

5.6.1.2 Headache Questionnaire/Disability Index and Headache Diary

The headache questionnaire showed that headache frequency, severity and disability had no statistically significant difference between the three treatment groups, but the index score between consultation five and six showed that the combination group (Group C) was statistically superior (p <0.0001) in its effect on disability. In terms of the headache diary (duration, intensity and frequency), no statistically significant difference was observed between for all groups.

Discussion:

Similar studies by Penter (1994) (n = 30), Bove and Nilsson (1998) (n = 75), de Busser (2001) (n = 30) and Prithipal (2003) (n = 60), observed there to be decreases in headache duration, intensity and frequency of ETTH in all groups when they compared single verses combination interventions. The interventions used in this study resulted in all groups improving equally which is comparable to these previous studies. However, between consultations five and six the combination group showed a statistically significant improvement in the disability index score over the other groups indicating that subjectively the combination therapy was superior in its treatment effect in the long term.

5.7 Review of the null hypothesis'

5.7.1 Null Hypothesis one

The null hypothesis was rejected as the group receiving CSM alone did show a statistically significant improvement in terms of subjective (headache diary and headache questionnaire) and objective (algometer and CROM measurements) data in the treatment of episodic tension-type headaches (ETTHs).

5.7.2 Null Hypothesis two

The null hypothesis was rejected as the group receiving dry needling alone did show a statistically significant improvement in terms of subjective (headache diary and headache questionnaire) and objective (algometer and CROM) data in the treatment of ETTHs.

5.7.3 Null Hypothesis three

The null hypothesis was rejected as the group receiving CSM combined with dry needling did show a statistically significant improvement in terms of subjective (headache diary and headache questionnaire) and objective (algometer and CROM) data in the treatment of ETTH.

5.7.4 Null Hypothesis four

The null hypothesis was accepted as there was no statistically significant difference in improvements of the combination treatment group (Group C) over the other two groups in the relief of ETTH as compared to either CSM or dry needling alone however, Group C did show superiority over the other groups in the long term with respect to the disability index.

5.8 Conclusion

This study investigated three treatment modalities, CSM alone, dry needling alone as well as CSM combined with dry needling for effective treatment of ETTHs. This was carried out in terms of objective and subjective measurements. Although no statistically significant differences were observed between the three groups in terms of these objective and subjective measurements, there were statistically significant improvements in all three groups and the combination group (Group C) showed superiority over the other two groups in the long term with respect to the disability index. Therefore, in terms of the subjective measurements, the combination group showed greater improvement over the long term.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The purpose of this study was to determine the effectiveness of cervical spine manipulation alone (CSM), dry needling alone and CSM combined with dry needling in the management of episodic tension-type headaches (ETTHs) in terms of objective and subjective findings.

The objective and subjective findings in this study concurs with the large body of literature that CSM alone and dry needling alone has a positive effect on the course of a tension-type headache (TTH). Statistically significant changes (p <0.05) were observed for each treatment modality, in isolation or combination in terms of objective and subjective findings.

This study observed there to be no statistically significant difference between the three treatment groups. The findings are in keeping with literature on combination therapies on ETTHs where no statistically significant differences were found between the treatment groups in terms of objective and subjective findings.

There is no current literature comparing CSM to dry needling to CSM combined with dry needling. However, the results of this study have shown that the three treatment approaches are equally effective in terms of pain pressure threshold and headache duration, frequency, intensity and severity. However, the disability index scores (subjective measurement) in the combination treatment group (Group C) were observed to be superior to the other two treatments (p <0.0001) in the one week follow up treatment (long term) and the CSM group (Group A) was noted to have a greater improvement (p <0.0001) in right lateral flexion when compared to the other two groups.

6.2 Recommendations

It is recommended that in future studies a larger sample size should to be used due to the fact that the results observed in this study are similar to other combination studies in episodic tension-type headache (ETTH). Furthermore, no statistically significant differences were observed between treatment groups.

Although participants were allowed to take medicines for their headaches an hour after the initial symptoms, it is recommended that in future studies the medication dosage and time of medication intake should be recorded in order to monitor any change in headache patterns and subsequent medication intake over the course of the treatments.

A final recommendation would be a longer follow up period to determine the long term effect of the treatments on the course of the headache.

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Appendix A:

Are you between the ages of **18** and **50** and suffer from:

Tension-Type Headaches

Research is currently being carried out at the Durban University of Technology Chiropractic Day Clinic

Free Treatment

is available to those who qualify to take part in this study.

Contact **Les Trollope** on 083 677 1570

or (031) 373 2205/ (031) 373 2512 for more information.

Appendix B:

Letter of information and informed consent

Dear Participant

Thank you for joining my research. I am a chiropractic student trying to obtain my M.Tech Chiropractic degree. Outlined below is a brief description of the study and what will be needed from you. Your participation is greatly appreciated and your involvement is contributing to making a successful study.

Title of the Research Study: *The relative effectiveness of cervical spine manipulation alone, dry needling alone and cervical spine manipulation combined with dry needling for the treatment of episodic tension-type headaches in people 18-50 years of age.*

Principle Investigator/s:

Leslie John Watts Trollope Contact number (031)-373 2205 /0836771570

Co-Investigator/s:

Dr. Vilash Boodhoo [M.Tech-Chiropractic] Contact number (031)-207 7968/0837877086

Dr. Laura Wilson [M.Tech-Chiropractic, CCEP] Contact number (031)-561 1645

Brief Introduction and Purpose of the Study:

You have been selected to take part in a study investigating the effectiveness of cervical spine manipulation alone, dry needling alone and cervical spine manipulation combined with dry needling therapy for the treatment of episodic tension-type headaches in people 18-50 years of age. Forty five people will be selected and required to complete this study. All participants will be randomly split into three equal groups (A, B and C). Each individual will receive a clinical treatment depending on the group they are allocated to.

Outline of the Procedures:

At the initial appointment you will be screened to determine whether you are suitable as a participant, using a case history, physical examination and cervical spine regional examination. All participants are requested to attend 6 consultations over a four week period at the Durban University of Technology Chiropractic Day Clinic.

Please do not change/alter your activities of daily living and lifestyle as this may interfere with the readings of the study and create false readings.

All participants that have contra-indications to dry needling therapy as well as spinal manipulative therapy will not be allowed to participate in this study. Participants that fail to sign the informed consent form will be excluded from the study.

Risks or Discomforts to the Subject:

All groups in the study will receive treatment that is safe and efficient with all the treatments carried out under the supervision of a qualified chiropractor.

Benefits:

This study will add to the information on how to effectively treat tension-type headaches. This will enable practitioners to choose the best treatment for his/her patients in order to help relieve the headache.

Completion of the study will allow the spectrum of tension-type headache knowledge to be broader. This strengthens the profession so that further research can be undergone and by so doing, efficiencies in treatment aspects are stronger and more reliable.

Reason/s why the Subject May Be Withdrawn from the Study:

You may be withdrawn from the study if your headache requires other further assessment or treatment, if you are unwilling to continue participation in the study and if you fail to comply with the rules of the study. Should you withdrawal from the study it will not compromise future treatment at the chiropractic day clinic.

Remuneration:

Patients taking part in the study will not receive any form of remuneration for taking part in the study.

Costs of the Study:

Participants receiving treatment for the duration of the study will not be charged but if the participant wants further treatment upon completion of the study, normal consultation rates will apply.

Confidentiality:

All patient information relevant to the study will be kept confidential and will be stored in the Chiropractic Day Clinic for 5 years, after which it will be disposed of. The results of the study will be made available at the Durban University of Technology Library for educational purposes, but no patient information will be revealed.

Research-related Injury:

Needle penetration into the skin may be perceived as unpleasant. Patients may experience minimal temporary pain with insertion of the needle. Bleeding from dry needling is minimal and temporary and will be controlled with mild compression by the researcher after needling. Post-needling soreness may affect some participants.
Other effects may include dizziness, nausea and syncope. This is a transient reaction which lasts a few minutes and patients who react will be placed in the recovery position. There are no long term effects.
The treatment protocol will be carried out according to a set clinic protocol and will not deviate from the norms of treatment as set forth by the clinic, therefore treatments being controlled under close supervision.

Persons to Contact in the Event of Any Problems or Queries:

If you any questions or problems with respect to the study please feel free to contact my research supervisor, Dr. Vilash Boodhoo on (031)-2077968 or you can contact The Faculty of Health Sciences research co-ordinator, Mr V. Singh on (031) 373 2701.

Statement of Agreement to Participate in the Research Study:

I,…..... (subject's full name), ID number……....., have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by
…….....

to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study.

Subject's name (print) ……..

Subject's signature: ……..……..... Date: ……..…....

Researcher's name (print) signature: ……....

Researcher's signature: …….....Date: .....

Witness name (print) signature: ……....

Witness signature: …….....Date: …….....

Appendix C:

DURBAN UNIVERSITY OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient:_____ Date:_____

File # :_____ Age: _____

Sex : _____ Occupation:_____

Intern :_____ Signature_____

FOR CLINICIANS USE ONLY:

Initial visit

Clinician: Signature :

Case History:

Examination:

Previous: Current:

X-Ray Studies:

Previous: Current:

Clinical Path. lab:

Previous: Current:

CASE STATUS:

PTT: Signature: Date:

CONDITIONAL:
Reason for Conditional:

Signature: Date:

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

Case Summary signed off: Date:

Intern's Case History:

1. Source of History:

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

3. Present Illness:

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

4. Other Complaints:

5. Past Medical History:

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

6. Current health status and life-style:

- Allergies
- Immunizations
- Screening Tests incl. x-rays
- Environmental Hazards (Home, School, Work)
- Exercise and Leisure
- Sleep Patterns
- Diet
- Current Medication
  Analgesics/week:
- Tobacco
- Alcohol
- Social Drugs

7. Immediate Family Medical History:

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

8. Psychosocial history:

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

9. Review of Systems:

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

Appendix D:

Durban University of Technology

PHYSICAL EXAMINATION: SENIOR

Patient Name : _____ **File no :**_____ **Date :**_____

Student : **Signature :**

VITALS:

Pulse rate:			Respiratory rate:	
Blood pressure:	R	L	Medication if hypertensive:	
Temperature:			Height:	
Weight:	Any recent change? Y / N		If Yes: How much gain/loss	Over what period

GENERAL EXAMINATION:

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

SYSTEM SPECIFIC EXAMINATION:

CARDIOVASCULAR EXAMINATION
RESPIRATORY EXAMINATION
ABDOMINAL EXAMINATION
NEUROLOGICAL EXAMINATION
COMMENTS

Clinician: **Signature :**

Appendix E: DURBAN UNIVERSITY OF TECHNOLOGY
REGIONAL EXAMINATION - CERVICAL SPINE

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

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

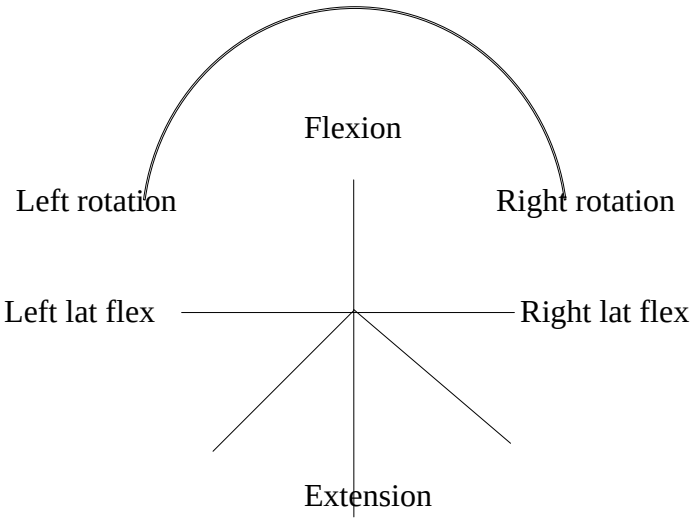
Clinician: ..... Sign: .....

OBSERVATION:

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

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

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



PALPATION:
Lymph nodes
Thyroid Gland
Trachea

ORTHOPAEDIC EXAMINATION:

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

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

NEUROLOGICAL EXAMINATION:

Dermatones	**Left**	**Right**	**Myotomes**	**Left**	**Right**	**Reflexes**	**Left**	**Right**
C2			C1			C5		
C3			C2			C6		
C4			C3			C7		
C5			C4					
C6			C5					
C7			C6					
C8			C7					
T1			C8					
			T1					
Cerebellar tests:		Left		Right				
Disdiadochokinesis								

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

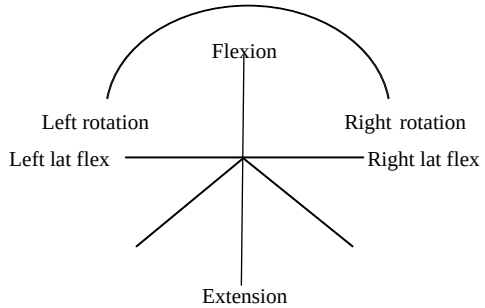
MOTION PALPATION & JOINT PLAY:
Left: Motion Palpation:
Joint Play:
Right: Motion Palpation:
Joint Play:

BASIC EXAM: SHOULDER:
Case History:

ROM: Active:
Passive:
RIM:
Orthopaedic:
Neuro:
Vascular:

BASIC EXAM: THORACIC SPINE:
Case History:

ROM:



Motion Palpation:	
Orthopaedic:	
Neuro:	
Vascular:	
Observ/Palpation:	
Joint Play:	

HEADACHE DIARY

Patient Name:_____

There are three questions that need to be completed. Please complete the following questions for the next 4 weeks

Day:_____ Date:_____

Question 1

The time chart below, represented in the form of blocks, shows one complete day from 6:00am to 6:00am the next day. Each block represents 30 minutes/half an hour. If you get a headache, please mark in the time block below when you get the headache

Day:

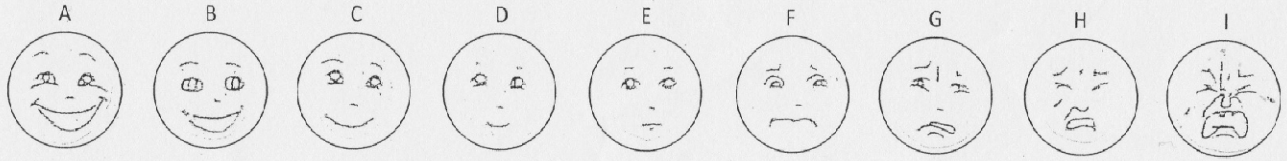
6.00am	6.30am	7.00am	7.30am	8.00am	8.30am	9.00am	9.30am	10.00am	10.30am	11.00am	11.30am	12.00noon	12.30pm	1.00pm	1.30pm	2.00pm	2.30pm	3.00pm	3.30pm	4.00pm	4.30pm	5.00pm	5.30pm

Night

6.00pm	6.30pm	7.00pm	7.30pm	8.00pm	8.30pm	9.00pm	9.30pm	10.00pm	10.30pm	11.00pm	11.30pm	12.00pm	12.30am	1.00am	1.30am	2.00am	2.30am	3.00am	3.30am	4.00am	4.30am	5.00am	5.30am

Question 2

Indicate by means of a tick/cross the face that describes the way you felt when you had the headache.



Question 3

How much did your headache hurt? Or, how strong was the pain? Please choose a colour block below

Mild	Moderate	Fairly severe	Severe

Appendix G (Yeomans, 2000):

The Headache Disability Index/Headache Questionnaire

Date:_____ Age:_____ Scores Total:_____; E____; F_____
(100) (52) (48)

Please circle the correct response:

1. I have a headache: [1] 1 per month [2] more than 1 but less than 4 per month [3] more than one per week
2. I describe my headache as: [1] mild [2] moderate [3] severe

The purpose of this questionnaire is to identify the difficulties you may be experiencing because of your headache. Please tick off "YES" or "SOMETIMES or "NO" to each question below, which pertains only to your headache.

	YES	SOMETIMES	NO
E1. Because of my headaches I feel handicapped.			
F2. Because of my headaches I feel restricted in performing my routine daily activities.			
E3. No one understands the effect my headaches have on my own life.			
F4. I restrict my recreational activities (sports, hobbies) because of my headaches.			
E5. My headaches make me angry.			
E6. Sometimes I feel that I am going to lose control because of my headaches.			
F7. Because of my headaches I am less likely to socialize.			
E8. My spouse (significant other) or family and friends have no idea what I am going through because of my headaches.			
E9. My headaches are so bad that I feel I am going to go insane.			
E10. My outlook on the world is affected by my headaches.			
E11. I am afraid to go outside when I feel that a headache is starting.			
E12. I feel desperate because of my headaches.			
F13. I am concerned that I am paying penalties at work or at home because of my headaches.			
E14. My headaches place stress on my relationships with family or friends.			
F15. I avoid being around people when I have a headache.			
F16. I believe my headaches are making it difficult for me to achieve my goals in life.			
F17. I am unable to think clearly because of my headaches.			
F18. I get tense (muscle tension) because of my headaches.			
F19. I do not enjoy social gatherings because of my headaches.			
E20. I feel irritable because of my headaches.			
F21. I avoid traveling because of my headaches.			
E22. My headaches make me feel confused.			
E23. My headaches make me feel frustrated.			
F24. I find it difficult to read because of my headaches.			
F25. I find it difficult to focus my attention away from my headaches and on other things.			

DURBAN UNIVERSITY of TECHNOLOGY

Faculty of Health Sciences

ETHICS CLEARANCE CERTIFICATE

Student Name	Claire Farrimond	**Student No**	20400621
Ethics Reference Number	FHSEC 035/09	**Date of FRC Approval**	17/06/2009
Qualification	M.Tech: Chiropractic		
Research Title:	The inter-examiner reliability and comparison of motion palpation findings of the knee joint in patellofemoral pain syndrome and asymptomatic knee joints.		

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

1. The researcher has read and understood the research ethics policy and procedures as endorsed by the Durban University of Technology, has sufficiently answered all questions pertaining to ethics in the DUT 186 and agrees to comply with them.
2. The researcher will report any serious adverse events pertaining to the research to the Faculty of Health Sciences Research Ethics Committee.
3. The researcher will submit any major additions or changes to the research proposal after approval has been granted to the Faculty of Health Sciences Research Committee for consideration.
4. The researcher, with the supervisor and co-researchers will take full responsibility in ensuring that the protocol is adhered to.
5. ***The following section must be completed if the research involves human participants:***

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