The relationship between cervical dysfunction and perimenstrual migraines

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DECLARATION

I, Simone Horwitz, declare that this dissertation is my own work. It is being submitted for the degree of Master of Science in Physiotherapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

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Abstract

In this cross-sectional study, forty perimenstrual migraine sufferers and forty-six controls were assessed for dysfunction that may be associated with perimenstrual migraines. A questionnaire assessed for the psychological factors. The blinded physical examination was conducted on the cervical area. This consisted of a posture assessment, muscle length testing, neural tension testing, trigger point examination, segmental cervical assessment, range of motion and muscle strength testing. The difference in most of the psychological risk factors was statistically significant, with higher incidence in the migraine group. These significant factors were: perimenstrual anxiety ($p= 0.04$), fatigue ($p=0.05$), perimenstrual fatigue ($p > 0.001$), perception of neck stiffness ($p > 0.001$) and perception of neck pain ($p > 0.001$). Compared to the controls, the migraine group had significantly more cervical dysfunction in muscle length restriction (right trapezius $p=0.004$, left sternocleidomastoid $p=0.05$, right occipitals $p=0.003$), more pain on muscle stretch (right levator scapula $p=0.001$, left levator scapula $p= 0.005$, right trapezius $p=0.005$, left trapezius $p=0.006$, left sternocleidomastoid $p=0.006$, right occipitals $p=0.003$, left occipitals $p=0.004$), reduced bilateral rotation range (right rotation $p=0.04$, left rotation $p=0.01$), worse neural tension (right elbow lag $p=0.02$, left elbow lag $p=0.04$), more active trigger points (right trapezius $p=0.02$, left trapezius $p=0.02$, right sternocleidomastoid $p=0.02$, left sternocleidomastoid $p=0.004$) and higher cervical pain (VAS C_4 $p=0.01$, C_5 $p=0.04$, C_6 $p=0.002$) and stiffness (C_5 $p=0.02$, C_7 $p=0.02$). Therefore it is concluded that both psychological and physical cervical impairment may be associated with the risk of developing perimenstrual migraine, increase migraine intensity and the resultant disability. These factors should thus be managed by physiotherapy and psychological support.

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LIST OF ABBREVIATIONS

FSH- Follicle stimulating hormone

FHP- forward head posture

GnRH- Gonado-trophin releasing hormone

LH- Lutenising hormone

PAIVMS- passive accessory intervertebral movements

PMS- premenstrual syndrome

Std dev- standard deviation

TCN- Trigeminocervical nucleus

VAS- visual analogue scale

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1. CHAPTER 1 - INTRODUCTION

1.1. Introduction

The International Headache Society (IHS) defines migraine as a common disabling primary headache disorder, with severe, throbbing, long lasting headaches usually accompanied by some autonomic symptoms such as photophobia, phonophobia and/or nausea (IHS, 2010; Schoonman et al, 2008). Migraines are divided into two main subtypes: ‘with’ and ‘without aura’. Migraine without aura is the most common subtype, having more frequent attacks and is therefore more disabling (IHS, 2010). Migraine is listed as number 19 on the World Health Organisation’s list of disabling conditions due to a high frequency of attacks and associated socio-economic effects, with more than 80% of sufferers reporting disability accompanying migraines.

Migraine is a typical “women’s disease”, not only due to the predominance in the female population but also due to the hormonal changes associated with the reproductive life cycle which have a direct effect on migraines (Granella et al, 1993). Russel et al (1995) and Cupini et al (1995) report a direct menstrual relationship with migraine without aura. Of the nine million women suffering from this poorly acknowledged health problem, 60% experience migraines during or around menses (Lipchik et al, 1998).

There is statistical evidence that shows a higher prevalence of migraine in women (17%) to men (6%). Pre-pubescent statistics report a similar prevalence of migraine between the sexes, with increasing female predominance in the median age of menarche which is between 13-15 years (Dzoljic et al, 2002). MacGregor (1996) and Epstein et al. (1975) also report a relationship between migraine onset and menarche.

The definition of a menstrual period is two or more consecutive days of bleeding (IHS, 2010). The IHS classifies menstrual attacks as those occurring from two days before onset to the last day of menses (Granella et al, 2004). The first day of menstruation is day 0, with negative days indicating pre-menses and positive days indicating during menstruation. Granella et al. (2004) states, citing four previous studies and including their own findings, a range of results of peak time of migraine attacks from -2 days,+1 and +2 days of the cycle. A study of 1943 women between 18-28 years found that 51% had migraine attacks on day +1 and with 48% of nonmigraine headaches occurring premenstrually on days -1 and -2 (Dzoljic et al, 2002).

These findings support evidence that indicates menstrual migraine occurs when there is the largest fluctuation in oestrogen levels, when oestrogen is suddenly withdrawn not when it is sustained at a high or low level (Dzoljic et al, 2002). This occurs during the late luteal phase of the cycle. The luteal phase includes all days from ovulation to the last day of menstruation (Martin et al, 2006). The late luteal phase is therefore five to seven days before the onset of the next menstruation (Kibler, 2005).

A local neuromodulator β endorphin is influenced by oestrogen and is found in decreased amounts during a headache. The fluctuation of oestrogen also alters plasma prostaglandin levels, with increased concentrations found during menstrual migraine attacks (Silberstein, 1993). Prostaglandins increase neurogenic inflammation and sensitise nociceptors, lowering their threshold. This inflammation may be a causative factor for the painful feeling of headache. Another function of prostaglandins that may be affected is the modulation of the descending noradrenergic pain control pathways (Silberstein, 1993).

The IHS classification for the different types of migraine related to menstruation is:
<u>Pure menstrual migraine:</u> migraine attacks starting from two days before to three days into menses and at no other time during the menstrual cycle.
<u>Menstrually associated/related migraine:</u> migraine attacks starting from two days before to three days into menses, also at other times in the month but aggravated during menstruation.
<u>Premenstrual migraine:</u> migraines occurring at two to seven days before menses.

A comparison of the characteristics of nonmenstrual and perimenstrual attacks in menstrual migraine sufferers found that the latter are significantly longer, more disabling and more refractory to acute treatment (Granella et al, 2004), with about 20% of migraineurs being absent from work at least one day per month (Pryse-Phillip et al. 1992 as cited in Dzoljic et al 2002). Considering the disability associated with perimenstrual migraines and the ineffectiveness of pharmacological treatment, proof for nonpharmacological treatment is vital.

Sjaastad et al (1983) conducted a case series on 22 participants (±66% females) with unilateral headache attacks provoked by neck movements (cervicogenic headaches). Digital pressure on neck tender spots on the symptomatic side could elicit the long lasting headache pain experienced. They found that injecting a local anaesthetic into C2 and C3 gave partial relief of pain in chronic paroxysmal hemicrania, a type of unilateral headache that may have migrainous phenomena in severe attacks. This provides evidence for the hypothesis that there is a cervical disorder associated with unilateral headaches.

Waelkens (1985) found that neck stiffness or pain, usually occurring posteriorly ipsilaterally, can be a premonitory symptom occurring a few hours before other migraine symptoms. Blau et al. (1988) reported that 43% of patients considered neck pain a trigger for their migraine. It was recommended to them to seek physiotherapy to prevent the neck acting as a causative factor. They commented that treating neck symptoms during the attack brings relief and that physiotherapy may decrease the attack frequency. In the article **Migraine and the Neck,** it was found that 64% of patients with migraine (82% women) experienced neck pain or stiffness during migraine attacks.

The above studies suggest extra cranial involvement during all migraine phases, and that migraines may be referred from the neck. A possible nerve pathway is the convergence of the afferent trigeminal nerves and afferent fibres from the upper cervical nerves in the trigemino-cervical nucleus (Shevel, 2004). Oestrogen, the proven precipitator of perimenstrual migraines, increases the receptor field size of trigeminal mechanoreceptors.

Due to the experience of physiotherapy in the treatment of mechanically related headache and the valid presumption that perimenstrual migraines are accompanied by some cervical dysfunction (Pryse-Phillips et al, 1998), research is necessary to provide evidence of effectiveness of physiotherapeutic perimenstrual migraine treatment.

<u>Problem statement</u>

In conclusion it is evident that perimenstrual migraines are a real monthly problem for women migraineurs. They are significantly longer, more disabling (Granella et al, 2004) and difficult to treat pharmacologically than nonmenstrual migraines (Silberstein et al. 1993). Therefore evidence to support non-pharmacological treatment for menstrual migraine is essential. There is an unproven hypothesis in the literature that suggests an accompanying cervical dysfunction to migraines caused by muscle tenderness, mechanical abnormalities, postural changes and neural modifications (Biondi, 2005); yet the value of physiotherapy has not been determined through research (Pryse-Phillips, et al, 1998). This study aims to establish if there is this association in women with perimenstrual migraines.

1.2. Research question

Do perimenstrual migraines have a component of cervical dysfunction and are there factors are associated with perimenstrual migraines that could serve to predict the susceptibility of women to perimenstrual migraines with a cervical component?

1.3. Aim

To determine if there is an association between perimenstrual migraines and cervical dysfunction.
To determine if there are risk factors that could predict if women have a component of cervical dysfunction to their perimenstrual migraines.

1.4. Objectives

1. To determine the neuromusculoskeletal and emotional risk factors that are associated with perimenstrual migraines in women.
2. To assess and compare characteristics of the cervical spine and associated structures to establish cervical dysfunction.
3. To determine if there is a relationship between cervical dysfunction and perimenstrual migraines.

2. CHAPTER 2 - LITERATURE REVIEW

2.1. Introduction

Migraine is a growing health and economic problem, with high associated disability and reduced productivity (Dzoljic et al, 2002). Women are three times more affected than men, with perimenstrual migraines being a common type of migraine. Worldwide, physiotherapists are first- contact health care practitioners for patients with headache (Boyling and Jull, 2004) and therefore can have an impact on this condition.

This literature review will explore the connection between migraines and menstruation. It will begin by comparing headaches and migraines, clarifying their differences and similarities. The review will then show the connection between headaches, migraines and the cervical spine. It will also explore the menstrual cycle and the systemic changes that accompany it, and the effect that these changes have on the cervical spine. It will then discuss the potential psychological and physical risk factors for this migraine type and the outcome measures and instruments used to assess these factors.

Methodology

This review was compiled from the literature found through PubMed, PEDro, Cinhal and EBSCO databases. The key words used to search included menstrual migraine, headaches, cervical spine, physiotherapy for migraines and trigeminocervical nucleus. Hand searches of reference lists were also conducted.

2.2. Headaches and migraines

In 1988, the International Headache Society reclassified headaches in an effort to improve the uniformity and reliability of headache classification. These classification systems are used by health care professionals in headache diagnosis. These systems list tension-type and migraine headache as separate conditions, although it is acknowledged that they often co-exist. Symptoms of migraine without aura include unilateral location, of a pulsating or throbbing quality, aggravation with routine physical activity, nausea and/or vomiting and/or photophobia with phonophobia (www.ihs-classification.org, 2010). Tension type headaches differ as they are bilateral in location, have a nonpulsating pain and are not aggravated by physical activity. They are absent of nausea and either have photophobia or phonophobia, if either happens to manifest (www.ihs-classification.org, 2010).

Marcus (1992) questions this classification, showing that these types appear to be different manifestations of the same pathophysiological process with common symptoms expressed to varying degrees and intensities. The same therapies are effective for both types. This places these types on a spectrum of headache disturbance.

It has been proposed that the three common headache types; migraine, cervicogenic and tension-type, share many features (Marcus, 1992). Recent research has found that there are considerable similarities between tension type headache and migraine suggesting that they are a continuum of the same condition (Jull et al 1999, Kidd et al 1993, Marcus et al, 1999). Studies report that up to 50% of the patients fulfilling the IHS cervicogenic headache criteria also fulfilled the tension type headache and migraine criteria (Boyling 2004, Marcus 1992).

Some ‘vascular’ symptoms previously thought to be unique to migraines have been shown to also be reported by ‘tension-type’ headache patients. These include throbbing pain, unilaterality and nausea/vomiting (Marcus, 1992). As with the ‘vascular’ symptoms’, crossover of the muscular symptoms traditionally attributed to ‘tension-type’ headaches has been reported (Marcus, 1992). Lebbink et al (1991) questioned 164 participants with chronic headache. Approximately two thirds reported having the ‘migraine’ symptoms of unilaterality, photophobia and phonophobia, with half reporting nausea. When questioned about the prevalence of muscle tightness in the neck, jaw and shoulders, 70% reported muscle tightness. This suggests that the muscular changes traditionally linked to tension type headache have also been found in similar or equal amounts in migraine sufferers (Marcus, 1992)

2.3. Perimenstrual migraines

The IHS classification document comments that migraines without aura are the commonest subtype of migraine and that they have a strict menstrual relationship. These migraines are further classified as pure and menstrually related migraines. Pure menstrual migraines are migraine attacks occurring exclusively from two days before menstruation (day -2) to three days into menstruation (day +3). Menstrually related migraines occur on the above days of the cycle and at other times in the cycle. Dzoljic et al (2002) state that 84, 5% of all female migraineurs suffer from migraine without aura, much of which is associated with menarche. Dzoljic et al (2002) and Silberstein et al (1993) report that 14% of female migraineurs have only pure menstrual migraine and 60% have menstrually related migraines. A comparative result is reported by Granella et al (1993) when 60% of 1300 migraine without aura female sufferers reported migraine in the perimenstrual period. These perimenstrual migraines are more severe, more prolonged and more refractory to pharmacological treatment. They also have a greater chance of recurrence than menstrually unrelated migraines (Dzoljic, et al, 2002). Perimenstrual migraines sufferers report more headache exacerbation with physical activity, more photophobia and phonophobia compared to non-menstrual migraineurs. Perimenstrual migraines are more disabling, with greater time lost and reduced productivity (Dowson et al, 2005).

2.4. Menstruation

The menstrual cycle is represented on a time line, with the first day of menses being day one of the cycle. The cycle is divided into phases. The days prior to ovulation are called the follicular phase and all days from the day of ovulation (about 14 days before the next menses) to the last day of the cycle are included in the luteal phase. The phases can be further subdivided into early and late. The late luteal phase is defined as the three days before the onset of menstrual bleeding. The early follicular phase is defined as days one to three of the menstrual cycle (Martin et al, 2005). Perimenstrual migraines occur between two days premenstrually to three days into menses. During these phases in the menstrual cycle there is the greatest fluctuation in ovarian hormone levels (Silberstein et al, 1993; Dzoljic, et al, 2002).

The menstrual cycle is a complex neuroendocrinologic event involving the coordinated activity of the hypothalamus, pituitary gland, ovaries and the uterus. Gonadotropin-releasing hormone (GnRH) is secreted in a pulsatile fashion by the hypothalamus. This hormone stimulates the release of follicle stimulating (FSH) and luteinising hormones (LH) by the pituitary gland. During the early to mid-follicular phases, these gonadotropins lead to follicular development in the ovaries. These follicles produce oestrogen, whose levels continue to rise during the late follicular phase until a critical level is achieved. Oestrogen stimulates growth of the endometrium of the uterus. Once the critical amount of oestrogen is reached, there is a positive feedback loop to the pituitary to release LH. The LH causes development of a dominant follicle and ovulation occurs within the next 48-72 hours. The remnants of the follicle become the corpus luteum, which secretes estradiol and progesterone during the luteal phase of the cycle. If fertilisation does not occur, the corpus luteum regresses; leading to decreased hormone levels of oestrogen and progesterone during the late luteal phase. The progesterone withdrawal causes arterial spasm, sloughing of the endometrium and menses. (Martin et al, 2006; Silberstein et al, 1993). It is the abrupt decline in oestrogen and progesterone that triggers the migraine (Silberstein et al, 1993).

This changing succession of hormones causes major systemic changes such as fluid balance and blood pressure fluctuations (Silberstein et al, 1993). Oestrogens can also cause fluid retention and have effects on the central nervous system such as increasing the receptor field size of trigeminal mechanoreceptors (Silberstein et al, 1993, Martin et al 2006, Rasmussen et al, 1993). The trigeminovascular nerve fibres transmit the nociceptive information to the trigeminocervical nucleus, which is the anatomical link between sensory signals from the cervical area and the head (Shevel, 2004). These sex hormones, especially oestrogen, can influence the endogenous opiodergic processes, therefore affecting pain modulation (Rhudy et al, 2010).

Another biochemical change linked to oestrogen fluctuations is an increase in prostaglandin release (Boyling and Jull, 2004). Prostaglandins have the following effects: sensitisation (lowering the threshold) of nociceptors, development of neurogenic inflammation which may generate part of the painful headache sensation and inhibition of noradrenergic pain control pathway transmission. NSAIDs, by blocking prostaglandin synthesis, are used to effectively treat migraines (Silberstein et al, 1993).

Progesterone has central nervous system effects such as modulation of the anxiety processes through the GABA- responsive chloride channels in the brain (Silberstein et al, 1993). In susceptible individuals, this may account for the mood changes accompanying premenstrual syndrome (PMS). In sufferers, anxiety increases progressively during the late luteal phase and decreases rapidly with menstruation (Silberstein et al, 1993).

2.5. Migraine and the neck

The convergence of afferent (sensory) signals from the upper three cervical nerves and the trigeminal nerve occurs in the grey matter of the upper cervical dorsal horn. The trigeminal nucleus is continuous with the dorsal horn grey matter of the upper cervical spine. Forming a single functional nucleus, it is termed the trigeminocervical nucleus and is the anatomical pathway for pain referral from the neck to the head. (Boyling and Jull, 2004).

Some of the structures and tissues that are innervated by the first, second and third cervical nerves are the: atlanto-occipital joint, atlantoaxial joints and ligaments, C_2- C_3, the first three cervical nerves, cervical dura mater, trapezius, sternocleidomastoid, suboccipital and other posterior neck muscles (Biondi, 2005). The afferent input from these structures may be capable of facilitating the cranio-cervical pain that can accompany migraines. Persistent discharge from dysfunctional structures could result in the spatial and temporal summation of neural signals, sensitising the trigeminocervical nucleus (TCN) and altering the nociceptors in the TCN. These sensitised neurons then have a reduced threshold and respond to previously innocuous stimuli (De las Penas et al 2006a, Robertson et al, 2008).

Nociceptive activity in the nucleus is normally inhibited by the serotonin controlled descending neural pathways and balanced by noradrenergic descending pathways (Boyling and Jull, 2004).

There are various influences that affect the inputs and therefore, outputs of the trigeminocervical nucleus. Nociceptive activity from the upper cervical spine can be increased if there are tight and tender cervical muscles. The input from this cervical dysfunction may contribute to the triggering of the trigeminovascular neuroinflammatory cascade, therefore eliciting and maintaining a headache (Shevel, 2004). Sensitisation of the nucleus may also lead to peripheral changes such as increased muscle tension. Therefore, cervical musculoskeletal dysfunction could arise as a result of trigeminocervical sensitisation, becoming a source of nociceptive input forming a cervical component to the migraine (Boyling and Jull, 2004). Therefore, migraine and cervical dysfunction have a bidirectional relationship with cervical problems influencing migraine and migraine predisposing to neck problems (Bevilaqua-Grossi et al, 2009). It has not been concluded whether cervical musculoskeletal structures play a role in the origin, maintenance and/or perpetuation of migraine (De las Penas, 2006b). If a test of a cervical structure provokes the usual migraine pain, then a pattern of referral or secondary hyperalgesia may be inferred (Robertson et al, 2008).

Cervical dysfunction has been reported in patients with migraine, with neck pain being a common and prominent migraine symptom (Biondi 2005). When compared to controls, migraineurs have more tender and tight craniocervical musculature, greater forward head posture and decreased cervical mobility (Bevilaqua-Grossi et al 2009, Biondi 2005). The United States Headache Consortuim (as cited in Biondi, 2005), in the review of the evidence for physical treatments for migraine, mention a controlled study that compared cervical manipulation and mobilisation. Both techniques showed significantly improved post-treatment scores for migraine frequency, severity and disability. Both techniques are used to improve joint function and mobility. Unfortunately, Biondi (2005) found only modest support for the use of physical treatments in migraine management.

Blau et al (1993) conducted a study investigating the neck symptoms of 50 migraine sufferers. Eighty percent of the subjects were female and the same percentage experienced migraine without aura. When questioned about neck pain and stiffness during the attacks, 64 percent of all subjects reported these neck symptoms, with 20 percent reporting premonitory pain. The neck pain was common on the posterior ipsilateral side of the neck. It was recommended to the participants to have physiotherapy management to remove the neck dysfunction acting as a precipitant to the migraine.

Partial relief may be gained in patients with migraine with physical therapies (Boyling and Jull, 2004). Although the pathogenesis of migraine does not lie primarily in musculoskeletal dysfunction, concomitant cervical dysfunction may further sensitise the trigeminocervical nucleus (Boyling and Jull, 2004).

The clinical features of cervicogenic headache, the definition of which is headache arising from musculoskeletal disorders of the upper cervical spine, might coexist with migraine (Lewis et al, 2010, Biondi, 2005).In Grieve's Modern Manual Therapy (2004) the physical examination recommended for a cervicogenic headache patient examines the areas that studies have found to be dysfunctional in cervicogenic headache sufferers. In agreement, Jaeger (1989) includes the following elements when assessing for cervical spine dysfunction: posture, neck range of motion and cervical segmental range of motion. Cervical segmental assessment investigates for painful cervical joint dysfunction and stiffness. Range of motion tests assess for movement restriction. A muscular component is assessed through strength tests for cervical movements and length tests for upper trapezius, levator scapulae, scalenes and suboccipitals. Posture is examined for a forward head posture, which could potentially indicate an upper cervical extension and weak deep neck flexors. Neural tension tests are performed to assess for mechanosensitivty of neural structures. (Boyling et al, 2004)

2.6. Outcome measures

2.6.1. Subjective risk factors associated with menstruation and migraines

2.6.1.1. Introduction

Modern science is realising that disease and pain are multifactorial in origin and perpetuation, with stress and emotional factors contributing to pain and increased muscle tension (Graff-Radford et al 1987). The biopsychosocial medical model acknowledges the influence that emotional and psychological factors have on physical symptoms. Research has identified psychological factors that could trigger or accompany migraines, as well as for the premenstrual syndrome that may accompany menstruation (Graff-Radford et al 1987). The potential physiological effect that these may have on perimenstrual migraines are discussed in this section.

2.6.1.2. Proof for inclusion of women on oral contraceptives

There is a debate in the literature about the effect that oral contraceptives have on menstrual migraines. The IHS (2008) suspects that the mechanism(s) of migraine may be changed when there are exogenous hormones. The prevention of ovulation by contraceptives alters the hypothalamic-pituitary- ovarian interactions. Therefore they recommend that for pharmacological research they should be kept separate.

Silberstein et al (1993) argues that although the contraceptive may have an effect on the frequency or qualities of the migraine due to the artificial oestrogen, in most women the migraine pattern is usually not affected. In agreement, Granella et al (1993, 2004) and Dzoljic et al (2002) report that migraines experienced by women on oral contraceptives showed the same qualities and response to treatment in all menstrual phases.

In conclusion, this study has chosen to include women on oral contraceptives if they have been on the same pill for 12 months and are expected to be on the same pill until their assessment.

2.6.1.3. Stress

A migraine attack can be precipitated by a variety of external factors including stress (Kidd et al, 1993). Up to 45% of female migraineurs identify tension and stress as the most significant precipitating factors in their migraines (Burnstein R, 2001, Rasmussen BK 1993). These factors can affect the sensitivity of the trigeminocervical nucleus and act as a causative factor for trigger point formation (Boyling and Jull 2004, De las Penas et al 2005, Graff Radford et al 1987).

Bansevicius and Sjaastad (1996, as cited in Boyling et al, 2004) found increased pain levels and trapezius activation during stress in patients with cervicogenic headaches. These results suggest that in vulnerable individuals stress can sensitise both the trigeminocervical nucleus and the periphery.

Nonpharmacological management of migraine sufferers includes stress management as an essential therapy in controlling the emotional triggers of migraine. The use of relaxation techniques, such as progressive muscular relaxation, aims to develop long-term prophylaxis by reducing the associated muscular tension. Biondi (2005) reports that the most effective treatment of migraine combines physiotherapy and relaxation training. Cognitive behavioural therapy identifies and modifies the maladaptive responses (emotional reactivity i.e. anxiety, tension, distress) that may trigger or aggravate migraines (Pryse- Phillips et al, 1998).

2.6.1.4. Tension and fatigue

Blau et al (1993) hypothesise that premonitory neck symptoms can be induced by the tension and fatigue that can precede a migraine. Granella et al (2004) has identified fatigue as one of the prodromal phenomena in perimenstrual attacks, a feature more frequent in menstrually associated attacks compared to nonmenstrual attacks. Decreased energy could lead to decreased strength and therefore control of muscles, reduced endurance of the postural and stabiliser muscles and poor posture, all potential contributing factors for migraines.

2.6.1.5. Anxiety, irritability, anger

The majority of pure menstrual migraine sufferers and a third of menstrually related migraine sufferers meet the criteria for premenstrual syndrome (PMS). PMS is a cyclic mood disorder that occurs from five days premenstrually to four days into menses. Granella et al (1993) found premenstrual syndrome being reported by 73,4% out of 1300 women who suffered from migraine without aura. The affective changes include anxiety, irritability and anger (Martin et al, 2006). One of the prodromal features that is more frequent in perimenstrual migraines compared to nonmenstrual attacks is irritability (Granella et al, 2004).

Martin et al (2006) report a moderate correlation between the PMS index and disability, headache severity, headache frequency and analgesia use, with the measures being highest during the early follicular and late luteal phases. Rhudy (2010) found similar pain modulation in both the late luteal and mid-follicular phases, although the late luteal phase is associated with increased negative affect, decreased positive affect and hyperalgesia. Negative emotions can induce pain facilitation (Rhudy et al, 2010). This shows the relationship between emotional changes and migraine, therefore suggesting a link between migraine occurrence and severity, and anxiety (Martin et al 2006, Silberstein et al 1993).

Increased frustration, anxiety or tension lead to a closed, protective posture (upper crossed syndrome) with increased muscle tone especially of the upper trapezius and levator scapulae muscles (Petty and Moore, 2004). This increased tension in the muscles causes more trigger points, which includes muscle tenderness. The same rationale holds for the question on increased irritability perimenstrually.

2.6.2. Physical factors

2.6.2.1. Introduction

The afferent inputs of cervical structures within the receptive field of the trigeminocervical nucleus (TCN) could contribute as facilitators to the migraine. If these structures (as listed previously) are dysfunctional, they cause TCN sensitisation. Studies investigating the role of this cervical dysfunction in migraine have included; among other tests commonly used by physiotherapists in cervical assessment; joint mobility, muscle length and strength, and range of motion (Robertson et al, 2008). These studies have found increased postural abnormalities; more trigger points, specifically active trigger points, and reduced range of motion in some movements in migraine subjects (Giamberardino et al 2007, Marcus et al 1999, Tfelt- Hansen et al 1981). These objective parameters need reliable and measurable outcome measures, to extract accurate information about the clinical characteristics of the participants. These outcome measures and their reliability are discussed in this section.

2.6.2.2. Posture

Posture is defined as the biomechanical alignment or position of the body segment when performing a specific task (Van Niekerk and Louw, 2008). Proper posture is defined as the state of musculoskeletal balance that involves a minimal amount of stress or strain to the body (Griegel-Morris et al, 1992). There is a question about the importance of proper posture, and the link between abnormal posture and pain (Griegel-Morris et al, 1992).

Normal head-neck posture requires equal anterior and posterior muscle tension. A forward head posture (FHP) is commonly associated with musculoskeletal dysfunction, neck pain and cervicogenic headache (Boyling et al 2004, Raine et al, 1997). Jaeger (1989) found that the majority of cervicogenic headache sufferers had postural abnormalities, such as FHP. FHP may lead to excessive compression on the facet joints and posterior vertebral bodies, thus negatively affecting the biomechanics of the head and neck (de las Peñas et al, 2006a). De las Peñas (2006b) found a smaller cranio-vertebral angle i.e. greater forward head posture, in patients with migraine compared to controls. Griegel-Morris (1992) found a high incidence of postural abnormality in the cervical region in healthy subjects, with the most common abnormality being a forward head posture.

Upper crossed syndrome is a common abnormal posture where there is elevation and protraction of the shoulders, winging of the scapulae and a FHP. This posture is commonly found in headache sufferers (Petty and Moore, 2004). Silverman et al (1991) implicate a head-forward posture in chronic neck pain sufferers being due to a weakness of the anterior cervical flexors (including deep neck flexors), thereby resulting in a tightness of the sternocleidomastoid muscles with a noticeable insertion. A marked elevation of the shoulder girdle can indicate a tight levator scapula muscle. Rotation or lateral flexion of the cervical spine can indicate unilateral muscle spasm.

Posture assessment is made easier and more accurate with the use of a vertical tangent line, hung onto a wooden sheet with grid lines (posture board). These gridlines help to visually assess for cervical rotation and lateral flexion, as well as differences in shoulder height (Griegel- Morris et al 1992, Kendall et al 2005, Rocabado 1983).

2.6.2.3. Muscle length

Normal muscle function requires normal muscle length and strength (Petty and Moore, 2004- original source). Muscle dysfunction includes: loss of muscle length, muscle spasm and limiting range of motion. The muscle tightness of shortened muscles restricts full range of movement of the associated joints leading to altered joint movements (Janda, 1983).

Lebbink et al. (1991) compared the tightness of neck, jaw and shoulder muscles of chronic headache sufferers and age- and sex-matched controls. Using the IHS criteria, the study questioned 272 subjects about their headache symptoms. The prevalence of neck and jaw tightness in the headache group increased significantly when the headache was present. The intensity of the tightness and soreness of the neck, shoulder and jaw muscles also increased during the headache. In the absence of a headache, the prevalence and intensity of neck muscle tightness was significantly higher in the headache than in the control group. Lebbink et al (1991) discuss that this increased muscle tightness in headache sufferers even in the absence of a headache, supports the idea that muscle dysfunction is a primary phenomenon related to chronic headache.

Muscle shortening may be due to altered posture with the important postural muscles having a greater tendency to shorten. Janda (1983) and Petty et al (2004) include the following as mainly postural muscles and therefore more prone to shortening: upper trapezius, levator scapulae, sternocleidomastoid, pectoralis major, scalene and deep occipitals. These muscles have also been claimed to be shortened in people with neck problems (Jull et al, 1999).

Muscle length can be measured through standard length tests, where the clinician stabilises one end of the muscle and then slowly moves the body part to stretch the muscle. To accurately measure muscle length; the starting position, method of fixation and movement are vital.

2.6.2.4. Neural tension testing

Another neuromuscular structure that could be affected in menstrually related migraine sufferers is the nervous system. Sustained abnormal postures affect the nervous system, through the deformation of the adjacent mechanical interfaces (Petty and Moore, 2004).

Neurodynamic tests are used to ascertain the amount of neural mobility and therefore may help identify the contribution of neural tension to the headache symptoms (Petty and Moore, 2004). The incidence of mechanosensitivity of the neural tissues in cervicogenic headaches has been reported to be between 8-10% (Boyling and Jull, 2004). De las Peñas (2009) has found that the pressure pain thresholds over the median, ulnar and radial nerves are significantly lower in migraine subjects compared to normal controls.

The upper limb tension tests are clinical tests which assess the neural tissue complex of the brachial plexus and its cervical nerve roots that are often involved in neck pain (Yaxley et al. 1991). The tests involve sequenced upper limb movements. Evidence indicates that shoulder girdle depression, glenohumeral abduction and elbow extension, tension the C5 and C6 nerve roots (Davidson et al 1981).

Elvey (1983, as cited in Yaxley et al 1991) sequenced his upper limb tension test as follows: shoulder girdle depression, shoulder abduction, shoulder external rotation, forearm supination, elbow extension and wrist and finger extension. This finishes the movement at the shoulder first, to rule out the shoulder as a source of symptoms later in the test. A test is positive if the patient’s symptoms are reproduced and/or the ROM of the affected side is reduced. Research into the normal responses to this test have shown that about 80 percent of participants report a deep stretch in the cubital fossa extending down the anterior and radial aspect of the forearm and radial aspect of the hand. Tingling in the thumb and lateral 3 digits is often recorded. The conclusion is that this distribution of sensations correlates to the C_5, C_6 and C_7 roots, thereby showing that the maximal tensioning occurs at these levels (Yaxley et al. 1991).

2.6.2.5. Trigger point identification

Short, tight muscles are prone to the development of myofascial trigger points. It characterises the myofascial pain syndrome, which many researchers have identified as a main cause of headache and neck pain (de las Peñas et al, 2005).

De las Peñas et al (2005) and Travell et al (1999) define a trigger point as “a hyperirritable spot, associated with a taut band of a skeletal muscle, painful on compression, palpation and/ or stretch, which can give rise to typical referred pain patterns as well as autonomic phenomena”. In ‘Manual therapies in myofascial trigger point treatment: A systematic review’ the minimum criteria for diagnosis of an active trigger point are the identification of: palpable taut band, an exquisite tender spot in the band, patient's recognition of the familiar pain and pain on tissue stretch or compression. (de las Peñas et al, 2005).

Trigger point identification is most commonly done through manual palpation of the muscle by a therapist using either a pincer or flat palpation or both. Interrater reliability for identification of tenderness and a tight band, reproduction of the pain and referred pain and therefore identification of the trigger point has shown statistically significant agreement. Therefore, the myofascial trigger point can be considered a reliable clinical sign (Gerwin et al, 1997).

An active trigger point causes spontaneous referred pain in addition to local pain and can cause restricted range of motion. Latent trigger points are not spontaneously painful and do not have a referral pattern on palpation, but can cause restricted range and fatigue in the muscle (Giamberardino et al, 2007; Travell et al, 1999). The myofascial trigger point characterises the myofascial pain syndrome, which many researchers have identified as one of the main causes of headache and neck pain (de las Peñas et al, 2005).

Evidence suggests that cervical muscle trigger points contribute to the activation of the trigeminovascular system, which is involved in the pathogenesis of migraine.
The possible pathophysiology may be that trigger points are powerful sources of peripheral nociceptive input, increasing the excitability of central sensory neurones, thus lowering their threshold for classic migraine triggers (Giamberardino et al 2007, Shevel 2004).

Giamberardino et al (2007) conducted a blinded experimental study that evaluated the contribution of myofascial trigger points to migraine symptoms. The results were significantly lower pain threshold (hyperalgesia) for migraineurs in both the trigger point and the referred area, compared to nonmigraineurs. Post treatment of the triggers, the number of migraine attacks, intensity of migraines and analgesia use decreased significantly. These results indicate the substantial contribution that cervical myofascial trigger points make to migraine symptoms.

Compared to non-migraine sufferers, patients with migraine have been shown to present with a significantly greater number of active myofascial trigger points in the ipsilateral cervical muscles (Giamberardino et al 2007, Tfelt- Hansen et al 1981). The most common sites of tenderness in headache and migraine sufferers are trapezius, sternocleidomatoid and suboccipital muscles. (Giamberardino et al 2007, Travell et al 1999, Tfelt- Hansen et al 1981). The referral patterns of these muscles coincide with headache pain.

De las Peñas (2006b) reports comparative results, with findings of at least three trigger points between upper trapezius, suboccipital and sternocleidomastoid muscles in unilateral migraine sufferers. Although, the control group also had trigger points, there was a statistically significant difference in the number of active trigger points. The active trigger points in migraine subjects were mainly on the ipsilateral side, with the exception of the suboccipitals which were located and referred bilaterally. The induced referred pain reproduced the same sensation that was usually felt during migraine attacks.

The trapezius muscle's most common trigger point is "trigger point one" found even in asymptomatic young adults. This trigger point is located about halfway on the anterior superior margin of upper trapezius. It is often overlooked as a source of headache, referring up the neck and into the temporal and occipital areas (Travell et al, 1999). The suboccipital muscles refer over the occipital and temporal bones and active trigger points have been found to be prevalent in tension type headache sufferers (de las Peñas et al, 2009).

The sternocleidomstoid muscle has three main trigger points along the sternal division (more superficial) which refer to the orbital and ear areas and the top and back of the head. The levator scapula muscle has two main trigger points which primarily refer inferiorly to the scapular area and are implicated in neck pain. The scalene muscles' trigger points refer towards the shoulder area and down the upper limb. (Travell et al, 1999)

2.6.2.6. Passive intervertebral movements

Segmental evaluation of cervical range of motion (ROM) is more revealing than simple range of motion tests (Jaeger, 1989). Segmental dysfunction is implicated in the initiation and perpetuation of myofascial pain. Decreased range of motion of the joints can lead to shortening and tightening of the muscle, which causes trigger point formation. Therefore, assessment of the range of each cervical segment is an essential part of a cervical examination.

Information on the passive intervertebral movement of the spine is obtained through evaluations that rely on palpation and subjectively perceived movement at joints that have very little excursion (Gonnella et al, 1982). There is no objective measure (i.e. goniometer) that can be used. Therefore, reliability and validity in measurements is difficult to obtain, yet this is one of the most commonly used assessment and treatment techniques in physiotherapy.

Findings in various studies have shown that intertherapist reliability is not at an acceptable level but intratherapist reliability is acceptably high (Gonella et al, 1982). This was shown in the study by Gonella et al (1982) which reported reasonably good intratherapist reliability, concluding that intratherapist assessment of the intervertebral joints of the cervical spine is a reliable tool. Sensitivity and specificity in a lumbar spine assessment by Phillips and Twomey (1996) was greatly improved by communication by the patient of pain reproduction at each level.

2.6.2.7. Range of motion testing

Assessment of cervical range of motion (ROM) is used to investigate impairment or dysfunction in the cervical spine (Malmstrom et al, 2003). Problems with the cervical spine often alter active range of motion in the four directions of flexion, extension, lateral flexion and rotation (Youdas et al, 1991).

Migraineurs are reported to have reduced cervical mobility compared to controls (Bevilaqua-Grossi et al 2009, Kidd et al 1993). There was no correlation between the presence of the migraine pain and the impairment of ROM and no lateralisation of impairment. Bevilaqua-Grossi et al (2009) report that transformed migraine sufferers have reduced motion in all cervical movements, compared to non-migraine sufferers, with a significant reduction in extension, left lateral flexion and right rotation. In partial agreement, de las Peñas (2006b) found that there was no difference between the mobility of the symptomatic and non-symptomatic side, but found only significantly reduced extension in migraineurs compared to controls. Zwart (1997) found no cervical ROM differences between patients with migraine, tension type headache patients and controls.

The measurement of cervical movement is commonly used by clinicians in cervical assessment, yet it has very low accuracy due to the lack of bony landmarks on the head as well as the soft tissue density (Chiu et al, 2002). The gravity goniometer is the preferred method due to the enhanced accuracy shown by Youdas et al. (1991). This goniometer has a metallic pointer that moves freely about an axis and unlike other methods it is not influenced by identification of anatomical landmarks. This goniometer is available as the Cervical Range of Motion instrument (CROM) which consists of a frame with three inclinometers with gravity dependant needles attached in three planes (Tousignant et al, 2000).

The CROM intratester reliability for all cervical motions is greater than other measurement methods (Youdas et al, 1991). All movements have a fair to high intratester reliability (from .70- .99) (Youdas et al, 1992). The criterion validity, measured against the gold standard of radiographs, was found to be high for flexion and extension measurements (Tousignant et al, 2000).

Normal cervical range of motion is flexion ≥ 60°, extension ≥75°, lateral flexion ≥ 45° and rotation ≥80° (Duane Saunders H, 2006). The normal values found by Youdas et al (1992) are smaller than those listed above. Youdas et al (1992) report that females have greater range of motion than males. Both genders lose about five degrees of cervical extension and three degrees of other cervical movements per decade of aging. Therefore normal values should be given according to age (Youdas et al, 1992).

Table 2-1 Normal range of motion values for the cardinal cervical movements (Youdas et al, 1992)

Flexion

Decade	**Range (degrees)**	**Mean (degrees)**	**Standard deviation**
20-29	0- 42-68	54.3	8.8
30-39	0-30-68	47.3	9.5
40-49	0-28-72	49.5	11.4

Extension

Decade	**Range (degrees)**	**Mean (degrees)**	**Standard deviation**
20-29	0-65-111	85.6	10.6
30-39	0-52-105	78.0	13.8
40-49	0-45-102	77.5	13.2

Rotation

Decade	**Range (degrees)**		**Mean (degrees)**		**Standard deviation**	
	Left	**Right**	**Left**	**Right**	**Left**	**Right**
20-29	0-62-85	0-62-85	71.6	74.6	5.7	5.9
30-39	0-52-84	0-60-78	65.9	71.7	8.1	5.7
40-49	0-50-80	0-56-83	64.0	70.2	7.9	6.6

Lateral flexion

Decade	**Range (degrees)**		**Mean (degrees)**		**Standard deviation**	
	Left	**Right**	**Left**	**Right**	**Left**	**Right**
20-29	0-34-56	0-30-56	42.8	46.2	4.6	6.7

30-39	0-30-60	0-32-62	43.6	46.5	7.9	8.4
40-49	0-20-58	0-30-65	40.8	42.5	9.3	9.2

2.6.2.8. Muscle strength testing

The function of the cervical muscles is to support the weight of the head. Garcés et al. (2002) state that head and neck pain and dysfunction often originate from muscular weakness or poor endurance leading to fatigue from the constant muscle contraction. Decreased strength and endurance of the anterior musculature has also been noted in patients experiencing headaches (Jordan et al, 1999). It has also been reported that oestrogen can influence the force generating capacity of skeletal muscle (Sarwar et al, 1996). Sarwar et al. (1996) found that the quadriceps strength in non-oral contraceptive users peaked during the mid cycle (ovulatory phase) of the menstrual cycle when the oestrogen levels are at their highest. The greatest difference in strength was found between mid cycle and the late luteal phase, where the oestrogen levels drop significantly. Women taking the oral contraceptive did not exhibit any changes in strength throughout the cycle, due to constant oestrogen levels throughout the cycle.

Muscle force is an important indicator of cervical dysfunction (Strimpakos et al 2004). The main cervical flexors are scalenes, longus colli, longus capitis and sternocleidomastoid. The main cervical extensors are erector spinae, the small suboccipitals and trapezius. The same muscles perform lateral flexion acting bilaterally and rotation acting unilaterally (Kendall et al, 2005).

The effect of age on strength should not play a role as Jordan et al (1999) found that although strength levels in women trail off with age, decreases did not attain statistical significance. Females are able to maintain their flexion and extension strength until the seventh decade. These results are similar to a comparative study by Staudte et al (1994) which found only significant declines in female strength from the seventh decade. The intratester reliability for hand- held dynamometry for cervical muscle testing has been found to be good to high (.84-.99), therefore the conclusion is that dynamometry is a reliable clinical tool (Bohannon 1986, Silverman et al 1991, Ylinen et al 2004).

2.6.3. Conclusion

The literature offers evidence that both psychological and physical cervical spine characteristics are potential contributing factors to perimenstrual migraines. The few human studies that have investigated the role of cervical dysfunction in migraine have been lacking in methodological adequacy, and have not looked specifically at perimenstrual migraines (Robertson et al, 2008). There is a need for more human studies with satisfactory methodology that not only quantify cervical dysfunction, but also qualify its relationship with perimenstrual migrainous symptoms.

3. CHAPTER 3 - METHOD

3.1. Introduction

Using the evidence cited in the literature review, a cervical assessment form was developed that was used in this study to assess these potential emotional and physical contributors to perimenstrual migraine. The results of the migraineurs will be compared to the results from normal subjects. This chapter contains information about how each part of the assessment was performed, the role of the assistant and the researcher and the position and instructions to the participant. The pilot study method, results and recommendations are discussed.

3.2. Study Design

Cross-sectional design. Comparative study between a perimenstrual migraine group and a non-migraine group.

3.3. Subjects

Subjects were sourced from:

- Helen Joseph Hospital
- Privately

3.3.1. Inclusion criteria included:

1. Menstruating women between the ages of 21-45 years (Martin et al, 2006)
2. Regular menstrual periods occurring every 21 to 35 days for the previous six months.
3. Fulfilment of the IHS criteria for menstrually associated, pure menstrual or premenstrual migraines without aura for the last 12 months for the subjects in the migraine group.
4. The occurrence of at least five perimenstrual migraines without aura in the last 12 months for the subjects in the migraine group.
5. Not receiving physiotherapy for migraines or headaches.

3.3.2. Exclusion criteria included:

1. Pregnant (or trying to fall pregnant)
2. Irregular menses
3. Use of hormone preparations in the last six months
4. History of medical problems that may affect migraines (e.g. lupus etc.)
5. Childbearing or lactation within the last year

6. History of breast, ovarian or endometrial cancer
7. History of any cervical dysfunction i.e. whiplash injury, cervical fracture or dislocation
8. Inability to attend the physiotherapy assessment two days prior to menstruation to three days into menstruation.

(Appendix 1)

3.3.3. Sample size

Subjects required: 40 nonmigraineurs
40 migraineurs

The groups were not matched.

3.3.4. Sample size calculation

For each risk factor that was examined, ten to fifteen participants were required. From the literature studied, it was anticipated that at most six to eight factors would be shown to be relevant to perimenstrual migraines and therefore would be included in the multivariate analysis i.e. logistic regression. Therefore a sample size of eighty subjects was aimed for.

3.4. Ethics

Ethical clearance was applied for from the University of the Witwatersrand Committee for Human Research (Appendix 2). Permission was applied for from the Helen Joseph Hospital where the study was conducted (Appendix 3). An information sheet was given to each participant (Appendix 4,5) before informed consent was signed (Appendix 6,7).

3.5. The pilot study (familiarisation procedures)

3.5.1. Aim:

- To ensure that the research assistant (a physiotherapist with seven years experience) was comfortable and confident with the assessment form and the tools.
- To refine the assessment order and procedure; to ensure it was as efficient, objective and as uniform as possible.
- To assess and, if necessary, improve the intra-rater consistency of the research assistant.
- To compare the assistant to an experienced neuromuscular physiotherapist, to ensure comparability.

3.5.2. Pre pilot study

Before the pilot study was started, a discussion and practical session were carried out to test the assessment form and to establish the standard physiotherapeutic testing procedures. This was done with the assistant, the researcher and two physiotherapy masters students who were not involved in the research. During this session, the practicalities of the testing procedure were agreed upon for all the outcome measures as are described in the outcome measures section (Appendix 8).

3.5.3. Pilot study 1

<u>Subjects</u>

Four subjects were assessed and reassessed a few days later by the same research assistant. Colleagues in the physiotherapy and occupational therapy departments at Helen Joseph Hospital participated.

<u>Method</u>

Day 1:

The potential participants were given an information sheet and informed consent was obtained.

Once consent has been obtained, the subjects were given the ‘Study inclusion and group determination’ form to fill in.

They were asked to fill out the subjective assessment.

They predicted their next menstruation and were given a date within two days premenstrually to 3 days into menstruation.

<u>Day of the assessment</u>

- Before they entered the examination room, they were told that the examiner did not and could not know if they suffered from headaches or not. They were asked not to tell the examiner if they have headaches or not and not to comment during most of the assessment, especially if a test provoked their headache pain. They were told not to comment until the final part of the assessment when they were asked specifically to comment on pain evoked during trigger point identification and cervical mobilisation.
- They were assessed.

<u>Conclusion</u>

Clinically it became apparent that the research assistant was getting different results at the reassessment and it was not known whether she was identifying changes in the patients or was not consistent in her results. One of the difficulties was in the rating of the stiffness of the cervical PAIVMS. The assessment of the muscle length restriction was inconsistent and the muscle identification for trigger pointing was found to be difficult. Therefore it was decided to establish the interrater reliability as well as the intrarater reliability of the assessor.

3.5.4. Assessment with an experienced physiotherapist

An experienced neuromuscular physiotherapist, who is a university lecturer and PhD student with over fifteen years of experience, then checked the research assistant's techniques and reliability. The assessment was done on a 'normal' volunteer and some changes to method and handling skills were made. This made the assessment more objective and accurate. (See appendix 9- italicised writing indicates the changes/additions given by the experienced physiotherapist)

3.5.5. Pilot study 2

<u>Subjects</u>

A second pilot study was carried out to confirm the intratester reliability of the research assistant during the objective assessment, with the changes and advice of the experienced physiotherapist. After five participants the confidence and reproducibility of the assistant were sufficient and no more participants were tested.

<u>Method</u>

Five participants were assessed with the revised method and were then reassessed about a week later by the same research assistant. The two assessments were compared and they showed good reproducibility. The results for the significant factors are presented in the results chapter.

<u>Conclusion</u>

The researcher and the research assistant felt confident with the reliability and the techniques after five participants had been examined.

3.6. Outcome measures

3.6.1. Subjective factors

The subjective factors were assessed in a questionnaire. The emotional risk factors cannot be measured therefore the participant was asked a yes/no question to determine if the parameter was present or not, not the intensity of the emotions. The participant was asked if they felt more irritable or frustrated during their menstrual period. The participant was asked if they are experiencing any feelings of anxiety, tension or stress and if these feelings were increased during the premenstrual or menstrual period. The participant was asked if they experienced increased fatigue during the perimenstrual period. The participant was about neck pain and stiffness. The last question was for the migraine participants only and asked from where they thought their migraine could be originating.

3.6.2. Physical factors

The objective factors were measured through a clinical assessment by the research assistant who was blinded to the allocation of participants into the two groups. An assessment form was drawn up to record the objective data (Appendix 10).

3.6.2.1. Posture

Participants were positioned in front of the plumb line, perpendicular to the grid board. A chair was placed in front of the participant for them to hold onto to. This helped to reduce postural sway.

Rocabado (1983) and Jaeger (1989) describe the measurement of the orthostatic position of the head on the neck. A plumb line was used, with the vertical tangent line running through the apex of the thoracic spine. The distance between the line and the mid- cervical spine of a normal head-neck posture is six centimetres. More than this distance is classified as a forward head-neck posture. This distance was measured using a rigid measuring tape.

Afterwards, the subjects stood in front of the grid board facing forwards with their hands relaxed at their sides and assuming their usual posture. The head was visually assessed for lateral flexion and rotation. Their shoulder heights were compared (Jaeger, 1989).

3.6.2.2. Muscle length testing

The movement of the segment should be slow and smooth (Petty and Moore, 2004). The amount of resistance during and at the end of the stretch, the amount of reduced range and displacement of the shoulder and neck were assessed.

The participants were told that the examiner would be stretching their neck to test their muscle length. They were instructed to relax completely and allow a passive stretch. To measure the length of upper trapezius, the patient was placed in supine to allow full relaxation. The neck was passively laterally flexed to the contralateral side with slight flexion added to stretch the cervical insertion (Janda, 1983; Petty et al, 2004). The examiner added contralateral shoulder depression (Petty et al, 2004). For levator scapulae, the patient was in supine and the examiner flexed, laterally flexed and rotated away (Janda, 1983). Shoulder depression was added at the end (Petty et al, 2004). Shortened muscle length would cause shoulder elevation on lateral flexion, as it pulls at the insertion at the scapula.

Petty et al (2004) describe the length test for the sternocleidomastoid muscle as chin tuck, lateral flexion away and rotation towards the tested side. This length test requires mainly upper cervical movement. Due to the two heads of pectoralis major, there are two length tests. The clavicular fibres were tested through 90º of abduction, with the clinician stabilising the trunk. The sternocostal fibres were tested through full flexion. (Petty et al, 2004)

The anterior scalenes were tested using extension, contralateral lateral flexion and rotation towards the tested side. The deep occipital muscle length was tested with the participant's head resting on the stomach of the assessor. This allowed the participant to fully relax their head. The head was then passively flexed and the muscles were palpated for tightness.

3.6.2.3. Neural tension testing

The participants were placed in supine on the edge of the bed on the tested side. It was explained that the participant must report the first symptom of pain or discomfort and the location. The test was stopped at the first report of neural type pain. If the test was stopped during elbow extension, the amount of elbow extension lag (degrees off full elbow extension) was visually estimated.

The sequence of the test was as follows: shoulder girdle depression, shoulder abduction to 90 degrees, shoulder lateral flexion, forearm supination, wrist and finger extension and elbow extension (Selvarantnam et al, 1994). The test was positive if the last movement was released and the pain was relieved. If no neural tension was felt by the end of full elbow extension, then the sensitising manoeuvre of contralateral lateral flexion was performed.

3.6.2.4. Trigger point assessment

This study assessed the following muscles: upper trapezius, levator scapula, scalenes, suboccipitals and sternocleidomastoid.

Participants lay in supine for assessment of the trapezius, scalene, sternocleidomastoid and suboccipital muscles. The muscles were assessed bilaterally and compared for tight bands and trigger points. The levator scapulae were assessed in prone, with the arms relaxed and hanging over the plinth. This ensures the relaxation of trapezius, to allow for the palpation of levator scapula. The examiner used both the pincer and flat palpation, depending on the muscle.

The examiner commented on the presence of tight bands and trigger points. Once a potential trigger point was identified, the participants were asked if there was pain, if the pain travelled and to where the pain travelled. The examiner identified if one side had more trigger points than the other.

3.6.2.5. Segmental cervical assessment

To improve reliability and accuracy in this segment of the assessment, the patient was asked if there was any pain on the passive accessory intervertebral movements (PAIVMS) at each level (Phillips and Twomey, 1996). This examination was done towards the end to maintain blinding during the rest of the examination.

In line with the studies reviewed, this study used only one examiner for all the participants across the groups. The ratings used in this study were as follows: 1- severe restriction, 2- moderate restriction, 3- minimal restriction, 4- normal. One unit difference between ratings was found to be the limit of reliability (Gonnella et al, 1982).

The participants were placed in prone on a plinth with their heads in the nose hole in cervical flexion and a pillow under their chest to ensure their head was relaxed and not pushing into the bed. The examiner first palpated the spine to identify the cervical levels. The spinous processes were counted from C_2 to C_7 (Robinson et al, 2009). As used by Robinson et al (2009), the participant was asked to extend their head to confirm the accuracy of C_6 which disappears on extension while C_7 remains under the finger. An explanation of the numeric rating scale was given to the participants.

To assess the comparative mobility of the cervical levels, two to three Maitland grade III PAIVMs on the spinous processes using the tips of the thumbs were performed at each level. A grade III allowed the full range of motion to be assessed (Maitland et al, 2005). The assessor assessed the movement for any restrictions and rated the amount of stiffness. The participants were asked to rate their pain at each level using the numeric rating scale. The researcher recorded the pain and stiffness ratings.

3.6.2.6. Range of motion testing

The goniometer used in this study was an optic visor headband with an attached inclinometer that could be adjusted for the three planes of movement i.e. sagittal, frontal, horizontal. The similar manual CROM was found to be reliable against a computerised ultrasound motion device

(Malmstrom et al, 2003). Most investigators measured their subjects in the sitting position (Youdas et al, 1992).

Range of motion was measured using the method described by Youdas et al (1991). To measure flexion, extension and lateral flexion, participants were placed in a standard chair, sitting upright, with their thoracic spine maintaining contact with the chair back. Their feet were positioned on the floor and arms relaxed. The researcher assisted in ensuring precision of the planes of the instrument, using the spirit levels that were attached to the inclinometer. The researcher also checked that the assistant stopped the lateral flexion before the trick movement of scapular elevation that would falsely increase the range. Rotation, due to the plane of the inclinometer, was done in supine with the head over the edge of the bed to prevent the bed from restricting the range. The head was lightly supported by the research assistant.

Maximal efforts and volition influence the ROM (Malmstrom et al, 2003). The participant was encouraged to do all the movements as far as possible, but was stopped when trick movements began.

3.6.2.7. Muscle strength testing

Strength testing was done using a hand held dynamometer. Silverman et al. (1991), using the same hand- held dynamometer that is used in this study, tested flexion strength in the supine position. Due to the lack of external support i.e. strong harnesses to limit trunk involvement as described in more recent literature, the supine position for flexion was concluded to provide optimal stabilisation for the most accurate flexor strength measurement (Phillips et al, 2000). Based on the positioning of O'Leary et al (2007), the participants were positioned in crook lying, arms folded over their chest and straps placed lightly over their shoulders to minimise trunk movement. The participants were instructed to tuck their chin in before doing the movement (Strimpakos et al, 2004).

The extension strength was tested in the prone position. Garcés et al. (2002) conclude that the seated position was most widely used in the literature and most comfortable for the patient. This position was therefore used for lateral flexion and rotation strength measurements, where stabilisation of the trunk could be easily accomplished by the assessor. The participants were seated comfortably in a chair with their back against the back rest, with the assessor stabilising the trunk to avoid compensatory movements. For rotation, the dynamometer was placed just above the ear's external auditory meatus to align with the rotational centre of the cervical spine which runs through the dens (Strimpakos et al, 2004).

Research on normative values report results of isometric testing, therefore for reliability and ease of comparison isometric testing beginning the test at half of the available range was used (Garcés et al 2002, Jordan et al, 1999). The testing was done with isometric (make) contractions where the patient pushes maximally against the dynamometer with resistance applied to maintain a constant head position. The measurements were repeated three times to allow the participant to get used to the movements and therefore to obtain an accurate average strength (Silverman et al, 1991). The contractions were held for five seconds, with a ten second break between the attempts. All participants were given the same verbal encouragement during the tests (Jordan et al, 1999). There was a 45 second break between the movements to allow resting (Ylinen et al 2004).

3.7. Procedure

- The research assistant was a physiotherapy master's student with six years of clinical experience. The researcher did sessions with the assistant where the assessment techniques were practised. These were done with two other physiotherapists to ensure that the techniques used by the assistant were standard techniques and accurately performed.
- The researcher and assistant confirmed surface anatomy of the relevant muscles.
- Two pilot studies were done to ensure that the assistant was comfortable and accurate with the assessment and tools.(See previous description)
- The researcher prepared the assessment guidelines for reference by the assistant during the assessments.
- The study was explained to potential participants, they were given the information sheet and completed the inclusion and exclusion criteria. If they met the criteria and consent was granted to participate in the study either as a control or migraine participant, a date (within two days premenstrually to three days into menstruation) and time was arranged for the assessment.
- At the assessment, they completed the subjective assessment questionnaire. The researcher was there to clarify any questions as necessary.
- Before they met the assistant, they were told that the examiner did not and could not know whether or not they suffer from headaches. They were asked not to tell the examiner if they have headaches or not and not to comment during most of the assessment, especially if a test provoked their headache pain. They were told that they could answer when they were asked to comment on pain evoked during the trigger point identification and the cervical mobilisation.
- At the end of the assessment, after the assistant had exited the room, the participants were asked if they had a headache post- assessment and if any of the tests provoked a headache pain

and if so, which ones. The migraine subjects were asked to answer specific to the familiar perimenstrual migraine pain.

- Their data were analysed to obtain the significant risk factors that contribute to the perimenstrual migraine.

3.8. Statistical analysis

Fisher's exact test was employed to compare study groups with respect to discrete (nominal and ordinal) variables and for continuous data the Welch t-test was applied and its results were confirmed using Wilcoxon's sum rank test (Mann-Whitney U-test). These tests highlighted the factors that were significantly different between the study groups. The discrete significant factors ($p \leq 0.05$) were then plugged into an odds ratio test to determine the relative risk of the factor contributing to perimenstrual migraines. The odds ratio test uses the Chi-square test to obtain the p-values. The odds ratio test also calculates the trend of odds, which shows the trend of risk for increasing severity of the factor.

3.9. Conclusion

The method of each component of the assessment was clarified through the pilot study and the changes that were made were incorporated into the assessment form for the main study. Standard procedures, according to physiotherapy textbooks and previous studies, were used. The same assessment order, techniques, instructions and encouragement was given to all the participants. Controls and migraine participants were assessed in a random order to ensure blinding and therefore unbiased results. The results were analysed using statistical tests and are represented in Chapter 4.

4. CHAPTER 4 – RESULTS

4.1. Introduction

This chapter contains the results of the pilot and main studies; with tabulated results for the demographic data, findings from the subjective assessment and the objective assessment. The results from the pilot study show the consistency of the assessor. The results will be discussed in the Chapter 5.

4.2. Pilot study results

The pilot study was done on the objective assessment. The pilot study was conducted on five participants, each assessed twice. Due to the small sample size, the data are interpreted descriptively as presented in Table 4.1.

Table 4.1 Pilot study results (intra tester)

Objective factor	Component	Number of tests done	Number of inconsistencies (percentage)
Muscle length tests (Six muscle groups, bilaterally)		60 (12 per person x5)	13 (21, 67%)
Neural tension	**Category of lag**	10 (2 per person x5)	1 (10%)
	Positivity of the test	10 (2 per person x5)	0
Trigger points (five muscle groups bilaterally)	**Presence of active/latent trigger points**	50 (10x5)	10 (20%)
	Side of most trigger points	25 (5x5)	4 (16%)
PAIVMS (six cervical levels)	**Category of restriction**	30 (6 per personx5)	1 (3,33%) [9 were within one-unit difference, therefore still within the limit of reliability]

One unit difference between ratings for cervical stiffness was found to be the limit of reliability (Gonnella et al, 1982). The percentages of reproducibility of the tests are within the accepted levels of intratester reliability for clinical tests.

4.3. Main study results

The participants' age and race distribution are presented in Table 4.2.

Table 4.2 Age and race distribution by study group (n=86; control n=46, migraine n=40)

	Control n(%)	**Migraine n(%)**	**p- value**
Age Category			***0.02**
0: 18-25 years	40 (86.96)	25 (62.5)	
1: 26-33 years	4 (8.7)	10 (25)	
2: 34-41 years	2 (4.35)	2 (5)	
3: 42-49 years	0	3 (7.5)	
Race			**0.14**
Caucasian	28 (60.87)	18 (45)	
Black, Coloured, Indian, Asian	18 (39.13)	22 (55)	

The age distribution the two study groups differ significantly (p=0.02), and in particular the migraine group tended to be older than the control group.
The largest percentage of both the control and migraine groups came from the youngest age group.

Table 4.3 summarises the answers to the subjective questionnaire. The questionnaire detailed the participants' general and perimenstrual emotional states and perceptions of neck pain and stiffness.

Table 4.3 Subjective, mental and perceived findings by study group (n=86; control n=46, migraine n=40)

Subjective factor	Control n(%)	Migraine n(%)	p- value
Anxiety			
Yes	18 (39.13)	22 (55)	
No	28 (60.87)	18 (45)	**0.19**
Perimenstrual anxiety			
Yes	24 (52.17)	30 (75)	***0.04**
No	22 (47.83)	10 (25)	
Fatigue			
Yes	16 (34.78)	23 (57.5)	
No	30 (65.22)	17 (42.5)	***0.05**
Perimenstrual fatigue			
Yes	20 (43.48)	36 (90)	***<0.001**
No	26 (56.52)	4 (10)	
Irritability			
Yes	8 (17.39)	11 (27.5)	
No	38 (82.61)	29 (72.5)	**0.30**
Perimenstrual irritability			
Yes	29 (63.04)	33 (82.5)	***0.05**
No	17 (36.96)	7 (17.5)	
Neck stiffness			
Yes	13 (28.26)	31 (77.5)	
No	33 (71.74)	9 (22.5)	***<0.001**
Neck pain			
Yes	6 (13.04)	27 (67.5)	
No	40 (86.96)	13 (32.5)	***<0.001**

All significant differences in Table 4.3 above are as a result of higher prevalence in the migraine group.

There are significant differences in the experience of perimenstrual anxiety, perimenstrual fatigue and perimenstrual irritability between the control and migraine participants, with significantly higher levels in the migraine population. General fatigue is also significantly more reported in the migraine group. Neck pain and stiffness are significantly more experienced by the migraine group, compared to the control group.

The objective factors/findings are presented in Tables 4.4-1 to 6.

Table 4.4 Objective factors/ findings (n=86; control n=46, migraine n=40)

Table 4.4-1 Posture assessment

Objective factor	**Component**	**Control n(%)**	**Migraine n(%)**	**p- value**
Posture	**Distance (centimetres): mean (standard deviation)**	7.26 (±1.51)	7.32 (±1.58)	0.85
	Within normal			
	Yes	11 (23.91)	7 (17.5)	
	No	35 (76.09)	33 (82.50)	0.60
	Cervical rotation			
	Yes	32 (69.57)	29 (72.50)	
	No	14 (30.43)	11 (27.50)	0.82
	Cervical lateral flexion			
	Yes	24 (52.17)	19 (47.5)	
	No	22 (47.83)	21 (52.5)	0.83

There are no significant postural differences between the control and migraine groups, with both groups having some cervical abnormality.

Table 4.4-2 Muscle length assessment

Objective factor		Component	Control n(%)	Migraine n(%)	p- value
Muscle length	**Levator scapula Right**	• **Normal** • **Slight restriction** • **Restricted**	17 (36.96) 15 (32.61) 14 (30.43)	10 (25) 14 (35) 16 (40)	0.45
		• **Painful** • **No pain** • **Pulling**	8 (17.39) 19 (41.30) 19 (41.30)	22 (55) 7 (17.5) 11 (27.5)	*0.001
	Levator scapula Left	• **Normal** • **Slight restriction** • **Restricted**	28 (60.87) 11 (23.91) 7 (15.22)	20 (50) 6 (15) 14 (35)	0.11
		• **Painful** • **No pain** • **Pulling**	6 (13.04) 23 (50) 17 (36.96)	16 (40) 9 (22.5) 15 (37.5)	*0.005
	Trapezius Right	• **Normal** • **Slight restriction** • **Restricted**	26 (56.52) 14 (30.43) 6 (13.04)	16 (40) 6 (15) 18 (45)	*0.004
		• **Painful** • **No pain** • **Pulling**	9 (19.57) 23 (50) 14 (30.43)	19 (47.5) 8 (20) 13 (32.5)	*0.005
	Trapezius Left	• **Normal** • **Slight restriction** • **Restricted**	34 (73.91) 5 (10.87) 7 (15.22)	23 (57.5) 5 (12.5) 2 (30)	0.22
		• **Painful** • **No pain** • **Pulling**	6 (13.04) 24 (52.17) 16 (34.78)	12 (30) 8 (20) 20 (50)	*0.006
	SCM Right	• **Normal** • **Slight restriction** • **Restricted**	38 (82.61) 5 (10.87) 3 (6.52)	31 (77.5) 4 (10) 5 (12.5)	0.67
		• **Painful** • **No pain** • **Pulling**	4 (8.7) 38 (82.61) 4 (8.7)	6 (15) 27 (67.5) 7 (17.5)	0.27

	SCM Left	• **Normal** • **Slight restriction** • **Restricted**	39 (84.78) 3 (6.52) 4 (8.7)	25 (62.5) 4 (10) 11 (27.5)	*0.05
		• **Painful** • **No pain** • **Pulling**	5 (10.87) 36 (78.26) 5 (10.87)	13 (32.5) 18 (45) 9 (22.5)	*0.006
	Pectoralis major Right	• **Normal** • **Slight restriction** • **Restricted**	39 (84.78) 4 (8.7) 3 (6.52)	32 (40) 4 (10) 4 (10)	0.839
		• **Painful** • **No pain** • **Pulling**	0 36 (78.26) 10 (21.74)	0 32 (80) 8 (20)	1.00
	Pectoralis major Left	• **Normal** • **Slight restriction** • **Restricted**	40 (86.96) 5 (10.87) 1 (2.17)	30 (75) 4 (10) 6 (15)	0.09
		• **Painful** • **No pain** • **Pulling**	1 (2.17) 35 (76.09) 10 (21.74)	3 (7.5) 24 (60) 13 (32.5)	0.24
	Scalene Right	• **Normal** • **Slight restriction** • **Restricted**	30 (65.22) 8 (17.39) 8 (17.39)	32 (80) 5 (12.5) 3 (7.5)	0.27
		• **Painful** • **No pain** • **Pulling**	4 (8.7) 30 (65.22) 12 (26.09)	8 (20) 23 (57.5) 9 (22.5)	0.37
	Scalene Left	• **Normal** • **Slight restriction** • **Restricted**	31 (67.39) 9 (19.57) 6 (13.04)	26 (65) 4 (10) 10 (25)	0.24
		• **Painful** • **No pain** • **Pulling**	5 (10.87) 27 (58.7) 14 (30.43)	11 (27.5) 22 (55) 7 (17.5)	0.09
	Occipital Right	• **Normal** • **Slight restriction** • **Restricted**	42 (91.3) 1 (2.17) 3 (6.52)	25 (62.5) 3 (7.5) 12 (30)	*0.003

		• **Painful** • **No pain** • **Pulling**	3 (6.52) 41 (89.13) 2 (4.35)	5 (12.5) 24 (60) 11 (27.5)	*0.003
	Occipital Left	• **Normal** • **Slight restriction** • **Restricted**	32 (69.57) 7 (15.22) 7 (15.22)	25 (62.5) 2 (5) 13 (32.5)	0.09
		• **Painful** • **No pain** • **Pulling**	3 (6.52) 40 (86.96) 3 (6.52)	7 (17.5) 22 (55) 11 (27.5)	*0.004

In the muscle length tests; the pain on stretch of levator scapula right and left, trapezius right and left, sternocleidomastoid left and occipitals right is significantly higher in the migraine group. The muscle length is significantly reduced in the migraine group compared to the control group in the trapezius right, sternocleidomastoid left and occipitals right.

Table 4.4-3 Muscle strength and range of motion assessment

Objective factor		Control mean (std deviation)	Migraine mean (std deviation)	p- value
Muscle strength (newtons)	**Cervical flexion**	59.27 (±17.57)	55.01 (±17.35)	0.26
	Cervical extension	107.49 (±23.61)	104.90 (±22.51)	0.60
	Cervical right lateral flexion	74.49 (±19.11)	70.46 (±20.29)	0.35
	Cervical left lateral flexion	66.46 (±19.03)	67.50 (±17.56)	0.79
	Cervical right rotation	74.68 (±18.12)	69.64 (±18.16)	0.20
	Cervical left rotation	66.11 (±16.23)	64.38 (±16.71)	0.63
Range of motion (degrees)	**Cervical flexion**	57.83 (±10.86)	53.68 (±11.05)	0.08
	Cervical extension	73.89 (±13.47)	71.15 (±11.78)	0.32
	Cervical right lateral flexion	46.07 (±9.95)	45.15 (±9.73)	0.67
	Cervical left lateral flexion	46.85 (±8.47)	46.25 (±14.77)	0.82
	Cervical right rotation	88 (±9.70)	82.88 (±12.60)	*0.04
	Cervical left rotation	93.52(±10.52)	87.53 (±11.29)	*0.01

There was no significant weakness in the cervical muscles of the migraine group, compared to the controls. The range of motion of bilateral rotation is significantly less in the migraine group, with other movements maintaining their range.

Table 4.4-4 Neural tension testing

Objective factor		Component	Control n(%)	Migraine n(%)	p- value
Neural tension	**Elbow extension lag category Right**	• **90º- 30º elbow extension lag** • **30º -0º elbow extension lag** • **Before the full test position**	19 (41.30) 21 (45.65) 6 (13.04)	7 (17.5) 20 (50) 13 (32.5)	*0.02
	Elbow extension lag Right	**Mean (std deviation)**	46 (±35.03)	59.81 (±30.96)	0.09
	Test positivity Right	**Positive** **Negative**	46 (100)	40 (100)	
	Elbow extension lag category Left t	• **90º- 30º elbow extension lag** • **30º -0º elbow extension lag** • **Before the full test position**	32 (69.57) 13 (28.26) 1 (2.17)	21 (52.5) 12 (30) 7 (17.5)	*0.04
	Elbow extension lag Left	**Mean (std deviation)**	29.33 (±28.91)	34.23 (±35.05)	0.51
	Test positivity Left	**Positive** **Negative**	42 (91.30) 4 (8.70)	38 (95) 2 (5)	0.68

Compared to the control group, the category of elbow extension lag for the migraine group is significantly more for the greatest lag. This reflects an increased neural tension in the migraine group, compared to the controls.

Table 4.4-5 Trigger point assessment

Objective factor		Component	Control n(%)	Migraine n(%)	p- value
Trigger points	**Levator scapula Right**	**No**	11 (23.91)	5 (12.5)	
		Tenderness	7 (15.22)	7 (17.5)	
		Latent	10 (21.74)	5 (12.5)	
		Active	18 (39.13)	23 (57.50)	0.26
	Levator scapula Left	**No**	20 (43.48)	10 (25)	
		Tenderness	6 (13.04)	4 (10)	
		Latent	5 (10.87)	5(12.5)	
		Active	15 (32.61)	21 (52.5)	0.21
	Trapezius Right	**No**	0	1 (2.5)	
		Tenderness	5 (10.87)	2 (5)	
		Latent	16 (34.78)	5 (12.5)	
		Active	25 (54.35)	32 (80)	*0.02
	Trapezius Left	**No**	5 (10.87)	1 (2.5)	
		Tenderness	4 (8.70)	1 (2.5)	
		Latent	16 (34.78)	7 (17.5)	
		Active	21(45.65)	31 (77.5)	*0.02
	SCM Right	**No**	19 (41.3)	5 (12.5)	
		Tenderness	3 (6.52)	6 (15)	
		Latent	5 (10.87)	6 (15)	
		Active	19 (41.3)	23 (57.50)	*0.02
	SCM Left	**No**	18 (39.13)	9 (22.5)	
		Tenderness	5 (10.87)	8 (20)	
		Latent	10 (21.74)	1 (2.5)	
		Active	13 (28.26)	22 (55)	*0.004
	Scalene right	**No**	34 (73.91)	24 (60)	
		Tenderness	6 (13.04)	3 (7.5)	
		Latent	1 (2.17)	0	
		Active	5 (10.87)	13 (32.5)	0.06
	Scalene left	**No**	23 (50)	23 (57.5)	
		Tenderness	5 (10.87)	3 (7.5)	
		Latent	5 (10.87)	2 (5)	

		Active	13 (28.26)	12(30)	0.73
	Occipitals right	**No**	14 (30.43)	7 (17.5)	
		Tenderness	11 (23.91)	9 (22.5)	
		Latent	9 (19.5)	7 (17.5)	
		Active	12 (26.09)	17 (42.5)	0.37
	Occipitals left	**No**	12 (26.09)	8 (20)	
		Tenderness	7 (15.22)	4 (10)	
		Latent	9 (19.57)	7 (17.5)	
		Active	18 (39.13)	21 (52.5)	0.67

For the trigger point assessment, tight bands were assessed as part of the criteria for trigger point identification. Active trigger points were confirmed by a referral in the common referral pattern according to Travell et al (1999); latent trigger points were palpated, tender trigger points without an active referral.

In the trigger point assessment, the presence of trigger points is significantly increased in the migraine group compared to the control group for the upper trapezius right and left and sternocleidomastoid right and left. For these muscles, there are also substantially more active trigger points in the migraine group compared to the control group.

Table 4.4-6 Segmental cervical assessment

Objective factor		Component	Control n(%)	Migraine n(%)	p- value
Cervical PAIVMS	**C2 stiffness**	• **Normal** • **Mild** • **Moderate** • **Severe**	13 (28.26) 14 (30.43) 17 (36.96) 2 (4.35)	12 (30) 10 (25) 14 (35) 4 (10)	0.77
	C2 pain score	**mean (std dev)**	1.24 (±1.58)	1.4 (±1.68)	0.65
	C3 stiffness	• **Normal** • **Mild** • **Moderate** • **Severe**	30 (65.22) 9 (19.57) 6 (13.04) 1 (2.17)	25 (62.5) 11 (27.5) 3 (7.5) 1 (2.5)	0.80
	C3 pain score	**mean (std dev)**	1.66 (±2.00)	2.44 (±2.12)	0.09
	C4 stiffness	• **Normal** • **Mild** • **Moderate** • **Severe**	20 (43.48) 14 (30.43) 8 (17.39) 4 (8.70)	14 (35) 14 (35) 11 (27.5) 1 (2.5)	0.42
	C4 pain score	**mean (std dev)**	2.07 (±1.95)	3.21 (±2.13)	*0.01
	C5 stiffness	• **Normal** • **Mild** • **Moderate** • **Severe**	18 (39.13) 20 (43.48) 8 (17.39) 0	9 (22.5) 12 (30) 17 (42.5) 2 (5)	*0.02
	C5 pain score	**mean (std dev)**	1.54 (±2.03)	2.54 (±2.29)	*0.04
	C6 stiffness	• **Normal** • **Mild** • **Moderate** • **Severe**	16 (34.78) 21 (45.65) 8 (17.39) 1 (2.17)	10 (25) 12 (30) 16 (40) 2 (5)	0.08
	C6 pain score	**mean (std dev)**	1.37 (±1.90)	2.91 (±2.37)	*0.002

	C7 stiffness	• **Normal** • **Mild** • **Moderate** • **Severe**	17 (36.96) 17 (36.96) 11 (23.91) 1 (2.17)	4 (10) 19 (47.5) 13 (32.5) 4 (10)	*0.02
	C7 pain score	**mean (std dev)**	1.39 (±1.72)	2.15 (±2.02)	0.07

For the assessment of stiffness and pain on cervical PAIVMS, there is significant increased stiffness for C_5, C_6 and C_7, and higher pain intensity on levels from C_4 to C_6.

Table 4.5 below illustrates the relative risk of the significant factors (p 45- 47).

Table 4.5 Relative risk of the significant factors (n=86; control n=46, migraine n=40)

Risk factor		**Odds Ratio (Crude)**	**95% Confidence interval**	**p-value (Association)**	**p-value (Trend)**
Perimenstrual anxiety	No	1			
	Yes	2.75	1.06 ; 7.13	0.03	0.03
Fatigue	No	1			
	Yes	2.54	1.03 ; 6.25	0.04	0.04
Perimenstrual fatigue	No	1			
	Yes	11.7	2.99 ; 45.86	<0.001	<0.001
Perimenstrual irritability	No	1			
	Yes	2.76	0.97 ; 7.84	0.05	0.05
Neck stiffness	No	1			
	Yes	8.74	2.82 ; 27.15	<0.001	<0.001
Neck pain	No	1			
	Yes	13.85	3.72 ; 51.52	<0.001	<0.001
Levator scapula (right) pain	No	1			
	Pulling	1.57	0.49 ; 5.00		
	Yes	7.46	1.94 ; 28.79	0.001	0.0005
Levator scapula (left) pain	No	1			
	Pulling	2.25	0.78 ; 6.55		
	Yes	6.81	1.74 ; 26.67	0.006	0.001
Trapezius length (right)	Normal	1			
	Slight restriction	0.7	0.22 ; 2.21		
	Restricted	4.88	1.47 ; 16.20	0.004	0.009
Trapezius (right) pain	No	1			
	Pulling	2.67	0.85 ; 8.38		
	Yes	6.07	1.73 ; 21.32	0.006	0.001
Trapezius (left) pain	No	1			
	Pulling	3.75	1.25 ; 11.24		
	Yes	6.00	1.48 ; 24.33	0.007	0.002
SCM (left)	Normal	1			

	Slight restriction	2.08	0.42 ; 10.30		
	Restricted	4.29	1.16 ; 15.84	0.05	0.01
SCM (left) pain	No	1			
	Pulling	3.6	0.99 ; 12.98		
	Yes	5.2	1.47 ; 18.33	0.006	0.002
Occipitals (right)	Normal	1			
	Slight restriction	5.04	0.47 ; 53.97		
	Restricted	6.72	1.58 ; 28.62	0.006	0.002
Occipitals (right) pain	No	1			
	Pulling	9.4	1.7 ; 52.05		
	Yes	2.85	0.61 ; 13.4	0.005	0.01
Occipitals (left)	Normal	1			
	Slight restriction	0.37	0.07 ; 1.98		
	Restricted	2.38	0.80 ; 7.02	0.08	0.18
Occipitals (left) pain	No	1			
	Pulling	6.67	1.53 ; 29.11		
	Yes	4.24	0.94 ; 19.10	0.004	0.004
Category of elbow extension lag (right)	30°-0° (full extension)	1			
	90°-30°	2.59	0.86 ; 7.73		
	Before full test position	5.88	1.39 ; 24.87	0.02	0.006
Category of elbow extension lag (left)	30°-0° (full extension)	1			
	90°-30°	1.41	0.53 ; 3.70		
	Before full test position	10.67	1.06 ; 107.37	0.04	0.02
Trigger points Trapezius Right	No/ tenderness	1			
	Latent	0.52	0.09 ; 3.14		
	Active	2.13	0.45 ; 10.03	0.04	0.1
Trigger points Trapezius Left	No/ tenderness	1			
	Latent	1.97	0.32 ; 12.07		
	Active	6.64	1.18 ; 37.48	0.009	0.005
Trigger points SCM	No/ tenderness	1			
	Latent	2.40	0.57 ; 10.05		

Right	Active	2.42	0.91 ; 6.41	0.16	0.06
Trigger points SCM Left	No/ tenderness Latent Active	1 0.14 2.29	 0.01 ; 1.30 0.88 ; 5.95	 0.006	 0.17
C5 stiffness	Normal Mild Moderate Severe	1 1.20 4.25	 0.41 ; 3.55 1.22 ; 14.82	 0.02	 0.004
C7 stiffness	Normal Mild Moderate Severe	1 4.75 5.02 17.00	 1.22 ; 18.49 1.16 ; 21.79 0.91 ; 316.02	 0.02	 0.006

The order of some of the results was changed when doing the odds ratio to allow for the trend of odds. The Fisher's exact test was done with trigger point severity listed in the following order: active, latent, none and tenderness; for the odds ratio the order was changed to ascending order of severity i.e. none, tenderness, latent and active trigger points. The slight differences in the p-values reported in Tables 4.5 and 4.4 result from applying the Chi-square test as opposed to Fisher's exact test. For trigger points the results for 'No trigger points' and 'tenderness' were combined.

The odds ratios are interpreted as follows (using perimenstrual fatigue as an example): when exposed to perimenstrual fatigue the risk of migraine is elevated 11.7 fold in women with perimenstrual fatigue compared to women without perimenstrual fatigue.

All the factors included in Table 4.5 have a high odds ratio (high relative risk) and may play a contributing role in perimenstrual migraines. The factors with the highest odds ratio (≥ 5) are highlighted in the list below:

- Perimenstrual fatigue (11.7)
- Neck stiffness (8.74)
- Neck pain (13.85)
- Right levator scapula pain on stretch (7.46)
- Left levator scapula pain on stretch (6.81)
- Right trapezius pain on stretch (6.07)

- Left trapezius pain on stretch (6.0)
- Left SCM pain on stretch (5.20)
- Right occipitals length restriction (6.72)
- Right elbow extension lag (5.88)
- Left elbow extension lag (10.67)
- Left trapezius active trigger points (6.64)
- C7 stiffness (17.00)

For most of the significant factors, there is also a significant trend of odds i.e. increasing risk for increasing severity of the factor.

5. CHAPTER 5- DISCUSSION

5.1. Introduction

In this chapter, the results are analysed and discussed. The procedure and results of the pilot studies are detailed. The significant findings ($p \leq 0.05$) are the focus of the discussion, with these findings in each part of the assessment being examined.

5.2. Pilot studies (familiarisation procedures)

Before the main study was started, pilot studies were conducted to familiarise the assessor and researcher with the procedure and tools, and to standardise the findings' interpretation. Great care was taken to establish the reproducibility of the assessor's results to ensure reliability of the assessments.

A first assessment was conducted with the researcher, research assistant and two qualified physiotherapists each with three years of experience. All physiotherapists present were enrolled in master's programmes. This assessment was carried out to ensure that standard physiotherapy tests and procedures were used in the objective examination. The first pilot study to test the intrarater reproducibility of the assessor was done on four subjects, each assessed twice. The results obtained were not satisfactory and an experienced physiotherapist was brought in to familiarise the assessor with 'normal' findings and therefore different degrees of restriction and dysfunction. The experienced physiotherapist also adjusted some of the testing techniques to optimise reproducibility, accuracy and finding interpretation.

A second pilot study was carried out to test the consistency of the assessor's results. Five subjects were each assessed twice, with a few days between the assessments to prevent memory interfering with the assessment. The consistency of the results showed sufficient reproducibility in the assessment parts that required the clinical skill of the assessor. The intratester reliability of the assessor was acceptable and the main study was begun.

5.3. Significant findings

Due to the clinical nature of the signs and symptoms that were investigated, it was expected that there would be large confidence intervals.

5.3.1. Demographic and subjective findings

5.3.1.1. Age

Age distribution between the study groups differed significantly (p=0.02), in particular the increased number of migraine subjects in the second youngest category (26-33 years). The older age of the migraine group may be attributed to increased emotional stressors such as more financial, work and familial responsibilities, leading to increased fatigue, anxiety and irritability. Due to the small age range, age was not thought to significantly affect physical outcomes. ROM loss between decades is only 3-5°, and a large percentage of the second category (the category with the largest difference between control and migraine) is still within the second decade (Youdas et al, 1992).

5.3.1.2. Perimenstrual anxiety and irritability

The role of anxiety (p= 0.03) and irritability (p=0.05) around the menstrual cycle has been shown by this study to be significant in perimenstrual migraines, with a 2.8 fold greater risk of perimenstrual migraine when exposed to these negative emotional factors. This is similar to the results of Martin et al (2006) who found the presence of these emotions to be significantly greater during the early follicular (days one to three of menstruation) and late luteal (the three days prior to onset of menses) phases. These PMS symptoms were found to be significantly correlated with headache frequency, severity, disability and use of medication (Martin et al, 2006). It is not known whether the presence of the migraine increases the experience of these PMS symptoms or whether these negative emotional experiences contribute to the migraine development (Martin et al, 2006).

The pain of the migraine, combined with the discomfort of menstruation and frustration at the ensuing disability caused can all increase anxiety and irritability. This could explain why these emotions are increased in the migraine sample. Another explanation could be that these emotions are more causal to the migraine, with the propensity to high anxiety and irritability levels increasing the risk of migraine. Psychological stressors increase muscle tension, increasing trigger point formation and perpetuation (Graff Radford et al, 1987), which are known contributors to headache pain.

The contribution of these factors to the migraine stresses the importance of addressing the psychological well being of the migraineur. The physiotherapist, as a trusted health care practitioner, can engage in counselling with regard to the healthy expression and reduction of negative emotions. Referral to a psychologist may be important for a patient who struggles to control these emotions.

5.3.1.3. Fatigue and perimenstrual fatigue

The findings of this study include significantly increased self-perceived report of general fatigue ($p = 0.04$), perimenstrual fatigue ($p<0.001$) and irritability in the migraine group. This is similar to the findings of increased prodromic symptoms, especially irritability and fatigue, found in perimenstrual attacks compared to nonmenstrual attacks as reported by Granella et al (2004).

This study suggests that the increased self-perceived fatigue is probably more affected by the migraine presence than the menstruation itself, as there is more self perceived perimenstrual fatigue in the migraine group compared to the control group. The migraine group included menstrually related migraine sufferers who also experience migraine at other times in the month, which could explain the increased general fatigue. Fatigue leads to less muscle activation and control, and contributes to a general feeling of weakness and malaise (ref!!). These negative emotions encourage focus and attention on pain, and contribute physically to the migraine as well. Patients need to be educated and trained about the internal control of negative emotions, and encouraged to be emotionally and physically active in the management of their migraine. Cognitive behavioural therapy administered by a psychologist may be an effective tool.

5.3.1.4. Perception of neck stiffness and pain

Pain is a subjective experience and therefore asking about the experience of the patient is the only way of assessing pain. The migraineurs recorded significantly more neck stiffness ($p <0.001$) and pain ($p <0.001$), which supports the results of the objective assessment. They feel the discomfort from their cervical spine, which could either be a contributing factor to their migraine pain or a perpetuating symptom of their migraine. The awareness of neck stiffness and pain increases the risk of perimenstrual migraines by 8.7 and 13.9 fold respectively.

5.3.2. Objective findings

5.3.2.1. Muscle length

In this study, the following muscles were shown to be more restricted in the migraine group, with significant trends of increasing severity: right trapezius ($p=0.004$), left sternocleidomastoid ($p=0.05$) and bilateral occipitals (right $p= 0.006$; left $p= 0.08$). There is also significant pain on stretch of these muscles and levator scapula. The presence of decreased muscle length increases the relative risk of perimenstrual migraines by 2.4 to 6.7 fold. Jull et al (1999) also reported findings of an abnormal response to passive stretching with significant tightness in trapezuis muscles in a group of patients with headache compared to controls.

The muscular system adjusts to neural and articular pain and therefore it is expected that there may be some muscular dysfunction accompanying other cervical changes. The trapezius and sternocleidomastoid muscles are also the muscles with significantly more trigger points in the migraine group. Trigger points develop in shortened muscles and are painful on stretch of the muscle (Travell et al, 1999).

The suboccipital area contains many muscles (rectus capitis posterior major and minor, obliquus capitis superior and inferior, splenius and semispinalis capitis) and is the passage for the suboccipital nerve (from C1 spinal nerve), greater occipital nerve (from C2 spinal nerve) and the third occipital nerve (from C3 spinal nerve). These first three cervical nerves innervate the suboccipital muscles, therefore neural changes and discharges may affect the length of these muscles. The pain on stretch of the tight suboccipital muscles can come from the mechanical irritation of the nerves, which then feed afferent signals into the TCN contributing to the headache pain.

The myofascial release and stretch of these muscles should help to increase their length and therefore reduce their contribution to the migraine pain. Other physiotherapy techniques, such as muscle energy techniques, can also be used. As the muscular tightness decreases, the pain on stretch of these muscles should also decrease.

5.3.2.2. Pain

Migraineurs have been found to have increased muscle sensitisation and reduced pain threshold (Bevilaqua- Grossi et al, 2009). This study found that the pain experienced by the migraine group during the muscle length tests and PAIVMS was significantly higher than that reported by the control group. The pain did not always support the significant findings in the test i.e. restricted muscle length and cervical stiffness. For muscle length there was significantly more pain in the migraine group for bilateral levator scapulae and left trapezius, but not significantly reduced length compared to the control group. In PAIVMS, there was considerable pain for cervical levels C_4 to C_6, yet only significant stiffness in cervical levels C_5 and C_7.

A possible hypothesis for this increased pain response is a peripheral and central sensitisation. This presents with increased tenderness to manual palpation and a pressure pain threshold sensitisation (de las Peñas, 2009). Persistent afferent discharge from dysfunctional cervical structures can sensitise the trigeminocervical nucleus (TCN), by causing changes in the second order nociceptive neurones in the TCN (Robertson and Morris, 2008). The effects of this sensitisation are a lowered firing threshold (fire in response to smaller noxious stimuli and to innocuous stimuli), increased responsiveness to noxious stimuli (fire harder and more causing a hyperlagesia) and an increase in spontaneous firing.

Increased prostaglandin release occurs which initiates neurogenic inflammation, the cause of peripheral nociceptor sensitization (Silberstein et al, 1993). Prostaglandins also affect the CNS and modulate the descending pain control noradrenergic systems. Furthermore, the menstruation related hormonal changes can alter endogenous pain modulation, with the late luteal phase reported to be associated with increased negative affect and hyperalgesia (Rhudy et al, 2010).

These possible peripheral and central changes indicate that chronic changes may be taking place in perimenstrual migraines and therefore, as a chronic pain condition, these migraines require a multidisciplinary approach to treatment. The psychological, behavioural and physical aspects need to be treated by the appropriate professionals. Physiotherapists can educate the patient on chronic pain and teach pain relief techniques such as heat and stretches.

5.3.2.3. Range of motion

The results of cervical range measurements in this study show only a significantly reduced bilateral rotation (right: p=0.04; left: p=0.01) in the migraine group, but no other movement restrictions. The general maintenance of cervical mobility is similar to the results of de las Peñas (2006b) and Zwart (1997).

A possible explanation for the reduced rotation is that chronic avoidance of movement may lead to joint stiffness and reduced range. Yet, if there was substantial joint stiffness then most of the movements should have been restricted.

In migraine, neck movements usually worsen the migraine pain. Therefore there may be a degree of kinesiophobic behaviour, where the migraineur is voluntarily restricting full movement through the cervical range as a pain avoidance technique (Bevilaqua- Grossi et al, 2009). This may also be reinforced as a learned protective pattern of movement. The research assistant attempted to counter this phenomenon with verbal encouragement to ‘turn as far as you can’.

Normal range can be regained through the release of stiff joints and muscles through joint mobilisation and myofascial release techniques. The patient needs to be shown and encouraged to move through the full cervical range when the pain is less or absent, to help maintain the range.

5.3.2.4. Neural tension

In the categorising of elbow extension lag, there was a significantly higher percentage (right 32,5%; left 17,5%) (right p=0.02, left p=0.04) of migraine subjects who had a positive neural tension before the full neural tension position was obtained, compared to the controls (right 13%; left 2,17%). The worse neural tension in the right upper limb may be due to the higher prevalence of right hand dominance in the general population. There was also a significant trend of odds for both the right (p=0.006) and the left (p=0.02) upper limbs, which reflects the trend to an increased severity of the neural tension in the migraine group.

De las Peñas et al (2009) found generalised mechanical pain hypersensitivity in bilateral peripheral nerve trunks in a unilateral migraine sample. This hypersensitivity may reflect a state of hyperexcitability of the central nervous system (CNS) where innocuous stimuli synapse onto and activate cells that usually only receive noxious stimuli. Increased neurogenic inflammation sensitises peripheral nerves and lowers the threshold of the nociceptive fibres of the nervi nervorum (the nerves that innervate the connective tissue of the nerve itself). The mechano-sensitivity of the peripheral neural tissue perpetuates the CNS excitability. Physiotherapy has been recommended to treat the neurogenic inflammation and therefore the mechanical hyperexcitability of peripheral nerves (de las Peñas et al, 2009).

Neural tension can also be assessed in the cervical spine through the passive neck flexion test and the whole spine through the slump test. If these are positive, they can be used to treat the neural tension. The treatment of neural tension may decrease the hypersensitivity of the peripheral nerves and in turn reduce the central sensitisation. This could decrease the neurogenic component to the migraine and therefore reduce the pain severity of the perimenstrual migraines.

5.3.2.5. Trigger points

The results of trigger point examination in this study showed significant differences between the migraine and control participants for the upper trapezius and sternocleidomastoid (SCM) muscles bilaterally. For the trapezius muscles, 80% and 78% of the migraine participants had active trigger points, compared to 54% and 46% of the control group for right (p=0.02) and left (p=0.02) respectively. For the right SCM, 73% of migraineurs had trigger points, compared to 52.17% of controls (p=0.02). For the left SCM, 55% of migraineurs had active trigger points, versus 28% of controls (p=0.004). The amount of latent trigger points was higher in the control group for three of the four muscles. This is not unexpected as latent trigger points have been commonly observed in healthy, normal subjects (de las Peñas et al, 2006b).

When exposed to upper trapezius and SCM trigger points, the risk of migraine is elevated 2.1 to 6.6 fold in women with these trigger points compared to women without them. A significant trend of odds towards increasing trigger point severity (i.e. active trigger points) in the migraine group, was found in the left trapezius (p=0.005) and right SCM (p=0.06) muscles.

Twenty eight of the migraine participants had a unilateral migraine, five of those reported alternating sides of the migraine. There were unavailable data from three participants. Therefore the remaining data from the 20 strictly unilateral migraines for the significant trigger point muscles (i.e. upper trapezius and sternocleidomastoid) will be analysed. For upper trapezius, 90% had active trigger points and 55% had more trigger points on the symptomatic side. For sternocleidomastoid, 65% had active and 40% had more trigger points on the symptomatic side. This shows the propensity towards active trigger points contributing to the migraine pain through their ipsilateral referral patterns.

The referral patterns for these two muscles are into the temporal areas and behind the eye, the headache referral areas. In addition these two muscles are within the receptive field of the TCN, and therefore may be included, and if dysfunctional, may contribute to the activation of the TCN (Robertson and Morris, 2008). Nociceptive inputs from the trigger points may produce a continuous afferent barrage onto the TCN, thereby sensitising it (Giamberardino et al, 2007). Trigger points are powerful sources of peripheral nociceptive input, with peripheral sensitisation contributing to sensitisation of the second order trigeminal interneurones and supraspinal dysfunction (Lipchik et al, 1997). When questioning the migraineurs about which part of the assessment evoked their migraine pain, the trigger point assessment was identified by 82.76%

(24/29) who had the migraine pain evoked by the assessment. This helps to confirm the muscular involvement in perimenstrual migraines.

Studies (Giamberardino et al 2007, Tfelt-Hansen et al 1981) have shown that treatment of these trigger points through local infiltration is highly effective in decreasing the frequency and intensity of the attacks, and accompanying nausea. Giamberardino et al (2007) comments that the injection of saline or local anaesthetic may not be more effective than just dry needling. Dry needling is a physiotherapy technique that can be employed in the treatment of these patients, together with manual trigger point release, massage and myofascial release. The release of these trigger points should make a significant contribution to the amelioration and prevention of perimenstrual migraine attacks.

5.3.2.6. Cervical stiffness

Significantly increased cervical stiffness was found in the lower cervical levels of five and seven. These levels fall outside of the TCN receptive field and therefore are not included in the model of cervical facilitation of migraine pain (Robertson and Morris, 2008).

A possible hypothesis is that the antero-posterior stiffness may be linked to the neural tension, but this has not been found in the literature. As discussed earlier, an increased neural tension was found in migraine subjects. The upper limb neural tension test used to test for neural tension primarily strains the C_5, C_6 and C_7 nerve roots. A maladaptive cervical stiffness may have developed to decrease the strain on these nerve roots. Alternatively articular stiffness may have contributed to the neural tension of the above nerve roots through a reduced stretch being given to these levels.

Stiffness at certain levels of the spine places more strain on the level above and below as they compensate for the lost motion. Maitland’s joint mobilisation can be used to reduce the cervical stiffness (Maitland et al, 2005). Normal motion of the cervical joints may reduce the contribution that the dysfunctional motion makes to the migraine pain, especially increased pain on movement.

5.3.3. Clinical recommendations, limitations of the study and suggestions for further research

This study has distinguished the significant from the non-significant factors in perimenstrual migraines. These results may help to narrow down the list of potential risk factors predisposing or intensifying these migraines. These factors are: age; perimenstrual anxiety, fatigue and irritability; general fatigue; perceptions of neck stiffness and pain; muscle length of trapezius, sternocleidomastoid and suboccipitals; increased pain response on muscle stretch of levator scapulae, trapezius, sternocleidomastoid and suboccipitals; reduced cervical rotation; moderate neural tension in the upper limbs; trigger points in upper trapezius and sternocleidomastoid muscles; increased pain response to PAIVMS; and stiffness of C_5 and C_7.

This study gives some evidence of the presence of physical dysfunction in the cervical region in women with perimenstrual migraines, compared to controls. This suggests that if these dysfunctional areas are treated and corrected using physiotherapeutic techniques, there could be a decrease in the severity and possibly the frequency of these migraines. The evidence suggests an inclusion of physiotherapy in the management of this condition. If a woman presents with perimenstrual migraine-type symptoms, the potential significant areas found in this study can be the first to be assessed and treated. Alternatively, if these symptoms are all present, the therapist can question about perimenstrual migraines and educate on this condition and recommend treatment. A multi-disciplinary approach would be most beneficial as a psychologist can be involved to target the emotional, cognitive and behavioural changes that accompany this chronic pain condition.

One of the difficulties encountered in this study was communication obstacles with certain instructions. The subjective nature of strength and range measurements, with the results being determined by the willingness and effort of the participant, makes it difficult to obtain a standard, accurate result. For example, if the dynamometer was causing the participant pain during the test, they would not push against it with the same power for fear of the pain. This was offset with a standard command and motivating statement used for all the participants.

A limitation of the study is the subjective assessment of the emotional factors. Validated self-reported questionnaires for neck pain and stiffness would have increased the validity of the subjective outcome measures and should be considered for future research.

One of the limitations of this study was that the focus was mainly on the shoulder girdle muscles. Further studies need to be done to investigate the role of the cervical (splenius captitis etc.), temporal (temporalis etc.) and temporomandibular joint muscles (masseter etc.). More research needs to be conducted to assess the effectiveness of a physiotherapy treatment regime targeting cervical dysfunction in perimenstrual migraine sufferers. A randomised clinical trial should be conducted to test a treatment regime. This regime can target the significantly dysfunctional areas that were found and then assess the impact on the severity, frequency and associated disability accompanying these migraines.

Future research could investigate the presence of cervicogenic dysfunction in a group of perimenstrual migraine participants in the middle of the menstrual cycle.

6. CHAPTER 6- CONCLUSION

The hypothesis of the study was that there is an emotional component and a physical cervical component contributing to the severity of perimenstrual migraines. Studies have investigated the role of neuromusculoskeletal dysfunction in migraines, but there is little evidence on this role in a ‘hormonal’ perimenstrual migraine. Therefore there is poor involvement of the physiotherapist in the management of these patients.

This study aimed to compare the emotional experiences of the perimenstrual time and the cervical assessment, of a perimenstrual migraine and a female control group. A subjective assessment was completed by the participants. This investigated specific negative emotions and perceptions that evidence has isolated as potentially aggravating factors in migraines. The participants were also asked to compare these emotions inside and outside the perimenstrual time. Significant between group differences were found in perimenstrual anxiety, perimenstrual irritability and general and perimenstrual fatigue; and perceptions of neck pain and stiffness. All results were higher for the perimenstrual group, with large relative risks (odds ratios). This confirms the considerable role that the psychological element plays in these migraines, and highlights the importance of incorporating coping skills, cognitive behavioural techniques and counselling into the treatment of this condition. Physiotherapists need to be aware of these psychological factors and, as trusted health care professionals, can participate within an educational and counselling function.

The cervical assessment showed significant comparative dysfunction in the perimenstrual migraine group in the following areas: levator scapular (pain only), trapezius, SCM and occipitals muscle length and pain on muscle stretch; reduced cervical rotation; increased neural tension in bilateral upper limbs; more active trigger points in trapezius and SCM muscles; increased C_5 and C_7 stiffness and increased pain on PAIVMS from C_4 to C_6. This considerable number of significant factors supports the hypothesis of cervical neuromusculoskeletal dysfunction in perimenstrual migraineurs. These dysfunctional areas can be treated with various physiotherapy modalities and their contribution to the migraine severity can be substantially reduced. Further research into the benefits of a physiotherapy treatment regime targeting these dysfunctional areas needs to be conducted.

In conclusion, there is evidence that both the psychological and physical factors contribute to increasing the risk of perimenstrual migraine and to the disabling severity of this condition. This suggests the need for inclusion of psychology and counselling to manage these emotional factors. The involvement of physiotherapy in the treatment and correction of the numerous cervical neuromusculoskeletal factors would reduce the risk and intensity of the migraines. Therefore it appears that physiotherapy is essential in the management of perimenstrual migraines.

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8. Appendices

8.1. Appendix 1: Study inclusion and Group determination

1. How long does your headache last if you don't take any medicines or if the medicines you take don't help?

   i. Does it last from 4-72 hours? **Yes/ No**

2. Do you have any of the following when you have your headache?

   i. Headache on only one side of your head? **Yes/No**

   ii. A throbbing feeling with the headache? **Yes/ No**

   iii. How bad is the headache- choose a number from 1-10 if 1 is just a little bit of pain and 10 is terrible, crying pain?

   iv. Do you feel that the headache gets worse when you move? **Yes/ No**

   Do you not want to move because you scared it will make the headache worse? **Yes/No**

3 During the headache do you:

   i. Feel like you want to vomit OR do you vomit? **Yes/ No**

   ii. Do bright lights or loud sounds make the pain worse? **Yes/ No**

   Do you avoid bright lights or loud sounds because you are scared they will make the headache pain worse? **Yes/ No**

4. How many times have you had a headache in the last year that you answered yes to question 1i, two of question 2, one of question 3?

   i. Less than 5 times? **Yes/ No**

   ii. 5 or more times? **Yes/ No**

Do these headaches happen 2 days before you start your period or up to 3 days into your period? **Yes/No**

Do these headaches also happen at other times of the month when you don't have your period? **Yes/ No**

Do these migraines only happen 2 days before your period to 3 days into your period and at no other times during the month? **Yes/ No**

Do these migraines happen during 2 out of every 3 periods you have? **Yes/No**

How are you treating your migraine? With:

Pain medicine? **How many do you take?**

Anti-inflammatories? **How many do you take?**

Massage/ rub?

Hot water bottle?

Other?

Please circle Yes or No for the following questions.

6. Are you between the ages of 21-45 years? **Yes / No**
7. Do you have regular menstrual periods occurring every 25 to 35 days? **Yes / No**
8. Have you had regular periods for the last 6 months? **Yes / No**
9. Do you receive physiotherapy for migraines or headaches? **Yes / No**
10. Are you pregnant or trying to fall pregnant? **Yes / No**
11. Have you used any hormone preparations in the last 6 months? **Yes / No**
12. Are you taking an oral contraceptive? **Yes / No**
13. Have you been taking the same oral contraceptive for 12 months and do you think you will continue to take to over the next few months? **Yes / No**
14. Do you have a history of any medical problems (e.g. lupus etc.)? **Yes / No**
15. Have you recently given birth or are breastfeeding? **Yes / No**
16. Do you have a history of breast or endometrial cancer? **Yes / No**
17. Do you have a history of any cervical dysfunction i.e. whiplash injury, cervical fracture or dislocation? **Yes / No**
18. Are you able to attend the physiotherapy assessment 2 days prior to menstruation to 3 days into menstruation? **Yes / No**

Patient name: Group allocation:

Age: Presence of perimenstrual migraines? Yes/ No

Patient reference number:

8.2. Appendix 2: Ethical clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Horwitz

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M081134**
PROJECT	The Relationship between Cervical Dysfunction and Perimenstrual Migraines
INVESTIGATORS	Mrs S Horwitz
DEPARTMENT	Physiotherapy Department
DATE CONSIDERED	08.11.28
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 08.12.12 **CHAIRPERSON** ....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof A Stewart

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and ONE COPY returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

8.3. Appendix 3: Permission from Helen Joseph Hospital

GAUTENG PROVINCIAL GOVERNMENT

DEPARTMENT OF HEALTH

Helen Joseph Hospital
Physiotherapy Department
(011) 489-0336
19/02/2009

To Whom It May Concern,

APPLICATION FOR PERMISSION TO DO RESEARCH AT HELEN JOSEPH HOSPITAL.

I am currently employed as a senior physiotherapist at Helen Joseph Hospital. I am in the second year of my Physiotherapy Masters degree by dissertation at the University of the Witwatersrand.

I would like to carry out my study at Helen Joseph Hospital in the Physiotherapy Department. My research title is "The relationship between cervical dysfunction and perimenstrual migraines". The study entails a subjective assessment through a questionnaire and an objective assessment through a clinical examination of the cervical spine and associated structures. The clinical examination includes the usual tests, measurements and equipment used in a physiotherapy assessment.

This study aims to show the association between cervical abnormalities i.e. posture, decreased muscle length etc. and perimenstrual migraines. This will hopefully lead to physiotherapy being included in the treatment of this condition and therefore benefit both patients and the physiotherapy profession.

Therefore, I would like to ask permission to conduct this study at Helen Joseph Hospital.

Thanking you sincerely,

Simone Horwitz
Senior Physiotherapist

Approved: Janine Webber
HOD Physiotherapy

Approved: Naomi Sithole (20/02/2009)
Clinical Executive

Helen Joseph Hospital • Perth Road • Auckland Park
Private Bag X 47 • Auckland Park 2006
Tel: (011) 489-1011 • Fax: (011) 726-5425

8.4. Appendix 4: Control information sheet

Hello, my name is Simone Horwitz and I am carrying out a study in order to complete my master's degree in physiotherapy through the University of the Witwatersrand.

I am investigating a condition called perimenstrual migraines, which are a specific kind of headache that occurs during the month in women but is aggravated by the menstrual period. This headache is usually treated with medicine only, but there may be other structures involved such as the neck muscles and joints. This study will be investigating if those other structures are related to the headaches and if they can be treated by physiotherapy and therefore help to improve these headaches. Although you do not suffer from these migraines, I require the same tests to be done on women who do not suffer from migraines in order to compare 'normal' results with those of the migraine sufferers.

You are invited to participate in the study. All that is required if you choose to participate is to allow a physiotherapist involved in the study to perform an assessment. This will involve answering a few questions and an examination. The examination will include some tests on your neck muscles, palpation of the neck muscles and measurement of the movement in your neck. It will also include an examination of the bones of your neck with the examiner's hands and an observation of your posture. The whole procedure will only take about one hour. There are no costs associated with this examination. If you are coming to the hospital specifically for the assessment, your transport costs will be paid. You will receive R50 transport money.

The examination will not be harmful to you. It may provoke a headache, some pain or momentary discomfort due to examination of potentially painful structures, but that should ease soon after the examination.

Participation in the study is voluntary and you are free to withdraw. This clinical study protocol has been submitted to the University of the Witwatersrand, Human Research Ethics Committee for approval.

8.5. Appendix 5: Participant information sheet

Hello, my name is Simone Horwitz and I am carrying out a study in order to complete my master's degree in physiotherapy through the University of the Witwatersrand.

You may be suffering from perimenstrual migraines. Perimenstrual migraines are a specific kind of headache that occurs during the month in women but is aggravated by the menstrual period. This headache is usually treated with medicine only, but there may be other structures involved such as the neck muscles and joints. This study will be investigating if those other structures are related to the headaches and if they can be treated by physiotherapy, therefore helping to provide you with another way to improve your headaches.

You are invited to participate in the study. All that is required if you choose to participate is to allow a physiotherapist involved in the study to perform an assessment. This will involve answering a few questions and an examination. The examination will include some tests on your neck muscles, palpation of the neck muscles and measurement of the movement in your neck. It will also include an examination of the bones of your neck with the examiner's hands and an observation of your posture. The whole procedure will only take about one hour. There are no costs associated with this assessment. If you are coming to the hospital specifically for the assessment, your transport costs will be paid. You will receive R50 transport money.

The examination will not be harmful to you. It may provoke your headache, some pain or momentary discomfort due to examination of potentially painful structures, but that should ease soon after the examination.

Participation in the study is voluntary and you are free to withdraw at any time. This clinical study protocol has been submitted to the University of the Witwatersrand, Human Research Ethics Committee for approval**.** Benefit of participating in the study is that it may be found that perimenstrual migraines may be helped by physiotherapy. This could create another avenue for treatment of your migraines without using medication.

8.6. Appendix 6: Control informed consent

I, the participant, have been fully informed as to the procedures that will be followed in this research and have been explained the potential discomforts, risks and benefits. I have read the information sheet and have asked and had answered any questions. In signing this consent, I agree to participate in this assessment and I understand that it is voluntary and that I can withdraw from participating in the study at any stage.

Patient name:

Patient signature:

Date:

Participant reference number:

8.7. Appendix 7: Participant Informed consent

I, the participant, have been fully informed as to the procedures that will be followed in this research and have been explained the potential discomforts, risks and benefits. I have read the information sheet and have asked and had answered any questions. In signing this consent, I agree to participate in this assessment and I understand that it is voluntary and that I can withdraw from participating in the study at any stage.

Patient name:

Patient signature:

Date:

Participant reference number:

8.8. Appendix 8: Practice session with two physiotherapy masters students, researcher and assistant.

1. Posture assessment

- Visual assessment for cervical rotation and/ or lateral flexion: Stand in front of the subject and visually assess for rotation and/or lateral flexion.
- The plum line is dropped in line with the thoracic spine and the distance from the line to the maximum curvature of the cervical spine is measured. This value should be less than or equal to 6 cm for normal cervical posture.

2. Muscle length assessment

- Levator scapula-flexion, contralateral lateral flexion & rotation away with shoulder depression. Ensure flexion is maintained throughout the stretch.

- Upper trapezuis- contralateral lateral flexion & flexion with shoulder depression. Only slight flexion.

- Pectoralis major-Clavicular: supine on edge of the bed, stabilisation of the trunk, shoulder abduction to 90º;Sternocostal- full flexion with overpressure.

- Sternocleidomastoid-chin tuck, lat flexion away, rotation towards

- Scalene- anterior: ext, lateral flexion away, rotation towards

- Deep occipital- passive flexion, palpating for tightness

3. Muscle strength

Isometric test- holds them to prevent any movement.
3 practice submaximal contractions to familiarise the patient with the testing.
3 maximal contractions in each position with a 45sec break between each.
Hold each contraction for 5 secs.

No touching of the participant until the start of the timing.
Supine, 45 º hip and knee flexion, arms folded over the chest, straps over the shoulders.

Flexion: supine, chin retraction before flexion.
Lateral flexion: supine
Rotation: supine, place dynamometer above the ear.
Extension: prone

Give constant encouragement to give the maximal effort. Use the same standard commands.

Researcher will use a stopwatch to ensure accurate 3 sec attempt.
After discussion it was decided that although lateral flexion and rotation use the same muscles as flexion and extension, due to the different contractions and ranges all the movements will be tested.

4. ROM

How to use the inclinometer:

- Ensure there is pure movement of the head- eliminate any back or shoulder movements.
- Repeat each mvmt twice, best of the two readings is recorded
- Flexion/ extension: a Velcro band is placed around the head above the eyebrows. The inclinometer is placed on the band just above the ear, the zero point aligned with the tragus. Patient instructed not to open their mouth during the movements. The patient is in a seated position with the back supported by the back of the chair.
- Lateral flexion: Keep the inclinometer on the side, turn the dial to face the front. The inclinometer is on the opposite side to the bending. Change the inclinometer to the other side for contralateral lateral flexion.
- Rotation: supine with the inclinometer facing upwards. The shoulders are on the plinth and the head is just off the edge of the bed- and supported during the movement.
- Subject is seated during all movements, except rotation. Instructed to sit up straight, right back into the chair.

5. Neural tension

- Due to the ULTT being the most specific for neural tension originating in the cervical area, this test was chosen.

- ULTT 1 will be used as it is a general test, with a median nerve bias.
- The ranges of each segment will not be measured as only a difference between the symptomatic and asymptomatic side and between the control and migraine group is required.
- Participant is in supine; Physio stands in front of the participant, on the side being tested
- Procedure:
  - Shoulder girdle depression
  - Shoulder abduction
  - Forearm supination
  - Wrist and finger extension
  - Shoulder external rotation
  - Elbow extension

6. Trigger points-ref: textbook of head and neck anatomy- James L Hiatt, Leslie P Gartner

Minimum criteria for TP identification:

- Palpable taut band of muscle
- Exquisite tender spot in the band
- Patient's recognition of the familiar pain
- Pain on stretch of the muscle

Muscles to be tested:

Position: all supine except levator scapulae which is in prone.

Name	**Location**	**Origin**	**Insertion**
Upper trapezius	Most superficial layer of the neck and upper back	Occipital protuberance, superior nuchal line, spinous processes of C7-T12	Lateral 1/3 of the clavicle, acromion, spine of the scapula
Sternocleidomastoid	Bisects the lateral aspect of the neck	Lateral head: medial 1/3 of clavicle Medial head: manubrium	Mastoid process lateral ½ of the superior nuchal line
Levator scapulae	Head is rotated towards the opposite	Transverse processes of	Medial border of

	side- gentle stretch. Therefore rotate towards to relax it? Push upper border of traps aside. Palpate against transverse process in the angle of the neck.	C1-4	the scapula, from superior angle to spine
Scalenes	Just deep to the clavicular head of the sternocleidomastoid	Transverse process of C3-6	Ridge and the scalene tubercle of the first rib
Suboccipitals	Just below the occiput		

7. PAIVMS

- Gr III-gentle, throughout the range.
- Ask if there is any pain at each level, VAS /10
- Feel for any resistance and rate as mild, moderate or severe
- Did you feel if any muscle spasm was elicited?

<u>Surface anatomy for the cervical spine (Robinson et al, 2009)</u>

C2- the first palpable spinous process below the occiput.

C3- smaller and tucked under C2- palpate anteriorly and cranially

C4/5- slightly larger than c3. Usually bifid, therefore may feel asymmetrical on palpation.

C6- not usually bifid. Should disappear on cervical extension, while C7 remains

C7- not usually bifid. Very prominent spinous process (T1 is also very prominent), will not slide away from your finger on cervical extension

8.9. Appendix 9: Assessment for the research assistant with corrections and additions

1. <u>Posture assessment</u>

- *The existing procedure was thought to be reliable and remained unchanged.*
- Visual assessment for cervical rotation and/ or lateral flexion: Stand in front of the subject and visually assess for rotation and/or lateral flexion.
- The plum line is dropped in line with the thoracic spine and the distance from the line to the maximum curvature of the cervical spine is measured. This value should be less than or equal to 6 cm for normal cervical posture.

During the anterior-posterior view of the posture assessment, look for traps tightness- one shoulder pulled up higher than the other.

2. <u>Muscle length assessment</u>

Is the length restricted? Compare with the other side.

Positions were changed to ensure better support of the head to allow the patient to fully relax and create truer passive movements.

- **Levator scapula**-flexion, contralateral lateral flexion & rotation away with shoulder depression. Ensure flexion is maintained throughout the stretch. *Fully flex the head against your body to give more control and support. As soon as you start lateral flexion, look for elevation of the scapula (shoulder). This indicates restriction of length.*

- **Upper trapezuis**- contralateral lateral flexion & flexion with shoulder depression. Only slight flexion. *Usually its not tight, usually it's the levator scapula that's tight.*

- **Sternocleidomastoid-**chin tuck, lat flexion away, rotation towards. *This muscle requires upper cervical lateral flexion.*

- **Scalene**- ext, lateral flexion away, rotation towards. *Look for scalene tightness as you laterally flex. Don't fully extend.*

- **Deep occipital**- passive flexion, palpating for tightness*. Don't put the head into full flex. Partial flexion and feel the muscles. Your fingers should be able to sink into the muscle. Can feel the difference between right and left.*

- **Pectoralis major**

Clavicular: supine on edge of the bed, stabilisation of the trunk, shoulder abduction to 90º

Sternocostal- full flexion

Place patient in crook lie to decrease the trick movement of lumbar extension. Resistance is the decreased weight of the arm on your hand. Don't go into overpressure.

3. Neural tension

- ULTT 1 will be used.
- The order was changed to finish the proximal joint (shoulder) first to rule out any joint restrictions.
- Elbow extension was the last movement and was stopped when the pain began. The amount of extension lag was noted and visually assessed.
- Release of wrist extension was used as the desensitising manoeuvre if the pain began before full extension; contralateral cervical lateral flexion was the sensitising manoeuvre if full extension was reached with no pain.
- The patient was asked where the pain was to ensure that the pain was neural and to improve data collection.
- Only a difference between the sides will be assessed.
- Participant is in supine; Physio stands in front of the participant, on the side being tested
- *Procedure:*

➢ *Shoulder girdle depression- make sure the depression pressure is equal on both shoulders. Maintain the depression is maintained throughout the test.*

➢ *Shoulder abduction.*

➢ *Shoulder external rotation. Finish with the proximal joint (shoulder) to exclude any joint problems.*

➢ *Supination- include the thumb*

➢ *Wrist extension- includes the thumb.*

➢ *Elbow extension last. Go to end of pain free range and then use the wrist extension as the sensitising manoeuvre.*

➢ *If full elbow extension- use the cervical lateral flexion as the sensitising manoeuvre.*

Explain to participant:

- ➢ *Tell me as soon as you feel ANY pain*
- ➢ *Where is your pain?*

4. Trigger points

Minimum criteria for TP identification:

- Palpable taut band of muscle
- Exquisite tender spot in the band
- Patient's recognition of the familiar pain
- Pain on stretch of the muscle
- *Referral pain pattern- active if there is a referral pattern, latent if there is local pain but no referral (Travel et al, 1999). An accurate referral pattern confirms the patient's reliability and the therapist's (correct muscle was palpated).*
- *A separate column was added in the assessment form to note if there were tight bands, as the muscle may have tight bands but no specific nodular trigger points*

Name	**Position**	**Location**
Upper trapezius	Supine	Most superficial layer of the neck and upper back
Sternocleidomastoid	Supine	Bisects the lateral aspect of the neck
Scalenes	Supine	Just deep to the clavicular head of the sternocleidomastoid
Suboccipitals	Supine	Just below the occiput
Levator scapulae	Prone	Push upper border of traps aside. Palpate against transverse process in the angle of the neck.

Ask the patient:

- ➢ *Is there pain?*
- ➢ *Where is the pain?*
- ➢ *Does the pain stay under my finger or does it go somewhere else?*

Temporal headache:

- *Trapezius (TrP1)*
- *SCM- sternal*

- *Suboccipital*

Frontal headache:

- *SCM- clavicular, sternal*

5. <u>PAIVMS</u>

- *Arms off the bed, pillow under the chest.*
- *Gentler technique- 'Feel the patient before they feel you'.*
- *Grade III-gentle, throughout the range.*
- Ask if there is any pain at each level, VAS /10
- *Palpate a normal moving segment- compare to the normal. Note when resistance was felt i.e. at the beginning of PAIVM (severe stiffness), end of range (mild stiffness) etc.*
- Did you feel if any muscle spasm was elicited?

<u>Surface anatomy for the cervical spine</u>

C2- the first palpable spinous process below the occiput. *Quite big.*

C3- smaller and tucked under C2- palpate anteriorly and cranially

C4- deepest may need to flex more

C4/5- slightly larger than C3. Usually bifid, therefore may feel asymmetrical on palpation.

C6- not usually bifid. Should disappear on cervical extension, while C7 remains

C7- not usually bifid. Very prominent spinous process (T1 is also very prominent), will not slide away from your finger on cervical extension

6. <u>Muscle strength</u>

Break test- go to mid-range and then hold in that position. Isometric resistance at mid range.

3 maximal contractions in each position with a ten second break between each, 45 second break between the movement sides.

Hold each contraction for 5 secs.

No touching of the participant until the start of the timing.

Flexion: supine, crook lie (hip and knee flexion), arms folded over the chest, straps over the shoulders, chin retraction before flexion.

Extension: prone

Lateral flexion: *sitting in a chair with back supported. One hand stops trunk trick movements.*

Rotation: *sitting in a chair with back supported. One hand stops trunk trick movements*. Place dynamometer above the ear.

Give constant encouragement to give the maximal effort. Use the same standard commands i.e. push against me as hard as you can! Keep pushing! Fight me!

7. <u>ROM</u>

Sitting position, with back fully supported. *Spirit levels to ensure sagittal and coronal accuracy.*

How to use the inclinometer:

- **Flexion/ extension**: The inclinometer is placed on the band just above the ear, the zero point aligned with the tragus. Patient instructed not to open their mouth during the movements. The patient is in a seated position with the back supported by the back of the chair.
- **Lateral flexion**: Keep the inclinometer on the side; turn the dial to face the front. The inclinometer is on the opposite side to the bending. Change the inclinometer to the other side for contralateral lateral flexion. The patient is in a seated position with the back supported by the back of the chair.
- **Rotation:** supine with the inclinometer facing upwards. The shoulders are on the plinth and the head is just off the edge of the bed- supported

8.10. Appendix 10: Assessment form

Patient reference number:

Subjective assessment (to be completed by the participant)

Please answer the following questions by circling yes or no.

1. Do you usually feel anxious, tense and/or stressed?

Yes / No

2. Do you feel more anxious, tense and/or stressed before and/or during your menstrual period, than other times of the month?

Yes / No

3. Do you usually suffer from fatigue?

Yes / No

4. Do you feel more tired before and/or during your menstrual period?

Yes / No

5. Are you usually irritable and/or frustrated? **Yes/ No**
6. Are you more irritable and/or frustrated before and/or during your menstrual period?

Yes / No

7. Does your neck feel stiff? **Yes / No**
8. Is your neck sore? **Yes / No**

For migraine subjects only

9. From where you think that your headaches could come? **Your:**

Back? **Head?**

Neck? **Other?**

Shoulders?

Objective assessment

1. Postural assessment

Distance from the plum line to the maximum curvature of the cervical spine

____

Any rotation or lateral flexion of the neck? ___________

2. Muscle length tests

Symptomatic side:

Muscle tested	**Side of body**	**Findings (normal, Slight restriction, Restricted, pulling/ Pain)**
Levator scapula	Right	
	Left	
Upper trapezuis	Right	
	Left	
Sternocleidomastoid	Right	
	Left	
Pectoralis major	Right	
	Left	
Scalene	Right	
	Left	
Deep occipital muscles		

Patient reference number:

3. Muscle strength using a hand-held dynamometer

Muscles tested	**Side of body (as applicable)**	**Finding-measurement on dynamometer**
Cervical flexors		
Cervical extensors		
Cervical lateral flexors	Right	
	Left	
Cervical rotators	Right	
	Left	

4. Range of motion of the neck using an inclinometer

Range measured	**Side of body (as applicable)**	**Findings (degrees)**
Cervical flexion		
Cervical extension		
Cervical rotation	To the right	
	To the left	
Cervical lateral flexion	To the right	
	To the left	

5. Neurodynamic test: ULTT 1

Side	**Range (normal, restricted)**	**Findings (Positive/ negative, referral)**
Right upper limb		
Left upper limb		

Patient reference number:

6. Presence of trigger points

Muscle palpated	**Side (as applicable)**	**Presence of tight bands**	**TPs Present?**	**Pain? Referral?**	**Physio: Which side are there more TPs?**
Levator scapula	Right				
	Left				
Upper trapezuis	Right				
	Left				
Sternocleido mastoid	Right				
	Left				
Scalene	Right				
	Left				
Deep occipital muscles					

7. PAIVMS of the cervical spine

Cervical level	**Stiffness/ Resistance:** **i. Rating-normal, mild, moderate, severe**	**Pain elicited:** **i. Yes/ No** **ii. VAS Score**
C_2		
C_3		
C_4		
C_5		
C_6		
C_7		

Patient reference number: