The impact of cervical spine radiographs in the diagnosis and management of patients that presented with neck pain to the Chiropractic Day Clinic at the Durban University of Technology

By

Louis Stephanus Eloff

Dissertation submitted in partial compliance with the requirements for the Master's Degree in Technology: Chiropractic

Durban University of Technology (DUT)

I, Louis Stephanus Eloff, do hereby declare that this dissertation is representative of my own work in both conception and execution (except where acknowledgements indicate to the contrary)

…… Date:……..
Louis Stephanus Eloff

Approved for Final Submission

…… Date:……..
Dr. G. Harpham (Supervisor)
M. Tech. Chiropractic

…… Date:……
Dr. S. McPhail (Co- Supervisor)
M. Tech. Chiropractic

DEDICATION

I dedicate this research to:

My fiancé, Hughnique Cawood; my parents, Veronique and Andre Muller; my grandma, Rose Lewis; my fiancés parents, Hugh and Wanda Cawood; and my friend's father, Hannes Victor.

I appreciate all your love and support during the past six years of study.

"Never confuse movement with progress"

Author unknown

And

"The knowledge that got you into the hole won't be the knowledge getting you out of it"

Author unknown

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ABSTRACT

Background:

Literature has shown that clinical and radiological diagnoses do not always correlate in patients with neck pain (Ferrari and Russel, 2003; Peterson and Hsu, 2004). It is not known if this applies to the Chiropractic Day Clinic (CDC) at the Durban University of Technology (DUT) and if the radiological diagnosis leads to a change in the patient's initial management plan. The impact of cervical spine plain film radiographs will therefore be investigated in the diagnosis and management of patients that presented with neck pain to the CDC at the DUT. It is also not known whether the reason for referral for cervical spine plain film radiographs is always indicated as per the indications in the clinic handbook and radiological referral guidelines.

Objectives:

Objectives were: (1) To determine the suspected pre-radiographic clinical diagnosis and management of the selected clinical records prior to referral for cervical spine plain film radiography; (2) To record the reasoning to send for cervical spine plain film radiographic imaging and to establish whether these are in line with proposed guidelines for referral as found in the literature; (3) To determine the relationship between the suspected pre-radiographic clinical and the radiological diagnoses of patients with neck pain; (4) To determine the number of incidental findings in the selected patients' plain film radiographs; (5) To determine any change in the pre-radiographic clinical diagnoses and management following radiological reporting of the selected patient's plain film radiographs.

Method:

This was a quantitative, retrospective, clinical study. The archives at the CDC at the DUT were searched for cervical spine plain film radiographs between 1 January 1997 to 31 December 2013 and these were matched with the corresponding clinical records. After applying the inclusion and exclusion criteria, 73 records were included

in the study. The patient's personal information was coded to ensure confidentiality (Appendix A) and specific clinical and radiological information was recorded (Appendix B). Statistical analysis included the use of frequency counts, percentages, mean, standard deviation and range for the descriptive objectives.

Results:

A total of 73 clinical files and corresponding plain film radiographs were assessed. The mean age of the patients was 44 years. The gender distribution was 64.4% (*n=47*) females and 35.6% (*n=26*) males. The most frequent primary radiological diagnosis was loss of lordosis at 41.1% (*n=30*) followed by cervical spondylosis at 35.6% (*n=26*) and old cervical spinal trauma at 12.3% (*n=9*). Sixty four percent (*n=47*) of patients in this study were sent for cervical spine plain film radiographs after their initial clinical consultation. Reasons that are not considered relevant indications for plain film radiographic referral were present in 46.2% (*n=34*) of cases; these described non-specific mechanical disorders. The most common reason for plain film radiographic referral was due to positive orthopaedic tests 57.5% (*n=42*). A total of 27.4% (*n=20*) of clinical files reviewed had a change in their initial clinical diagnosis and 72.6% (*n=53*) of these patients had no change in diagnosis. All of the post-radiographic clinical diagnoses were non-specific mechanical conditions. Numerous treatment modalities were utilized by the students with the most common pre-radiographic treatment being soft tissue therapy at 63.0% (*n=46*). A total of 75% (*n=55*) of patients had a change of treatment after plain film radiographs were performed and spinal manipulative therapy (SMT) was the main treatment added in 41% of cases.

Conclusion:

Cervical spine plain film radiographs have little impact on the diagnosis of patients with non-specific mechanical neck pain without red flags. It was however found that plain film radiographs had an impact on the management in the majority of cases, especially with an increase in SMT use after plain film radiographs.

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LIST OF DEFINITIONS

Asymptomatic Without symptoms or producing no symptoms (Medilexicon Dictionary, 2006).

Cervical Spine The portion of the spine comprising the C1 to C7 vertebrae of the cervical spine (Medilexicon Dictionary, 2006).

Chiropractic A health care profession concerned with the diagnosis, treatment and prevention of disorders of the neuro-musculoskeletal system and the effects of these disorders on general health. There is an emphasis on manual techniques, including joint adjustment and/or manipulation, with a particular focus on joint dysfunction (World Health Organization, 2012).

Degeneration: Degeneration is used interchangeably with spondylosis and primarily refers to progressive, age-related degenerative changes of the spine (Thomas, 2004).

Incidental findings Any abnormality not related to the illness or causes that prompted the diagnostic imaging test (Lumbreras *et al*., 2010).

Modalities A form of application or employment of a therapeutic agent or regimen (Medilexicon Dictionary, 2006.

Plain film radiographs Examination of any part of the body for diagnostic purposes by means of x-rays with the record of the findings usually exposed onto photographic film (Medilexicon Dictionary, 2006).

Radicular-type pain	Pain along any spinal nerve pathway (Stedman's Medical Dictionary, 2005).
Radiographic latency Period	The time interval from when a pathological process or or traumatic event manifest clinically until when it becomes visible radiographically (Yocum and Rowe, 2005).
Sensitivity	In clinical pathology and medical screening, the proportion of affected patients who give a positive test result for the disease that the test is intended to reveal, true-positive results divided by total true-positive and false-negative results, usually expressed as a percentage (Medilexicon Dictionary, 2006).
Loss of lordosis	Is a term used to describe loss or a decrease in the lordotic curve of the cervical spine (Opper, 1999).
Spondylosis	Spondylosis is used interchangeably with degeneration in this research study as these terms primarily refer to a degenerative process that occurs in the spine as a result of chronic wear and tear or as a natural consequence of aging (Rao, 2002).
Specificity	In clinical pathology and medical screening, the proportion of those tested with negative test results for the disease that the test is intended to reveal, true negative results as a proportion of the total of true-negative and false-positive results (Medilexicon Dictionary, 2006).
Spinal manipulative therapy	A therapeutic intervention performed on synovial joints in the spine (Tsakitzidis *et al*., 2013).

LIST OF ABBREVIATIONS AND SYMBOLS

AAA	Aortic abdominal aneurysm
ABCS	Alignment, bone, cartilage and soft tissue
AIDS	Acquired Immuno-Deficiency Syndrome
AP	Antero-posterior
CCSR	Canadian Cervical Spine Rule for Radiography
CDC	Chiropractic Day Clinic
CT	Computed tomography
DUT	Durban University of Technology
DMR	Dermatomes, myotomes and reflexes
ER	Emergency Room
GI	Gastro intestinal
HIV	Human immunodeficiency virus
IFC	Interferential current therapy
IVD	Intervertebral disc
MFPD	Myofascial pain and dysfunction
M	Myocardial Infarction
MRI	Magnetic resonance imaging
MVA	Motor vehicle accident
NEXUS	National Emergency X-Radiography Utilization Study
NP	Neck pain
N	Sample size or count
Nr	Number
NRE	Nerve root entrapment
NSAID	Non-steroidal anti-inflammatory drug
OA	Osteoarthritis
P	Probability
PNF	Proprioceptive neuromuscular facilitation
SD	Standard deviation
SMT	Spinal manipulative therapy
SOAPE	Subjective, objective, assessment, plan and education
SPSS	Statistical Package for the Social Sciences

TENS	Transcutaneous electrical nerve stimulation
TMJ	Temporomandibular joint
TOS	Thoracic outlet syndrome
TP	Trigger point
US	Ultra sound (Therapeutic)
WAD	Whiplash associated disorder
WHO	World health organization
Yr's	Years
>	Greater than
>=	Greater than or equal to

CHAPTER 1

1.1 INTRODUCTION TO THE STUDY

Neck pain is a common condition (Borghouts *et al*., 1998; Ndlovo, 2006; Carroll *et al*., 2008; Slabbert, 2009; Muchna, 2010) and will affect most individuals at some point with in their life time (Carroll *et al*., 2008). The prevalence of neck pain in the general population is 23.1% with a point prevalence of 14.4% and a one year prevalence of 25.8% (Hoy *et al*., 2010). Literature has shown that neck pain is a frequent finding especially in females and the elderly population (Manchikanti, 2004; Skillgate *et al*., 2012). Neck pain is a multifactorial condition that is classified clinically as either mechanical or pathologic, with the latter presenting with ominous symptoms or signs also known as red flags (Nordin *et al*., 2008; Carroll *et al*., 2008). When red flags are detected during the clinical consultation then it serves as an indication that further specialised investigation needs to occur (Ferrari and Russell, 2003).

The clinical dilemma is that most neck pain has an absence of an identifiable underlying disease or abnormal anatomical structure when non-specific signs and symptoms are present (Hoy *et al*., 2010). Researchers have attempted to link the findings of the subjective patient history and objective physical findings in non-specific neck disorders but this is very difficult since the patient history is often non-specific and tests conducted during the physical and orthopaedic examination have variable reliability (Hardin, 2001; Ferrari and Russell, 2003; Karnath, 2012). Plain film radiographs are usually used as a first line investigation to help rule out instability or pathology (Yocum and Rowe, 2005) but they have been shown to have little diagnostic yield in early stages of pathology and minor trauma (Yocum and Rowe, 2005; Helliwell and Porter, 2007; Couri *et al*., 2012).

Chiropractors commonly make use of plain film radiography to assist them with predicting the course of treatment and so as to be made aware of any factors that might interfere with treatment (Wyatt and Lawrence, 2004; Bussières *et al*., 2014).

Ferrari and Russell (2003) stated that plain film radiographs are more useful in ruling out abnormalities related to pathology or trauma than to make a specific diagnosis.

The radiation omitted by plain film radiographs has been linked to neoplasm formation thus it is important to utilize this specialized investigation only when it is indicated as per guidelines found in literature (Wyatt and Lawrence, 2004; Herbst and Fick, 2012; Bussières *et al*., 2014). There are proposed guidelines in the literature of when to refer a patient for plain film radiography (Yocum and Rowe, 2005; Bussières, 2008) but it has been shown that adherence to these are not consistent among Chiropractic practitioner's (Carey and Garrett, 1996; Ernst, 1998; Ammendolia *et al*., 2002; Bussières *et al*., 2014).

The management of a patient may be affected if incidental findings on cervical plain radiographs are observed (Peterson and Hsu, 2004; Yocum and Rowe, 2005). Incidental findings are a common occurrence in the asymptomatic population and in many cases do not relate to the patients clinical presentation (Ferrari and Russell, 2003; Rao, 2007).

In conclusion, plain film radiographs are frequently used as a first line investigation by various medical practitioners including Chiropractors. Discrepancies have been shown in the literature with regards to the limited clinical use and sensitivity of plain film radiographs in diagnosing the cause of neck pain. This renders the need to investigate the impact that cervical spine plain film radiographs have in the diagnosis and management protocol of patients that presented with neck pain that were sent for plain film radiography. The reason for referral of the patients also needs to be investigated to establish whether these are in line with proposed guidelines provided for plain film radiographic referral found in the clinic manual and radiological literature, especially considering the adverse effects radiation can have on the human body.

1.2 AIMS AND OBJECTIVES

1.2.1 The aims of the study

The aim of this research was to determine what impact the radiological diagnosis of the cervical plain radiograph had on pre-radiographic clinical diagnosis and management of patients after plain film radiographs have been performed. The researcher also aimed to determine whether a correlation exists between the clinical and radiological diagnosis and to determine whether the reason for plain film radiographic referral was justified.

1.2.2 The objectives of the study

- To determine the suspected pre-radiographic clinical diagnosis and management of the selected clinical records prior to referral for cervical spine plain film radiography.
- To record the reasoning to refer patients for cervical spine plain film radiography and to establish whether these are in line with proposed guidelines for referral as found in the literature.
- To determine the relationship between the suspected pre-radiographic clinical and the radiological diagnoses of patients with neck pain.
- To determine the number of incidental findings in the selected patient's plain film radiographs.
- To determine any change in the pre-radiographic clinical diagnoses and management following the radiological diagnosis of the selected patient's plain film radiographs.

1.3 SCOPE OF THE STUDY

The archives of the Chiropractic Day Clinic (CDC) at the Durban University of Technology (DUT) were searched using a purposive sampling method and 73 cervical spine plain film radiographs and corresponding clinical records were selected that satisfied the inclusion and exclusion criteria. Patient confidentiality was ensured by coding the personal information acquired from the clinical records (Appendix A). The clinical and plain film radiographic records were kept under lock

and key at all times and only the researcher, supervisor and co-supervisor were allowed access to it. Data collection was accomplished in a stepwise, systematic manner and the findings were overseen by the research supervisors.

1.4 LIMITATIONS OF THE STUDY

Only cervical spine plain film radiographs that were taken at the radiographic department at the DUT were accepted and only those that were taken during the treatment period at the CDC at the DUT. The cervical spine plain film radiographs used in this research are not representative of all the cervical spine neck pain cases seen at the CDC at the DUT between 1997 to 2013, since there may have been cervical spine plain film radiographs that have gone missing or the patient file and/or plain film radiographs did not comply with the inclusion and exclusion criteria. Incomplete clinical records were not included in this dissertation since it was impossible for the researcher to find or verify information that was not recorded at the time.

CHAPTER 2 : LITERATURE REVIEW

2.1 INTRODUCTION TO NECK PAIN

Neck pain (also known as cervicalgia) is the fourth leading cause of disability in the world and is a common debilitating phenomenon in Western societies (Borghouts *et al*., 1998; Carroll *et al*., 2008; Cohen, 2015). It is defined anatomically (**Figure 2.1**) as pain between the occiput and superior nuchal line to the third thoracic vertebrae and the spine of the scapula, extending around the superior surface of the clavicles bilaterally to the supra sternal notch (Cote *et al*., 2004; Guzman *et al*., 2009). Another definition of neck pain by Ferrari and Russell (2003) describes it as pain and/or stiffness experienced in the dorsal aspect of the neck, extending from the occipital condyles to the C7 vertebral prominence and may include the jaw or upper thoracic spine.

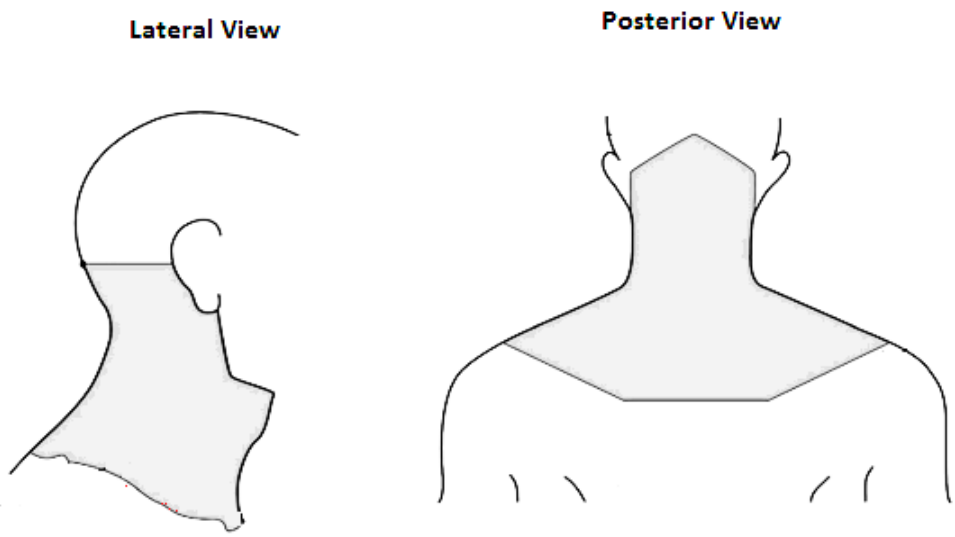

Figure 2.1: The anatomical distribution of neck pain
(Ferrari and Russell, 2003; Guzman *et al*., 2009)

A recent population based study conducted in Australia found that the overall prevalence of neck pain was an average of 23.1% and point prevalence was 25.8% (Hoy *et al*., 2010). Similar results by Fejer *et al.* (2006) found the point prevalence to

be 22% and up to 38% in the elderly population, while the lifetime prevalence ranged from 14.2% to 71%. In Canada it was found that chronic neck pain was second to chronic lower back pain with an annual incidence of 20-30%. It was determined that at any given time, 10% of the Canadian population reported having neck pain on a minimum of seven days out of any given month (Ferrari and Russell, 2003). Research conducted by Hogg-Johnson *et al.* (2008) and Manchikanti *et al.* (2004) found the prevalence of neck pain to increase with age and to be especially high in females. Studies conducted in the South African setting reported that the prevalence of neck pain was 50% in the Caucasian population (Slabbert, 2009) and 45% in the indigenous African population (Ndlovo, 2006). In the Indian population, males had a higher prevalence of 55.7% compared to 44.3% in females (Muchna, 2010).

2.2 NECK PAIN AND CHIROPRACTIC

Chiropractic is the most popular drug-free, primary contact health care profession in the world and is growing at an exponential rate (Western Province Chiropractic Association, 2015). Chiropractors mainly focus on the diagnosis and treatment of neuro-musculoskeletal conditions in a conservative manner without the utilization of medicine or surgery (World Federation Chiropractic, 2012). Neck pain is the second most common condition seen in Chiropractic practices after lower back pain. Effective management of it has been reported by many authors after chiropractic management was applied (Murphy and Freeman, 2004; Carroll *et al*., 2008; Slabbert, 2009; Muchna, 2010).

A recent report sent to the World Health Organization on the current state of the Chiropractic profession stated that the most common reason for patients visiting a Chiropractor was due to lower back pain in 60% of patients. Patients with neck pain, shoulder and arthritic pain were at 20% and patients with headaches at 10%, especially those with migraines (World Federation Chiropractic, 2012). Similar findings were reported by Lew and Snow (2012) in a retrospective study of 4010 patients in a Chiropractic teaching clinic where they found neck pain to be the second most common condition seen by chiropractic students and also the second most common area that was sent for plain film radiography.

2.3 CLINICAL ASSESMENT AND DIAGNOSIS OF NECK PAIN

Neck pain is categorized clinically as either mechanical or pathologic (Nordin *et al*., 2007; Carroll *et al*., 2008) with the majority being mechanical (Binder, 2007a; de Jong *et al*., 2007; Remmen *et al*., 2013). Pathological (or non-mechanical) neck pain is associated with a pathological process in the cervical spine or as a result of pain referral to the neck from pathology elsewhere (Ferrari and Russell, 2003). Pathological neck pain usually presents with identifiable pathological indicators that can be attributed to the neck pain, these are known clinically as red flags (Nordin *et al*., 2008). Red flags are signs and symptoms the patient presents with that are associated with serious pathological processes or instability (Nordin *et al*., 2008). Red flag symptoms include unexplained weight loss, unexplained fatigue, constant unremitting night pain, fever and night sweats may suggest an underlying neoplasm or infection present (Nordin *et al*., 2008).

The most common type of mechanical neck pain (and neck pain overall) is non-specific neck pain (Binder, 2007a; de Jong *et al*., 2007; Remmen *et al*., 2013). This involves pain in the musculoskeletal system of the cervical spine without any identifiable evidence of organic disease or trauma that could be attributed to it and typically presents with local tenderness or axial tenderness dorsally that may refer into the head, upper thoracic spine, chest or upper extremities (Borghouts *et al*., 1998; Ferrari and Russell, 2003; Nordin *et al*., 2008; Tsakitzidis *et al.,* 2013). It may be associated with physiological and emotional stress, prolonged postures, history of trauma, referred pain or nerve root entrapment in the cervical spine (Rao, 2002; Karnath, 2012). It can also be a component of headache, temporal-mandibular joint syndrome and fibromyalgia (Nordin *et al*., 2008). The natural course of non-specific neck pain is unclear but is usually resolved in days to weeks and is mainly diagnosed on clinical grounds by performing a thorough patient history, physical examination and ruling out red flag conditions (Hoy *et al*., 2010). Another type of mechanical neck pain is pain as a result of significant trauma to the cervical spine which may present with red flags such as loss of consciousness or function, an open wound, obvious instability or fracture depending on the degree of damage or instability (Opper, 1999; Douglas and Bope, 2004). The most common type of traumatic neck injury is as a result of whiplash injuries in motor vehicle accidents

(MVA) and gives rise to a condition known as whiplash associated disorder (WAD) (Opper,1999; Douglas and Bope, 2004).

Compression or irritation of the peripheral or central nervous system may be a result of mechanical or pathological processes and is known clinically as a radiculopathy and myelopathy respectively (Rao, 2002). Radiculopathy may also give rise to red flags such as neurogenic pain, changes in either one (or more) of the dermatomes, myotomes, or reflexes of the patients upper extremities (Rao, 2002). In cases where a myelopathy is suspected red flags such as decreased or loss of coordination, change in gait and sphincter abnormalities may be present (Rao, 2002; Douglass and Bope, 2004; Murphy and Freeman, 2004).

Diagnosing neck pain traditionally involves taking a thorough patient history in an attempt to identify any key red flags, establishing the cause of pain and identifying psychological factors associated with chronicity (Murphy and Freeman, 2004). It is important to identify red flags in the history so as to rule out a pathology or trauma, and if any are identified, to deliver a prompt diagnosis, appropriate management and specialized referral (Douglas and Bope, 2004). In cases where the patient was involved in a MVA or had any neck injury, plain film radiography is required especially in patients with whiplash associated disorder (WAD) Grade III and IV. Detailed guidelines for blunt neck trauma need to be applied in these instances, as per the Canadian C-Spine Rule (CCSR) and The Nexus Low-Risk Criteria (NLC) (Hoffman *et al*., 2000; Panacek *et al*., 2001; Pollack *et al*., 2001; Stiell *et al*., 2003; Dickinson *et al*., 2004; Douglas and Bope, 2004;) (**Table 2.1)**.

The CCSR and NEXUS instruments are sensitive decision making sets of rules developed to assist health care workers to determine when plain film radiography is indicated after occurrence of cervical spinal trauma (Stiell *et al.*, 2003; Kerr *et al*., 2005; Bussières *et al*., 2008).

Table 2.1 The CCSR and NEXUS decision rules for cervical spinal trauma

CCSR (Canadian Cervical Spine Rule for Radiography)
• Age 65; dangerous mechanisms of injury; paraesthesia's in extremities • Not a simple rear end collision; patient unable to sit in the waiting room; not ambulatory at one time since trauma; immediate cervical pain onset; presence of midline cervical tenderness • Patient unable to actively turn his head to 45° in both directions
NEXUS (National Emergency X-Radiography Utilization Study)
• Normal level of consciousness (may be temporally confused, have mild dizziness or headache) • No evidence of intoxication • Absence of tenderness on palpation of the midline of the neck • Absence of focal neurologic deficit • Absence of painful traction injury

(Adapted from Hoffman *et al.,* 2000)

The purposes of these decision rules are to minimize unnecessary referral for plain film radiography in patients with cervical spine injury. These decision rules are 90-100% effective and studies have shown a 40% decrease in plain film radiographic use amongst practitioners when these decision rules are applied. These tests are however not accurate in non-traumatic patients, GCS < 15, unstable vital signs, age <16 years, in vertebral disease or with previous cervical spinal surgery (Stiell *et al*, 2003; Kerr *et al*., 2005; Bussières *et al*., 2008; Thiruganasambandamoorthy *et al*., 2015). **Figure 2.2** depicts the chiropractic assessment of a patient with neck pain.

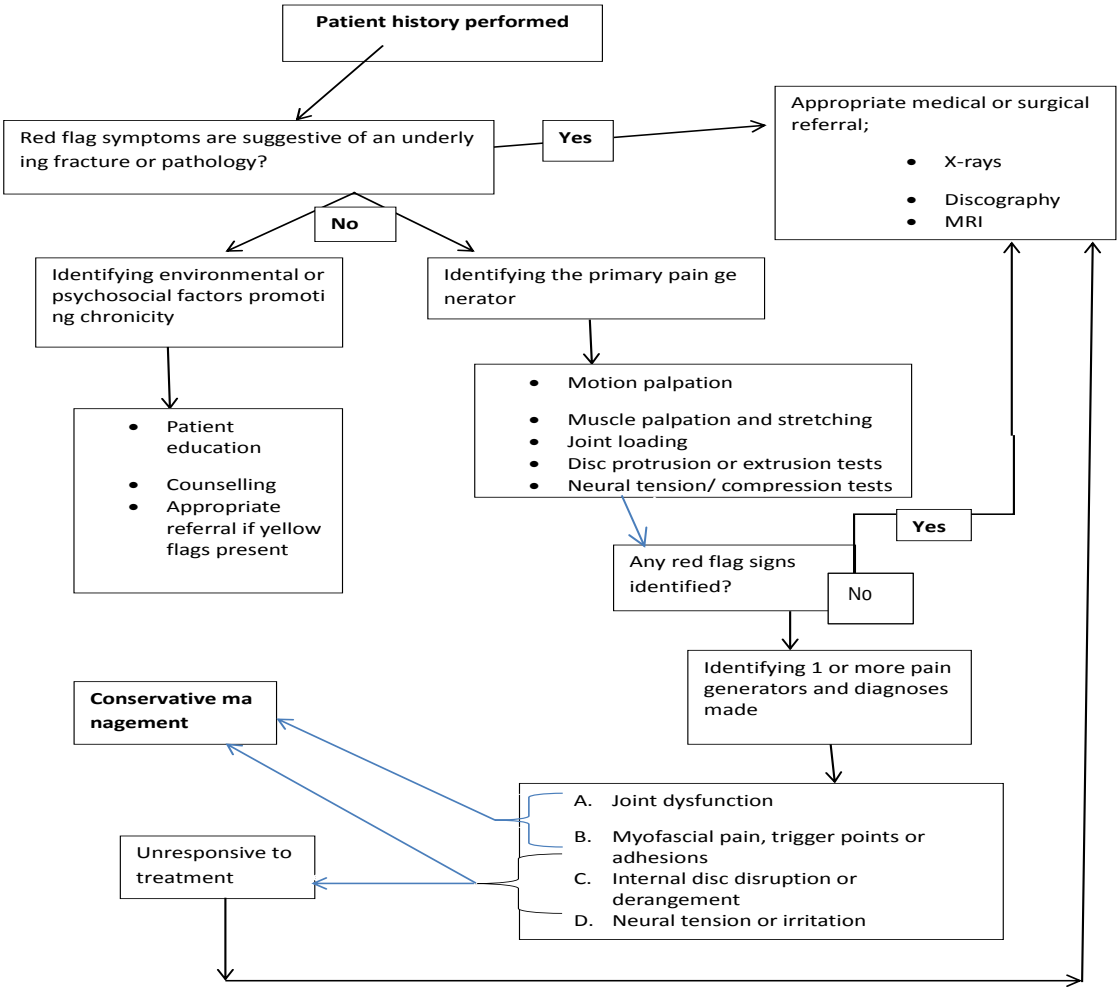

Figure 2.2: Chiropractic assessment of a patient with neck pain
Adapted from Murphy and Freeman (2004)

The Chiropractic assessment involves a thorough patient history and physical examination to determine the primary pain generating structure and during this process the patient is screened for red flag signs or symptoms (Murphy and Freeman, 2004) (**Figure 2.2**). The Chiropractor will also identify psychosocial factors (yellow flags) that may contribute to the chronicity of the patient's neck pain and seek to intervene by either implementation of patient education or appropriate referral (Murphy and Freeman, 2004) (**Figure 2.2**). The physical examination involves motion palpation, muscle palpation and stretching, joint loading, disk protrusion and extrusion tests and neural compression tests (Murphy and Freeman, 2004) (**Figure**

2.2). In cases where red flags are detected, the patient is then referred to the appropriate medical authority for further specialized investigations to be performed (**Figure 2.2**). These include plain film radiography, computerized tomography (CT), discography, myelography and magnetic resonance imaging (MRI) (Ferrari and Russell, 2003; Herbst and Fick, 2012). Patients suspected of having scoliosis, spondylolisthesis, fractures or other structural abnormalities may require plain film radiography (Cohen, 2015). Plain film radiography is usually the initial investigation of choice followed by the more expensive specialized investigations such as MRI, CT, discography and myelography. MRI may be used to visualize soft tissue structures such as intervertebral disk conditions (e.g. disk herniation). MRI and CT meylography may reveal spinal cord compression (Rhee and Riew, 2005). Plain film radiography may be required in a patient that does not respond to 6-8 weeks of conservative therapy and still suffers with persistent axial neck pain (Seidenwurm *et al.,* 2000; Murphy and Freeman, 2004).

2.4 THE RELATIONSHIP BETWEEN THE HISTORY, PHYSICAL EXAMINATION AND DIAGNOSIS OF NECK PAIN

The dilemma facing a clinician is that red flags are usually indicative of pathology or trauma, but most patients with neck pain do not present in such a specific manner; they often have a generalized presentation in terms of location, character and referral of pain or sensory changes (Binder, 2007b; de Jongh *et al*., 2007). The physical examination is often unremarkable and often the only signs would be a decreased range of motion and tenderness, making it very difficult to determine the cause of the underlying pain generator (Tsakitzidis *et al.*, 2013). The inverse may also apply where a patient suffers from anxiety, depression or has a tendency to focus on a symptom which tends to exaggerate the patients pain response during the physical examination and may be interpreted as red flags, even though it is non-specific mechanical in nature (Ferrari and Russell, 2003). Researchers have attempted to link patient history and physical examination findings with certain disorders such as cervical spondylosis, intervertebral disk bulges, cervical radiculopathy and thoracic outlet syndrome, although no correlation exists in the majority of cases (Ferrari and Russell, 2003). Neck pain is usually accompanied with a range of symptoms but it often becomes difficult to correlate physiologically (Ferrari

and Russell, 2003). The presentation of neck pain is commonly the only feature of an underlying condition such as myofascial pain syndromes, fibromyalgia and cervico-brachial syndrome. In most cases the patient may present asymptomatically or have a presentation of non-specific signs and symptoms while having an underlying condition (Hardin, 2001; Ferrari and Russell, 2003; Karnath, 2012).

Thus there is no universal gold standard when diagnosing patients with neck pain since the patient history is often non-specific and tests conducted during the physical examination have variable reliability in most cases (Bogduk, 1995; Binder 2007b; Nordin *et al*., 2008). Furthermore, there is growing evidence that these tests are more useful in ruling out structural lesions or neurologic compression than to diagnose them (Wainner *et al*., 2003; Rubinstein and Tulder, 2007). The reality is that neck pain is a multifactorial phenomenon that involves a number of systems such as the neurophysiological, psychological and somatic systems which requires a process of exclusion for accurate diagnosis (Murphy and Hurwitz, 2011).

2.5 INTRODUCTION TO PLAIN FILM RADIOGRAPHY AND NECK PAIN

Plain film radiography is usually the first line investigation when the patient history or physical examination reveals red flags (Ferrari and Russell, 2003). An anterior-posterior (AP) view of the lower cervical spine and a neutral lateral view are required as a minimal series to evaluate the cervical spine, since most of the structural components will be visualized. Supplementary views include AP open mouth, flexion and extension and oblique pillar views (Kathol, 1997; Peterson and Hsu, 2004; Yocum and Rowe, 2005).

2.6 ADVANTAGES AND DISADVANTAGES OF PLAIN FILM RADIOGRAPHS

Plain film radiographs are inexpensive in comparison to other imaging modalities, are non-invasive, easily interpretable and widely available (Yocum and Rowe, 2005). They provide a basic screen of the bony anatomy and are primarily used to identify abnormalities or instability that may be attributed to the patient's sinister signs and symptoms, or red flags (Kaiser and Holland, 1998). Plain film radiographs have been

shown to aid in the diagnosis of patients with neck pain in both mechanical and pathological conditions and as such are used as a first line investigation medically (Yocum and rowe, 2005). Patients that received trauma to the cervical spine may present with fractures or instability on their plain film radiographs and this will allow proper grading of injury and appropriate referral depending on the radiological diagnosis (Douglas and Bope, 2004).

Most patients in their middle ages present with some degree of spondylosis with plain film radiography such as osteophytes, facet joint hypertrophy or degeneration and decreased intervertebral disk spaces (Rao, 2002). It has been shown that degeneration to the facet joints may cause facet joint syndrome and myofascial pain due to arthrogenic muscle inhibition (Rao, 2002; Murphy and Freemen, 2004). Spondylotic changes such as osteophyte formation or facet joint hypertrophy may impinge the spinal nerve roots or spinal cord and as a result give rise to a radiculopathy and in rare cases a myelopathy (Beck *et al*., 2004). Structural and functional scoliosis may also be distinguished from each other and its development monitored over time (Cohen, 2015).

Pathological neck pain may present on plain film radiographs with a visible mass, a lytic lesion, periosteal reaction or fracture suggestive of an infectious disease or tumour as seen in metastatic tumours (e.g. prostatic disseminated carcinoma), metabolic disorders (e.g. osteomalacia) and infective diseases (e.g. Tubercolosis, osteomyelitis) (Yocum and Rowe, 2005). Spondylo-arthropathies may present with syndesmophytes (e.g. ankylosing spondylitis), subluxation or sclerosis of the atlanto-axial region (e.g. rheumatoid arthiritis) or sclerosis of the anterior longitudinal ligament (e.g. diffuse idiopathic skeletal hyperostosis) (Ferrari and Russell, 2003; Yocum and Rowe, 2005; Demondion *et al*., 2006; Pullman-Mooar, 2015) .

The limitations of plain film radiographs include the following; bone mineral loss will only be noticed when a 30-50% loss is present and lesions are usually only noticed when they are at least one to five centimetres in size (Yocum and Rowe, 2005). A hair line fracture is very difficult to detect on a plain film radiograph highlighting the lack of sensitivity to detect early stages of pathology or minor trauma (Yocum and Rowe, 2005; Helliwell and Porter, 2007; Couri *et al*., 2012). Plain film radiographs

have a limited capacity to visualize soft tissue injury and certain conditions have a radiographic latency period associated with them, such as minor trauma or certain pathologies (Ferrari and Russell, 2003; Yocum and Rowe, 2005). Instances where radiculopathy, myelopathy, early lytic changes and tumours are suspected but not diagnosed radiologically require specialized investigations such as a bone density scan, ultra sound or MRI to exclude these as possible differential diagnoses (Rao, 2002).

The dilemma is that the clinical examination may reveal red flag signs and symptoms that need to be investigated radiographically but many times, important radiological findings are not present as seen with early stages of pathology or acute trauma; resulting from a radiographic latency period (Ferrari and Russell, 2003; Yocum and Rowe, 2005). In other cases there may be radiological changes found that were not expected that may or may not be clinically significant and these are known as incidental findings (Peterson and Hsu, 2004; Yocum and Rowe, 2005).

2.7 INCIDENTAL FINDINGS ON CERVICAL PLAIN FILM RADIOGRAPHS AND THE IMPLICATIONS THEREOF

Incidental findings are a common finding on cervical spine plain film radiographs but in most cases these findings are not related to either the red flags identified during the clinical examination or the clinical diagnosis of neck pain (Rhee and Riew, 2005). Koren *et al*. (2013) evaluated 356 cervical spine plain film radiographs for incidental findings of patients that presented with whiplash injury to the Emergency Room (ER); the most common finding was spinal stenosis with disk narrowing in 2.8% of patients and congenital anomalies in 2.2%. Other incidental findings included enlarged sella turcica at 0.6%, calcification of the stylomastiod ligament in 0.3% of patients and increased age seemed to be directly related to the prevalence of these findings. Bussieres *et al*., (2014) stated that plain film radiographs are misleading since incidental findings are frequent and usually found in asymptomatic people. In their study they investigated plain film radiographs of asymptomatic patients between 50-69 years of age and the results revealed 79% had disk narrowing, endplate sclerosis or osteophytes present.

Beck *et al*., (2004) conducted a study in New Zealand of anomalies found on plain film radiographs that may alter intervention strategies. They evaluated 847 full spine plain film radiographs and their results revealed that the most frequent anomaly was degenerative joint disease (23.8%) followed by posterior ponticles (13.5%), transitional segments (9.8%) and spondylolisthesis (7.8%). Rhee and Riew (2005) found that the most common congenital anomalies were posterior ponticles present in 14% of anatomical specimens and 0.5% with a cervical rib(s) present. Jenkins et al., (2010) investigated 2814 cervical spine radiographic reports of the Macquarie University Chiropractic outpatient clinic and the results revealed 28% had congenital anomalies with the most common being posterior ponticles at 21.3% and cervical ribs in 5.1% of patients.

Another common incidental finding is the presence of a compression fracture which may be related to osteoporotic changes of advanced age, history of whiplash injury or both (Opper, 1999; Rhee and Riew, 2005). Calcified intervertebral disks are very rare incidental findings and usually occur in pediatric patients but may persist well into early adulthood, especially when associated with sequestration of the nucleus pulposis which may cause radiculopathy or myelopathy (Park *et al*., 2005).

2.8 INDICATIONS AND NON-INDICATIONS FOR PLAIN FILM RADIOGRAPHY IN PATIENTS WITH NECK PAIN

In literature there are proposed indications and non-indications when considering requesting cervical spine plain film radiographs for patients and these should serve as a guideline for healthcare professionals in practice (Ferrari and Russell, 2003; Yochum and Rowe, 2005; Bussieres *et al*., 2008). **Table 2.2** shows the indicators and non-indicators for plain film radiography of the cervical spine.

Table 2.2: Indications and non-indications to plain film radiography for the cervical spine

Indications	• Neck pain following trauma • Adult patient with acute neck injury andpositive CCSR • Neck pain with associated unexplained weight loss, neck lumps, night pain, evidence of radiculopathy, inflammatory arthritis, history of malignancy, fever of unknown origin, abnormal blood findings, deformity • Neck pain that fails to respond to therapy • Medico legal implications • Neck pain with patients older than 50 years, drug/ alcohol abuse, routine corticosteroid use, systemic disease, unavailability of alternate imaging, recent

	immigration, therapeutic risk assessment and response and if previous plain film radiographs are lost • Adult patient with non-traumatic neck pain and radicular symptoms • Adult patient re-evaluation in the absence of expected treatment response or worsening after 4 weeks • Adult patient with complicated (i.e., "red flag") neck pain & indicators of contra-indications to SMT • Suspected atlanto-axial instability (AAI) • Suspected cervical compressive myelopathy (CCM) and radiculo-myelopathy
Non-indications	• Patient education and routine screening, discharge status assessment, routine biomechanical analysis, pre-employment status, financial gain, recent high level radiation and pregnancy • Adult patient with acute neck injury and negative CCSR • Adult patient with acute uncomplicated neck pain (up to a 4 week duration) • Adult patient with uncomplicated sub-acute neck pain (4-12 weeks' duration) with or without arm pain • Adult patient with persistent neck pain (Longer than 12 weeks) with or without arm pain

Adapted from Ferrari and Russell, 2003; Yocum and Rowe, 2005; Bussieres *et al.* 2008
SMT=Spinal manipulative therapy; CCSR= Canadian Cervical Spine Rule for Radiography

2.9 PLAIN FILM RADIOGRAPHY AND CHIROPRACTIC

Chiropractors utilize plain film radiography in practice to help them predict the course of treatment and to become aware of any factors that might interfere with chiropractic treatment in the presence of red flags (Wyatt and Lawrence, 2004). Some Chiropractors may refer for plain film radiographs to asses' posture and the presence of fixations in the spine, but this is very controversial since literature has shown effective assessment of these with the clinical examination only (Peterson and Hsu, 2004; Wyatt and Lawrence, 2004). Literature has shown that plain film radiographs are more useful in ruling out abnormalities related to pathology or trauma than to make a specific diagnosis (Ferrari and Russell, 2003). It has also been shown that plain film radiographs have very little diagnostic yield in non-specific spinal pain especially when the patient history and physical examination reveal no red flags. Conversely, if a patient with red flags is not sent for plain film radiography, then possible pathology can be missed thus red flags serve as a guideline for radiographic referral (Ebdon-Jackson, 2000; Kendrick *et al*., 2001; Ferrari and Russell, 2003). Plain film radiographs are not without any adverse risks; over utilization of plain film radiographs has been linked to neoplasm formation due to the effects ionizing radiation has on the DNA of cells. Therefore, the severity of the patient's condition must outweigh the risk of exposure (Wyatt and Lawrence, 2004;

Herbst and Fick, 2012). Spinal manipulative therapy utilized by the Chiropractor may cause unwanted injury to the region receiving treatment if an underlying pathology was present thus may explain the higher utilization of plain film radiography as compared to other health care providers (Peterson and Hsu, 2004).

Chiropractors that receive their training from an accredited academic institution receive extensive training on radiographic positioning, radiation physics and safety. They are also taught how to identify red flags in the patient history and physical examination and which specialized investigations are needed to confirm the presence of an underlying pathology (Peterson and Hsu, 2004). Guidelines for plain film radiography exist and it has been shown that practitioners who adhere to these have a lower utilization rate of radiographic use (Jackson, 2001; Ferrari and Russell, 2003; Yocum and Rowe, 2005; Bussieres *et al*., 2008; Bussieres *et al*., 2014). Even though these guidelines exist, a high rate of over exposure and misuse amongst Chiropractors persists, especially in non-specific neck and lower back pain patients (Bussieres *et al*., 2014). The results of a pan-European survey have shown Chiropractors to have a very high plain film radiography referral rate as compared to other health care providers; the results revealed that 64% of all chiropractic patients and 72% of patients with lower back pain are sent for plain film radiographs of which 25% are performed by the Chiropractor, 18% by hospitals and 11% by private radiological clinics. In the Netherlands it was found that 80% of patients that visit a Chiropractor will go for plain film radiography as part of their initial examination (Ernst, 1998).

At the Chiropractic Day Clinic (CDC) at the Durban University of Technology (DUT) plain film radiographs may only be requested if the case adheres to research based guidelines for plain film radiographic referral since unnecessary exposure to ionizing radiation must be avoided (Chiropractic Clinic Manual, 2013). The patient may only be referred if the plain film radiograph will significantly contribute to the diagnosis and management of the patient (Chiropractic Clinic Manual, 2013). The primary purpose must be to confirm or reject any clinical suspicion of possible pathology or fracture after a thorough patient history, physical examination and orthopaedic examination was performed (Chiropractic Clinic Manual, 2013).

2.10 OVERVIEW OF THE MANAGEMENT OF NECK PAIN

The management plan for the patient's neck pain is diagnosis dependent and commences once all red flags are ruled out (Ferrari and Russell, 2003; Herbst and Fick, 2012). In cases where conservative therapy is utilized for an excess of four weeks without improvement then further specialized investigations are indicated (Ferrari and Russell, 2003). In evidence based literature, neck pain is usually treated with drug therapy and/or physical modalities.

Evidence based literature has shown that Acetaminophen and non-steroidal anti-inflammatory medication (NSAIDS) are effective first line analgesic drugs in most patients (American Pain Society, 1999; Panel on Persistent Pain in Older Persons, 2002). NSAID's were also found to be an effective first line analgesic especially in acute inflammatory neck pain conditions (Deyo, 1996; Douglas and Bope, 2004) but due to their gastro intestinal side effects, COX-2 inhibitors are recommended in cases of long term use as seen in the elderly (Panel on Persistent Pain in Older Persons, 2002). Muscle relaxants may be used as a first line analgesic with the most favorable result shown after four days of use (Practice guidelines for chronic pain management, 1997). Muscle relaxants are not recommended in patients with WAD grade II and III due to the lack of evidence based results (Quebec Task Force on Whiplash-associated disorders cohort study 1995; Guidelines for the management of whiplash-associated disorders, 2001).

Short term use of opioids has shown favorable analgesic effects in cervical pain syndromes (Sanders *et al*., 1999). Anti-depressants and anti-convulsants have been shown to be the most effective in patients with chronic or neuropathic pain (American Pain Society, 1999; Practice guidelines for chronic pain management, 1999; Panel on Persistent Pain in Older Persons, 2002). Sedative hypnotics are only effective in muscle spasms (American Pain Society, 1999; Sanders *et al*., 1999) and steroids such as epidural injections for radicular pain have variable results but it has definitively been shown to be non-effective in non-radicular pain (Ferrante *et al*., 1993; Deyo, 1996). Percutaneous radio-frequency neurotomy has been shown to be effective in patients with WAD related neck pain (Lord *et al*., 1996).

Physical modalities found to be effective according to evidence based research include manipulation and mobilization, which have been shown to provide the most relief in the short term (Hurwitz *et al*., 1996; Kjellman *et al*, 1999; Binder, 2002) and have been recommended in WAD grade II and III (Quebec Task Force on Whiplash-associated disorders cohort study, 1995). Pulsed electromagnetic field therapy has shown favorable results in terms of relief of pain and improved range of motion (Magee *et al*., 2000, Hoving *et al*., 2001; Binder, 2002). Some physical modalities have no or little scientific literature to support their efficacy such as thermotherapy which provided poor results in systemic reviews (Binder, 2002).

Immobilization with a cervical collar is recommended for no longer than 3 days after which it will just worsen disability; however, it has been recommended in WAD grade II and III patients (Magee *et al*., 2000; Guidelines for the management of whiplash-associated disorders, 2001; Hoving, 2001; Binder, 2002). TENS and therapeutic ultra sound has been shown to provide very little pain relief (Quebec Task Force on Whiplash-associated disorders cohort study, 1995; Philadelphia panel evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain, 2001). However Jenson and Harms- Ringahl (2007) found that TENS provided effective short term relief of pain in their study group. Educational advice on posture only provided favorable results in patients with acute neck trauma (Quebec Task Force on Whiplash-associated disorders cohort study, 1995; Binder, 2002) and cervical traction and acupuncture presented with inconclusive results (Van der Heijden *et al*., 1995; Quebec Task Force on Whiplash-associated disorders cohort study, 1995; Kjellman *et al*., 1999; Sanders *et al*., 1999; Philadelphia panel evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain, 2001). **Figure 2.3** shows the medical management of patients with neck pain.

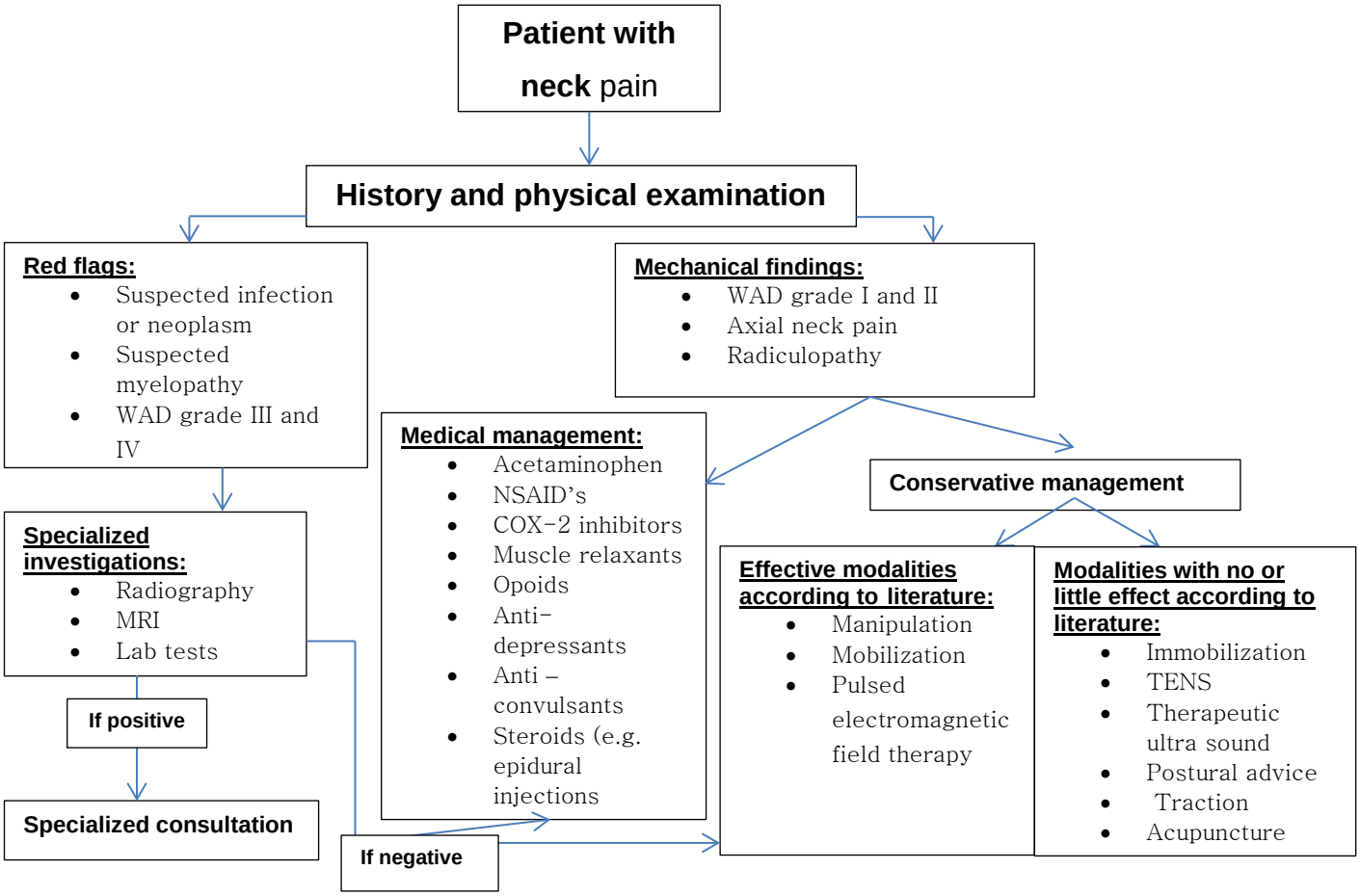

Figure 2.3: Management of a patient with neck pain
Adapted from Douglas and Bope (2004)

2.11 CHIROPRACTIC MANAGEMENT OF NECK PAIN

Chiropractic care is a form of conservative treatment and is considered effective in the treatment of neck pain that is of musculoskeletal origin (Hooper, 2004). Chiropractic management usually follows a thorough patient history and physical examination. If any red flags are detected then the patient will be sent for specialized investigations or the patient will be referred to the appropriate medical authority. Conservative therapy is indicated in cases that are without red flags and of musculoskeletal origin (Rhee and Riew, 2005). The Chiropractor's primary focus is to reduce the patient's pain by treating the pain generating structure and in sub-acute and chronic cases to identify and correct any dysfunctional biomechanical chains. The modalities that may be utilized by Chiropractors for the management of neck pain include high velocity, low amplitude manipulative techniques as well as mobilization, traction and distraction, acupuncture, electro-modalities and

rehabilitative exercises (Hooper, 2004; Bronfort *et al*., 2004).

Treatment of specific pain generators such as joint dysfunction is primarily treated with spinal manipulative therapy (SMT) (Hurwitz *et al*., 1996; Bronfort et al., 2004). Other modalities such as mobilization, TENS or massage have been shown to also provide relief but SMT was shown to be superior to these (Nordemar and Thorner, 1981; Gross *et al*., 1996; Rhee and Riew, 2005). Myofascial trigger point therapy, ice, heat, spray and stretch, interferential current and massage. Myofascial trigger points can directly be treated by either dry needling or ischemic compression to the active trigger point (Hong *et al*., 1993; Rhee and Riew, 2005) and has been compared to a variety of other modalities with results revealing that ischemic pressure and dry needling are the most effective treatment for myofascial trigger points (Garvey *et al*., 1989; Rhee and Riew, 2005). Internal disc disruption or derangement has been shown to respond favorably to SMT and other physical modalities but manipulation in the direction of instability should be avoided (Rosenfeld *et al*., 2000).

The McKenzie rehabilitative program needs to be implemented in patients with internal disc disruption and favorable results are expected after 6 months (Murphy and Freeman, 2004). Neural irritation or compression is location and severity dependent. Cases of myelopathy or radiculopathy are referred to the appropriate medical authority for specialized investigations in cases where progressive neurological symptoms are present. In intervertebral disk herniation cases, spinal manipulative therapy is controversial but considered safe (Croft, 1994; Ombregt *et al*., 1995; Rhee and Riew, 2005). Cervical traction has been reported to relieve intra-discal pressure (Yi-Kai *et al*., 1998) and interferential current application may be used in inflammatory radiculopathy which is a result of a herniated intervertebral disk (Dillin and Uppal, 1992; Rhee and Riew, 2005). Neural mobilizations have been shown to reduce neural tension in acute cases (Hall and Elvey, 1999).

In the majority of cases the pain generating structure cannot be identified since there may be more than one present in a particular patient (Ferrari and Russell, 2003). A Chiropractor will identify any contra-indications to spinal manipulative therapy and the other modalities mentioned, so as to ensure patient safety and to deliver the

most appropriate modality to correct the underlying problem (Rhee and Rhiew, 2005). The World Health Organization (2005) has proposed absolute contra-indications to SMT (**Table 2.3**), most of which may be seen on plain film radiographs**.**

Table 2.3: Absolute contra-indications to spinal manipulative therapy

Absolute contra-indications to SMT
• Anomalies such as dens hypoplasia, unstable os odontoideum and occipitalization of C1
• Acute fracture
• Spinal cord tumor
• Acute infection such as osteomyelitis, septic discitis, and tuberculosis of the spine
• Meningeal tumor
• Hematomas, whether spinal cord or intracanalicular
• Malignancy of the spine
• Frank disc herniation with accompanying signs of progressive neurological deficit
• Basilar invagination of the upper cervical spine
• Arnold-Chiari malformation of the upper cervical spine
• Dislocation of a vertebra
• Aggressive types of benign tumours, such as an aneurismal bone cyst, giant cell tumour, osteoblastoma or osteoid osteoma
• Internal fixation/stabilization devices
• Neoplastic disease of muscle or other soft tissue
• Congenital, generalized hypermobility
• Signs or patterns of instability
• Syringomyelia
• Hydrocephalus of unknown etiology
• Diastematomyelia
• Cauda equina syndrome

Adapted from the World Health Organization (2005)
SMT= Spinal manipulative therapy

These contra-indications may present with red flag signs and symptoms but in some cases may present with little or no symptoms, thus it is important to do a thorough clinical workup of the patient. There may be incidental findings that are considered a contra-indication to SMT on their plain film radiographs that might not be related to the patient's neck pain and is a frequent finding in asymptomatic patients (Ferrari and Russell, 2003). Incidental findings such as some congenital or developmental structures mentioned in **Table 2.3** may be contra-indicated in SMT thus they need to be ruled out. Some reported congenital anomalies that are frequently found that may contra-indicate SMT but were not included in the World Health Organization (2005) list of contra-indications included a posterior ponticle, cervical ribs, transitional

vertebral segments, spondylolisthesis; these may alter chiropractic intervention strategies (Beck *et al*., 2004; Jenkins *et al*., 2010).

Patients that present to the CDC at the DUT with neck pain undergo a thorough clinical examination and the Chiropractic student will take the results into account and work out the best suited treatment for the presenting complaint. There are a number of modalities to be utilized by the student once treatment commences and these range from primarily spinal manipulative therapy and mobilization. Electrical modalities may also be used such as transcutaneous electrical nerve stimulation (TENS), interferential current therapy (IFC) and ultrasound (US) (Chiropractic Clinic Manual, 2013). Other modalities used are dry needling, ischemic compression, massage, linear or Leander traction, ice or heat application and proprioceptive neuromuscular facilitation stretches (PNF) (Chiropractic Clinic Manual, 2013). A Chiropractic student may also provide nutritional advice; prescribe appropriate home stretches and rehabilitative strengthening exercises to achieve the most relief in the shortest time (Chiropractic Clinic Manual, 2013).

2.12 CONCLUSION

There are many causes of neck pain and these may either be of a mechanical or pathologic origin. Literature has shown that non-specific mechanical neck pain is the most common clinical presentation and researchers have tried to link the patient history and physical examination to certain pain generating structures and conditions but reliability of these tests are variable. Red flag signs and symptoms in the patient's clinical examination may indicate an underlying pathology and are indicative for further specialized investigations, but most neck pain does not present in such a specific manner. Plain film radiography is the first line investigation in clinical practice but literature has shown it has little use in non-specific neck pain. It was also shown that practitioners do not always make use of evidence based guide lines for plain film radiographic referral and as a result, over expose their patients to ionizing radiation. Incidental findings on plain film radiographs may be a contra-indication of some Chiropractic modalities in patients with neck pain and these may or may not be the pain generating structure.

CHAPTER 3 : MATERIALS AND METHODS

3.1 INTRODUCTION

This Chapter provides an overview of the methods followed in this study. The aspects that were covered were; study design, research methodology, sampling method, patient and student confidentiality, inclusion and exclusion criteria and the statistical analysis applied.

3.2 STUDY DESIGN

This design was a quantitative, retrospective clinical study. The data was collected from cervical spine plain film radiographs and their accompanying clinical records of patients treated at the Chiropractic Day Clinic (CDC) at the Durban University of Technology (DUT) presenting with neck pain between 1 January 1997 and 31 December 2013.

3.3 RESEARCH PROCEDURE

Permission was obtained from the Chiropractic Head of Department and the Chiropractic Day Clinic directors to enable the researcher to access the clinical records and cervical spine plain film radiographs needed for this research (Appendix C).

Table 3.1: The five stages in which this research was conducted

Stage 1
The process commenced whereby the researcher searched the archives at the CDC at the DUT for all cervical spine plain film radiographs from 1 January 1997 to 31 December 2013 and a total of 110 were obtained. The plain film radiographs were matched with the corresponding clinical records by making use of the CDC's electronic data base under the supervision of the reception staff. A clinic room at the CDC was used for data collection purposes. The clinical records were then evaluated and 73 clinical records and related cervical spine plain film radiographs satisfied the inclusion and exclusion criteria.
Stage 2
The patient's name, file number and date of birth were recorded on a data sheet and coded with an alpha numerical code as to maintain confidentiality (Appendix A) and these codes were used on all subsequent documentation.
Stage 3
The researcher then studied the cervical spine plain film radiographs by means of the ABCS system where the alignment, bony anatomy, cartilage and soft tissue were analysed and a diagnosis made. The plain film radiographs were then searched for incidental findings and recorded. This was done first so as to ensure that the researcher was not influenced by the radiological report or the clinical findings thus eliminating bias. The information obtained was recorded on a data sheet (Appendix B).
Stage 4
The radiologist report was then investigated and their radiological diagnosis recorded. The reason for plain film radiographic referral was then recorded and the request form and accompanying clinical record was analysed for red flags.
Stage 5
The clinical records were then viewed for the patient's main complaint of the neck pain and any red flags that may have been present. The student's diagnosis was then recorded before and after the plain film radiograph was taken, the treatment number at which the plain film radiograph was performed and whether or not the pre-radiographic treatment changed. The plan of management and treatment was then recorded before and after the cervical spine plain film radiograph was performed and any changes were noted.

3.4 PATIENT CONFIDENTIALITY

Permission was obtained from the Chiropractic Head of Department and the CDC Clinic Directors to enable the researcher to access the clinical records and cervical spine plain film radiographs needed for this research (Appendix C). Approval to conduct the study and ethical clearance was obtained from the Faculty of Health Sciences Research Committee at the DUT on 22 July 2014. (Ethics clearance certificate number: IREC 046/14) (Appendix F). All patients treated after 1 January 2001 at the CDC signed a consent form (Appendix D) whereby they agreed that the clinical and radiological information obtained during their treatment at the clinic may be used for research purposes. Permission was obtained from the Executive Dean of Health Science, Prof. L Puckree to act as gatekeeper of the clinical and plain film radiographic information prior to 2001 (Appendix E) due to the fact that the clinical records prior to this time did not state explicit permission for their data to be used for research purposes. The clinical records and cervical spine plain film radiographs were kept under lock and key and only the researcher, co-supervisor and supervisor were allowed access to them. A numerical coding system was utilised to maintain

confidentiality of the patients' information (Appendix A). The data sheets and electronic copies will be kept in storage at DUT for a fifteen year period after which it will be destroyed.

3.5 SAMPLING METHOD AND SAMPLE SIZE

A purposive, non-probability sampling method was used and the sample size was the total number of clinical records and accompanying cervical spine plain film radiographs from 1 January 1997 to 31 December 2013 at the CDC at the DUT. A total of 110 clinical records and accompanying cervical plain film radiographs were acquired from the archives in the CDC at the DUT of which only 73 satisfied the inclusion and exclusion criteria.

3.6 INCLUSION AND EXCLUSION CRITERIA

3.6.1 Inclusion Criteria

- The patient must have received treatment at the CDC for neck pain and have complete clinical records available with regards to patient history, physical examination, cervical spine regional, SOAPE (Subjective, Objective, Assessment, Plan and Education) and referral letter for plain film radiographs.
- The patient must have had a plain film radiographs taken of their cervical spine during their treatment period at the CDC with at least an AP and lateral view available with a radiological report.
- An informed consent document where the patient signed that they allow their clinical information to be used for research purposes (Appendix D)

3.6.2 Exclusion Criteria

- Plain film radiographs that were not done at the DUT or taken prior to patient's initial appointment.
- Incomplete clinical records.
- When the request for plain film radiographic referral letter is absent in the patients file.
- When the radiologist report is absent in the patients file.

3.7 STATISTICAL ANALYSIS:

IBM SPSS version 22.0 (SPSS Inc, Chicago, Illinois, USA) and McNemar's chi square test for paired proportions were supposed to be used to analyse the data but this was not possible due to the type of data collected. The gathered data were recorded on data sheets (Appendix B) and statistically analysed using frequency counts, percentages, mean, standard deviation and range for the descriptive objectives. Statistical testing using paired *t*-tests was not possible in order to assess the association between the clinical diagnosis and radiological diagnoses, as the categories were not the same. The other objectives were purely descriptive and the outcomes were reported using frequency counts and percentages since all outcomes were categorical variables (Esterhuizen, 2015).

3.8 Conclusion

This was a quantitative, retrospective study that involved clinical records and accompanying cervical plain radiographs between 1997 and 2013. Data collection occurred in a stepwise manner and patient confidentiality was ensured throughout the study.

CHAPTER 4 : RESULTS

4.1 INTRODUCTION

This chapter presents the data collected from the clinical records and associated plain film radiographs (*n=73*) at the Chiropractic Day Clinic (CDC) at the Durban University of Technology (DUT). Its purpose was to outline the relationships between information acquired as per the objectives of this study. The aspects covered in this chapter was age and gender, the relationship between the clinical and the radiological diagnoses of patients with neck pain, justification for diagnostic cervical spine referrals, preliminary diagnosis and treatment of patients and Incidental radiological findings.

4.2 AGE AND GENDER

A total of 73 clinical files and corresponding plain film radiographs were assessed. The Mean age of the patients was 44 years with a standard deviation of 16 years and a range from 17 to 87 years. The gender distribution was 64.4% (*n=47*) females and 35.6% (*n=26*) males as shown in **Figure 4.1.**

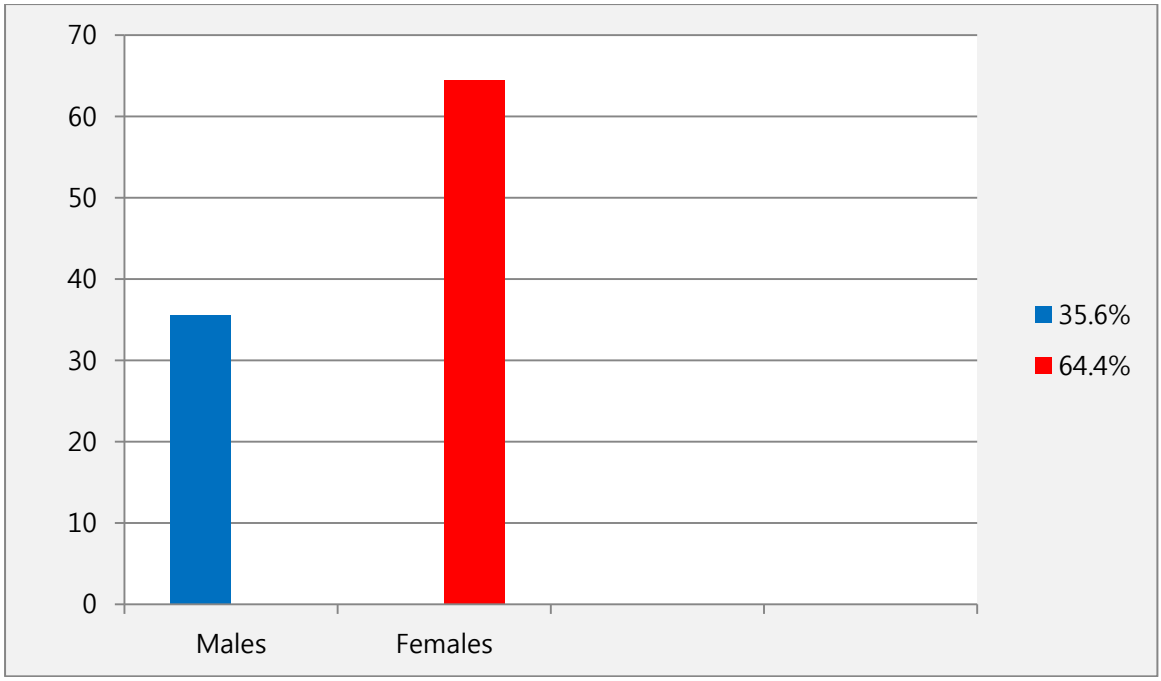

Figure 4.1: Gender distributions of patients whose plain film radiographic and clinical records were inspected

4.3 THE RELATIONSHIP BETWEEN THE CLINICAL AND THE RADIOLOGICAL DIAGNOSES OF PATIENTS THAT PRESENTED WITH NECK PAIN

Statistical testing using paired *t*-tests was not possible in order to assess the association between the clinical diagnosis and radiological diagnoses, as the categories were not the same. Similarly there were too many categories of each to allow statistical comparison using a chi square test, as the number of small and zero counts invalidated the tests. Therefore, a descriptive assessment of the radiological diagnoses for each clinical diagnosis was performed by cross tabulating the pre-radiographic primary clinical diagnosis with the primary and secondary radiological diagnosis of the radiologist respectively. This information was tabulated as follows; pre-radiographic primary clinical diagnosis versus the radiologist's primary radiological diagnosis (**Table 4.1**) and the pre-radiographic primary clinical diagnosis versus the radiologist's secondary radiological diagnosis (**Table 4.2**). The pre-radiographic primary clinical diagnosis refers to the diagnosis made by the student after a history, physical and regional examination were performed and the most likely differential diagnosis made from the results obtained. The primary radiological diagnosis refers to the main diagnosis made by the radiologist after the most salient

features on the plain film radiograph were studied and the secondary diagnosis refers to the additional features that were noticed on the plain film radiograph.

The totals reflected in **Table 4.1** and **Table 4.2** along the totals column represents the total number of patients to whom that particular pre-radiographic primary clinical diagnosis applies. The totals in the horizontal row reflect the total number of radiological diagnoses (**Table 4.1 and 4.2)**. The totals seen in **Table 4.2** along the vertical column accounts to more than 73, due to the fact that more than one secondary radiological diagnosis may have been recorded per plain film radiograph investigated.

The most frequent pre-radiographic primary clinical diagnosis was cervical facet syndrome at 56.2% (*n=41*) followed by acceleration-deceleration injury at 9.6% (*n=7*) (**Table 4.1**). Cervical radiculopathy was the third most common pre-radiographic primary clinical diagnosis at 5.5% (*n=4*) followed by no primary diagnoses and thoracic outlet syndrome at 4.1% (*n=3*) respectively (**Table 4.1**). The most frequent primary radiological diagnosis was loss of lordosis at 41.1% (*n=30*) followed by cervical spondylosis at 35.6% (*n=26*) and old cervical spinal trauma at 12.3% (*n=9*) (**Table 4.1**). The most frequent secondary radiological diagnoses were cervical spondylosis and old cervical spine trauma both at 27.4% (*n=20*). This is followed by loss of lordosis at 26% (*n=19*) and evidence of hypertonic musculature at 24.7% (*n=18*) (**Table 4.2**).

Of the 41 patients with a pre-radiographic primary clinical diagnosis of cervical facet syndrome, 39.0% (*n=16*) were given a primary radiological diagnosis of cervical spondylosis and 36.6% (*n=15*) displayed a loss of lordosis (**Table 4.1**). The seven patients with a pre-radiographic primary clinical diagnoses of acceleration-deceleration injury, were given a primary radiological diagnosis of loss of lordosis in 71.4% (*n=5*) of cases following plain film radiographic imaging (**Table 4.1**). It is interesting to note that in the three patients where no pre-radiographic primary clinical diagnosis was established, the most frequent primary radiological diagnoses were cervical spondylosis at 66.6% (*n=2*) and loss of lordosis 33.3% (*n=1*) (**Table 4.1**). Pre-radiographic clinical diagnoses of adhesive capsulitis, supraspinatus tendonitis and rotator cuff dysfunction do not seem to belong since these are

primarily shoulder complaints (**Table 4.1 and Table 4.2**). Cervical radiculopathy that is considered a red flag condition revealed primary radiological diagnoses of 75% (*n=3*) spondylosis and 25% (*n=1*) loss of lordosis.

Table 4.1: Primary clinical diagnosis vs radiologist's primary radiological diagnosis

		Primary radiological diagnosis							
		Loss of lordosis	Spondylosis	Old cervical spinal trauma	Osteoporosis	Spinal stenosis	Evidence of hypertonic muscles	Normal	Total
Pre-radiographic primary clinical diagnosis	**Cervical Facet syndrome**	15	16	4	2	1	2	1	**41**
	Acceleration-Deceleration injury	5	1	1	0	0	0	0	**7**
	Cervical Radiculopathy	1	3	0	0	0	0	0	**4**
	Thoracic Outlet Syndrome	2	0	1	0	0	0	0	**3**
	No 1' Diagnosis	1	2	0	0	0	0	0	**3**
	Cervicogenic Headache	0	0	1	0	1	0	0	**2**
	Cervical myofaciitis	0	1	1	0	0	0	0	**2**
	Tension Type Headache	0	1	0	1	0	0	0	**2**
	Cervical Spondylosis	0	1	0	0	0	0	0	**1**
	Ulnar nerve neuritis	1	0	0	0	0	0	0	**1**
	Migraine Headache	1	0	0	0	0	0	0	**1**
	Inter-vertebral disk herniation	1	0	0	0	0	0	0	**1**
	Adhesive Capsulitis	1	0	0	0	0	0	0	**1**
	Mechanical neck pain	1	0	0	0	0	0	0	**1**
	Supraspinatus Tendonitis	0	0	1	0	0	0	0	**1**
	Torticolis	1	0	0	0	0	0	0	**1**
	Rotator cuff dysfunction	0	1	0	0	0	0	0	**1**
	Total	**30**	**26**	**9**	**3**	**2**	**2**	**1**	**73**

Table 4.2: Primary clinical diagnosis vs radiologist's secondary radiological diagnosis

		Secondary radiological diagnosis								
		Spondylosis	Loss of lordosis	Evidence of hypertonic muscles	No secondary radiological diagnosis	Old cervical spinal trauma	Congenital anomaly	Osteoporosis	Spinal stenosis	Total patients
Pre-radiographic Primary clinical diagnosis	**Cervical Facet syndrome**	11	9	10	7	13	4	1	1	**41**
	Acceleration-Deceleration injury	1	1	3	0	3	0	0	0	**7**
	Cervical Radiculopathy	1	1	1	1	1	0	0	0	**4**
	No primary diagnosis	1	2	1	1	0	0	0	0	**3**
	Thoracic Outlet Syndrome	2	0	1	1	1	0	0	0	**3**
	Cervicogenic Headache	1	2	1	0	0	0	0	0	**2**
	Tension Type Headache	0	1	1	1	0	0	0	0	**2**
	Cervical Myofaciitis	0	0	0	0	0	0	1	0	**2**
	Migraine Headache	1	0	0	0	0	0	0	0	**1**
	Cervical Spondylosis	0	1	0	0	1	0	1	0	**1**
	Inter-vertebral disk herniation	0	0	0	1	0	0	0	0	**1**
	Adhesive Capsulitis	0	0	0	0	1	0	0	0	**1**
	Ulnar nerve neuritis	1	0	0	0	0	0	0	0	**1**
	Mechanical neck pain	0	0	0	1	0	0	0	0	**1**
	Supraspinatus Tendonitis	0	1	0	0	0	0	0	0	**1**
	Torticollis	1	0	0	0	0	0	0	0	**1**
	Rotator cuff dysfunction	0	1	0	0	0	0	0	0	**1**
	Total	**20**	**19**	**18**	**13**	**7**	**4**	**3**	**1**	**73**

4.4 JUSTIFICATION FOR PLAIN DIAGNOSTIC CERVICAL SPINE REFERRALS

Table 4.3 depicts the consultation and reasoning for cervical spine plain film radiographic referral as recorded on the referral letter by the student. This information was based on the clinical findings after the patients were assessed with regards to their neck pain. (The totals seen in **Table 4.3 and Table 4.4** may be more than 73 since more than one reason for plain film radiographic referral may have been recorded on the radiographic referral letter). **Table 4.4** depicts the frequency of reasons for plain film radiographic referral. A total of 64.4% (*n=47*) of cervical spine plain film radiographs were performed after the initial clinical consultation. This percentage progressively decreases from the second (55.5%) to sixteenth (1.4%) clinical consultation. The most common reason for radiographic referral was due to positive orthopaedic tests at 57.5% (*n=42*). The second and third most common reason were neck pain with radicular symptoms at 35.6% (*n=26*) and past history of motor vehicle accident (MVA) or neck trauma with myofascial symptoms at 32.9% (*n=24*) respectively (**Table 4.4**). The most common reason for plain film radiographic referral in the first visit was due to positive orthopaedic tests during the clinical assessment at 35.6% (*n=26*) (**Table 4.3**); this was also the main reason for plain film radiographic referral seen in visit number six at 4.1% (*n=3*) (**Table 4.3**). Other frequent reasons for referral provided during the first visit were history of MVA or neck trauma with associated myofascial symptoms at 21.9% (*n=16*), neck pain with radicular symptoms at 19.7% (*n=14*) and neck pain with associated myofascial symptoms at 17.8% (*n=13*) (**Table 4.3**). The main reasons for plain film radiographic referral seen in visit number two were positive orthopaedic tests, neck pain with associated radicular symptoms and history of MVA or neck trauma with associated myofascial symptoms all at 2.7% (*n=2*) (**Table 4.3**). The main reasons for plain film radiographic referral in visit number three were history of MVA or neck trauma with associated myofascial symptoms all at 5.5% (*n=4*) (**Table 4.3**). The main reason for plain film radiographic referral after number four at 4.1% (*n=3*) was neck pain with associated myofascial symptoms and after treatment number five the main reason was no or little relief of pain after more or equal to three treatments (**Table 4.3**). The main reasons provided at the seventh visit were positive orthopaedic tests and no or little relief of pain after three or more treatments both at 4.1% (*n=3*) (**Table 4.3**). It is

interesting to note that the main reason for plain film radiographic referral after visit number fourteen was dermatome, myotome or reflex (DMR) abnormalities at 2.7% (*n=2*) and it's curious why this was only noticed at this stage. Reasons provided in the sixteenth visit both at 1.4% (*n=1*) were constant neck pain for two weeks or more and no or little relief of neck pain after three or more treatments (**Table 4.3**). In two patients in the initial visit the reason for referral was being a smoker for ten years or more (**Table 4.3**).

Table 4.3: Summary of the consultations at which cervical spine plain film radiographs were requested and the reasons therefor

Treatment Number	Patient count(*n*)	Patient Percent	Reason for plain film radiographic referral
1	**47**	**64.4%**	• Positive orthopaedic test/tests (*n=26*) • Neck pain with associated myofascial symptoms (*n=13*) • Past history of MVA or neck trauma with associated myofascial symptoms (*n=16*) • Neck pain with associated radicular symptoms (*n=14*) • Recent MVA with associated ominous symptoms (*n=10*) • Constant neck pain for > or = 2 weeks (*n=9*) • DMR abnormalities (*n=7*) • Recent MVA with associated myofascial symptoms (*n=5*) • Decreased cervical ROM (*n=4*) • Cervicogenic headaches (*n=3*) • Smoker for > or = 10 years (*n=2*) • Past history of MVA or neck trauma associated with ominous symptoms; Previous cervical spine plain film radiographs showing advanced disc narrowing; Fibromyalgia of the cervical muscles; Cervical crepitus with chronic sub occipital cervicogenic headaches; History of hypertension; Headache constant throbbing and of 5 year duration; Family history of spinal tumors; Postural abnormality; Patient on HRT; Patient history of RA; History of recent malignancy (*n=1* each)
2	**4**	**5.5%**	• Positive orthopaedic test/tests; Neck pain with associated radicular symptoms; Past history of MVA or neck trauma with associated myofascial symptoms (*n=2* each) • Neck pain associated myofascial symptoms; Decreased cervical ROM (*n=1* each)
3	**5**	**6.8%**	• Past history of MVA or neck trauma with associated myofascial symptoms; Neck pain with associated myofascial symptoms (*n=4* each) • Positive orthopaedic test/tests; Neck pain with associated radicular symptoms (*n=3* each)
4	**4**	**5.5%**	• Neck pain with associated myofascial symptoms (*n=3*) • Positive orthopaedic test/test; No/little relief of pain after > or = 3 treatments; Constant neck pain for > or = 2 weeks; Neck pain with associated radicular symptoms (*n=2* each)

			• Decreased cervical ROM; Previous cervical spine plain film radiographs showing advanced disc narrowing; Nausea with cervical extension and rotation (*n=1* each)
5	**4**	**5.5%**	• No/ little relief of pain after > or = 3 treatments (*n=3*) • Positive orthopaedic test/tests; Constant neck pain for > or = 2 weeks (*n=2* each) • Neck pain with associated radicular symptoms; Neck pain with associated myofascial symptoms; Past history of MVA or neck trauma with associated myofascial symptoms; Cervicogenic headaches; Numbness in arm/arms for more than 3 months (*n=1* each)
6	**4**	**5.5%**	• Positive orthopaedic test/tests (*n=3*) • No/little relief of pain after > or = 3 treatments; Constant neck pain for > or = 2 weeks; Neck pain with associated myofascial symptoms (*n=2* each) • Neck pain with associated radicular symptoms (*n=1*)
7	**3**	**4.1%**	• Positive orthopaedic test/tests; No/little relief after > or = 3 treatments (*n=3*) • Past history of MVA or neck trauma with associated myofascial symptoms; Neck pain with associated radicular symptoms; Neck pain with associated headache; Past history of MVA or neck trauma with associated headaches; Neck pain with ominous symptoms (*n=1* each)
14	**1**	**1.4%**	• DMR abnormalities (*n=2*) • Positive orthopaedic test/tests; No/little relief of pain after > or = 3 treatments; Neck pain with associated radicular symptoms (*n=1* each)
16	**1**	**1.4%**	• No/little relief of pain after > or = 3 treatments; Constant neck pain for > or = 2 weeks (*n=1* each)
Total	**73**	**100%**	

MVA= Motor vehicle accident; ROM= Range of motion; HRT= Hormone replacement therapy; RA= R heumatoid arthritis

Table 4.4: The frequency ranking of reasons used for plain film radiographic referral

Ranking	Reason for plain film radiographic referral	Frequency of use overall
1.	• Positive orthopaedic test/tests	**57.5% (n=42)**
2.	• Neck pain with associated radicular symptoms	**35.6% (n=26)**
3.	• Past history of MVA or neck trauma with associated myofascial symptoms	**32.9% (n=24)**
4.	• Neck pain associated myofascial symptoms	**31.5% (n=23)**
5.	• Constant neck pain for > or = 2 weeks	**21.9% (n=16)**
6.	• No/ little relief of pain after > or = 3 treatments	**16.4% (n=12)**
7.	• Recent MVA with associated ominous symptoms	**13.7% (n=10)**
8.	• DMR abnormalities	**12.3% (n=9)**
9.	• Decreased cervical ROM	**8.2% (n=6)**
10.	• Recent MVA with associated myofascial symptoms	**6.8% (n=5)**
11.	• Cervicogenic headaches	**5.5% (n=4)**
12.	• Previous cervical spine plain film radiographs showing advanced disc narrowing • Smoker for > or = 10 years	**2.7% (n=2)**

13.	• Neck pain with ominous symptoms • Past history of MVA or neck trauma associated with ominous symptoms • Headache constant throbbing and of 5 year duration • Patient on HRT • Family history of tumors • History of recent malignancy • Cervical crepitus with chronic sub occipital cervicogenic headaches • History of hypertension • Postural abnormality • History of RA • Fibromyalgia • Nausea with cervical extension and rotation • Numbness in arms for > 3months • Neck pain with associated headache • Past history of MVA or neck trauma with associated headache • Neck pain with ominous symptoms	**1.4% (n=1)**
	Total	**100% (n=197)**

MVA= Motor vehicle accident; ROM= Range of motion; HRT= Hormone replacement therapy; RA= R heumatoid arthritis

4.5 PRELIMENARY DIAGNOSIS AND TREATMENT OF PRIOR TO REFERRAL FOR CERVICAL SPINE PLAIN FILM RADIOGRAPHS

Since the clinical records used in this study may have shown multiple treatments, the totals in the horizontal row will account to greater than 73 whereas totals in the vertical column represent the number of clinical records (**Table 4.5**). Treatment options utilized by the students ranged from spinal manipulative therapy (SMT), dry needling, electro-modalities such as; transcutaneous electrical nerve stimulation (TENS), ultra-sound (US) and Interferential current (IFC). Other modalities that were utilized were cervical mobilization, ice and heat therapy and soft tissue therapy (STT) which comprised light or deep massage and ischemic compression. Stretches included static or proprioceptive neuromuscular facilitation stretches (PNF). If no treatment was given at that particular consultation, it was referred to as “no treatment” (**Table 4.5**).

Figure 4.2 depicts the frequency of management options utilized before referral for plain film radiographs and this revealed that soft tissue therapy was the most frequent modality utilized at 63.0% (*n=46*). The second and third most commonly utilized treatment modality were stretches and spinal manipulative therapy at 39.7%

(*n=29*) and 34.2% (*n=25*) respectively (**Figure 4.2**). Cervical facet syndrome was the most frequent clinical diagnosis in 41 patients and of these treatment included primarily soft tissue therapy at 63.4% (*n=26*) followed by stretches at 24.4% (*n=22*) and SMT and electro modalities both at 34.1% (n=14) (**Table 4.5**). No treatment was given in 5.5% (*n=4*) of cases where the clinical diagnoses was cervical facet syndrome, 2.7% (*n=2*) with thoracic outlet syndrome and 1.4% (*n=1*) with “no primary diagnosis given” (**Table 4.5**).

Table 4.5: Suspected clinical diagnosis and management prior to plain film radiography

		Pre-radiographic treatment											
		Soft Tissue Therapy	Stretching	SMT	Electro Modalities	Dry Needling	Cryo Therapy	Mobilization	Referred	No Treatment	Ice and Heat Therapy	Cervical Traction	Total patients
Pre-radiographic primary clinical diagnosis	**Cervical Facet syndrome**	26	22	14	14	7	5	3	1	2	2	0	**41**
	Acceleration-Deceleration injury	7	2	0	1	0	1	3	0	0	0	0	**7**
	no primary diagnosis	1	0	0	1	0	0	0	2	1	0	0	**4**
	Cervical Radiculopathy	1	1	1	0	2	1	1	2	0	0	0	**4**
	Thoracic Outlet Syndrome	2	0	1	0	1	0	0	0	1	0	0	**3**
	Tension Type Headache	1	1	2	1	0	0	0	0	0	0	0	**2**
	Cervical Spondylosis	0	0	1	1	0	0	0	0	0	0	0	**1**
	Ulnar nerve neuritis	1	0	1	1	1	0	0	0	0	0	0	**1**
	Migraine Headache	0	0	1	0	0	0	0	0	0	0	0	**1**
	Cervicogenic Headache	2	1	1	0	2	0	0	0	0	0	0	**2**
	Inter-vertebral disk herniation	1	0	0	0	0	0	0	0	0	0	1	**1**
	Adhesive Capsulitis	1	0	0	1	0	0	1	0	0	0	0	**1**
	Cervical Myofaciitis	1	0	0	0	1	0	1	0	0	0	0	**1**
	Mechanical neck pain	1	1	1	0	0	0	0	0	0	0	0	**1**
	Supraspinatus Tendonitis	1	1	0	0	0	0	0	0	0	0	0	**1**
	Torticollis	0	0	1	1	0	1	0	0	0	0	0	**1**
	Rotator cuff dysfunction	0	0	1	0	1	1	0	0	0	0	0	**1**
	Total	**46**	**29**	**25**	**21**	**15**	**9**	**9**	**5**	**4**	**2**	**1**	**73**

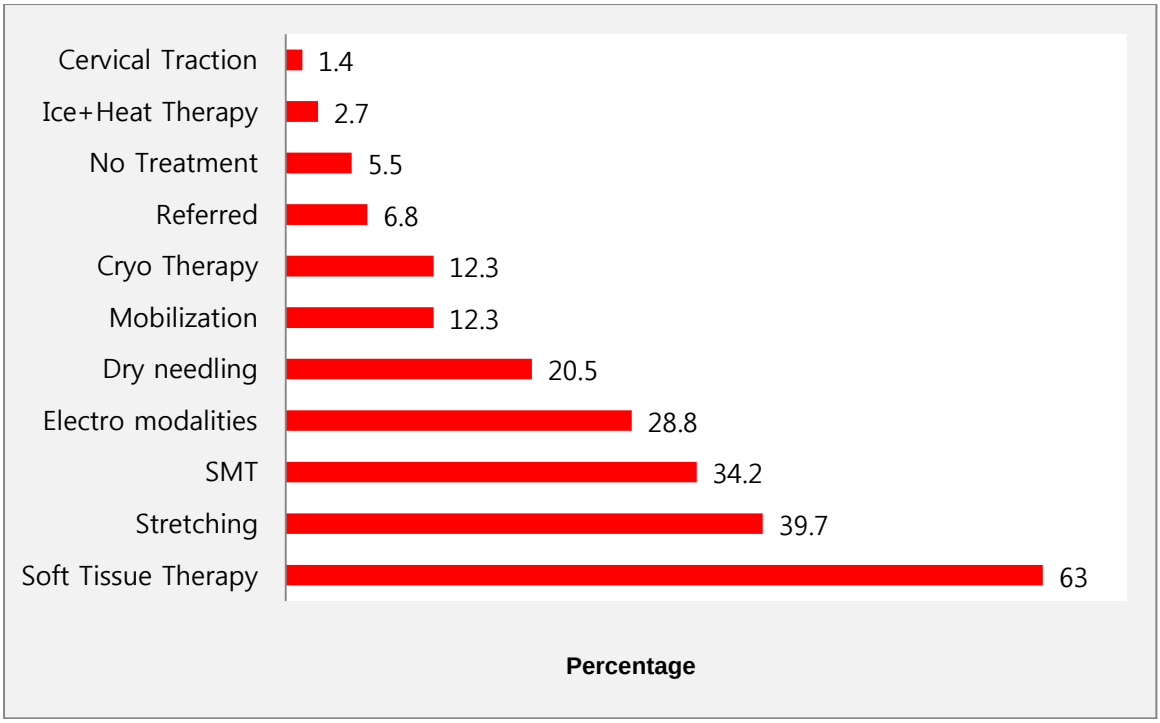

Figure 4.2: Management prior to plain film radiographs

4.6 CHANGES IN CLINICAL DIAGNOSIS AND MANAGEMENT AFTER PLAIN FILM RADIOGRAPHS

A total of 27.4% (*n=20*) of clinical files reviewed had a change in their initial clinical diagnosis and 72.6% (*n=53*) of these patients had no change in diagnosis (**Figure 4.3**). **Table 4.6** depicts the changes in clinical diagnosis after plain film radiographs were performed and the most frequent clinical diagnosis after plain film radiographs was cervical facet syndrome at 16.4% (*n=12*).

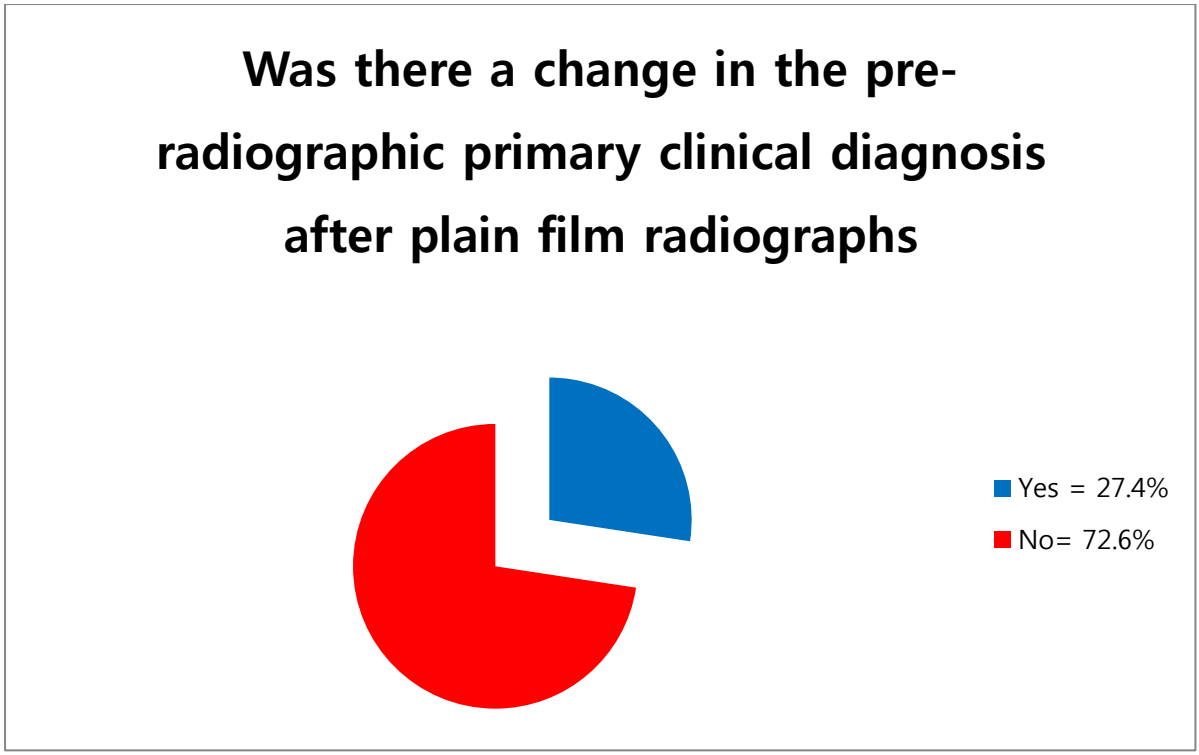

Figure 4.3: Change in initial clinical diagnosis of the patients after cervical spine plain film radiographs were obtained

Table 4.6: Details of change in diagnosis

Pre-radiographic primary clinical diagnosis	primary radiological diagnosis	Post-radiographic primary clinical diagnosis	count
Cervical Facet syndrome	Osteoporosis	no change in pre-radiographic primary clinical diagnosis	1
		Cervical Spondylosis	1
	Spondylosis	no change in pre-radiographic primary clinical diagnosis	13
		Cervical Radiculopathy	1
		Cervical Myofaciitis	2
	Spinal stenosis	no change in pre-radiographic primary clinical diagnosis	1
	Loss of lordosis	no change in pre-radiographic primary clinical diagnosis	15
	Old cervical spinal trauma	no change in pre-radiographic primary clinical diagnosis	3
	Cervical Myofasciitis	no change in pre-radiographic primary clinical diagnosis	2
	Old cervical spinal trauma	no change in pre-radiographic primary clinical diagnosis	1
	Normal	no change in pre-radiographic primary clinical diagnosis	1
Acceleration-Deceleration injury	Loss of lordosis	no change in pre-radiographic primary clinical diagnosis	5
	Spondylosis	no change in pre-radiographic primary clinical diagnosis	1

	Old cervical spinal trauma	no change in pre-radiographic primary clinical diagnosis	**1**
Cervical Radiculopathy	Spondylosis	Cervical Facet syndrome	**2**
		Cervical Spondylosis	**1**
	Loss of lordosis	Cervical Facet syndrome	**1**
Thoracic Outlet Syndrome	Loss of lordosis	no change in pre-radiographic primary clinical diagnosis	**1**
		Cervicogenic Headache	**1**
	Old cervical spinal trauma	Cervical Facet syndrome	**1**
No 1' Diagnosis	Spondylosis	Cervical Spondylosis	**1**
		Cervical Myofaciitis	**1**
	Loss of lordosis	Mechanical neck pain	**1**
Cervical myofasciitis	Spondylosis	no change in pre-radiographic primary clinical diagnosis	**1**
	Osteoporosis	Cervical Facet syndrome	**1**
Cervicogenic Headache	Spinal stenosis	no change in pre-radiographic primary clinical diagnosis	**1**
	Old cervical spinal trauma	Cervical Facet syndrome	**1**
Tension Type Headache	Spondylosis	no change in pre-radiographic primary clinical diagnosis	**1**
	Old cervical spinal trauma	no change in pre-radiographic primary clinical diagnosis	**1**
Supraspinatus Tendonitis	Old cervical spinal trauma	Cervical Facet syndrome	**1**
Torticollis	Loss of lordosis	Cervical Facet syndrome	**1**
Rotator cuff dysfunction	Spondylosis	AC joint dysfunction	**1**
Inter-vertebral disk herniation	Loss of lordosis	Cervical Radiculopathy	**1**
Adhesive Capsulitis	Loss of lordosis	no change in pre-radiographic primary clinical diagnosis	**1**
Mechanical neck pain	Loss of lordosis	no change in pre-radiographic primary clinical diagnosis	**1**
Cervical Spondylosis	Spondylosis	no change in pre-radiographic primary clinical diagnosis	**1**
Ulnar nerve neuritis	Loss of lordosis	Cervical Radiculopathy	**1**
Migraine Headache	Loss of lordosis	no change in pre-radiographic primary clinical diagnosis	**1**
Total			**73**

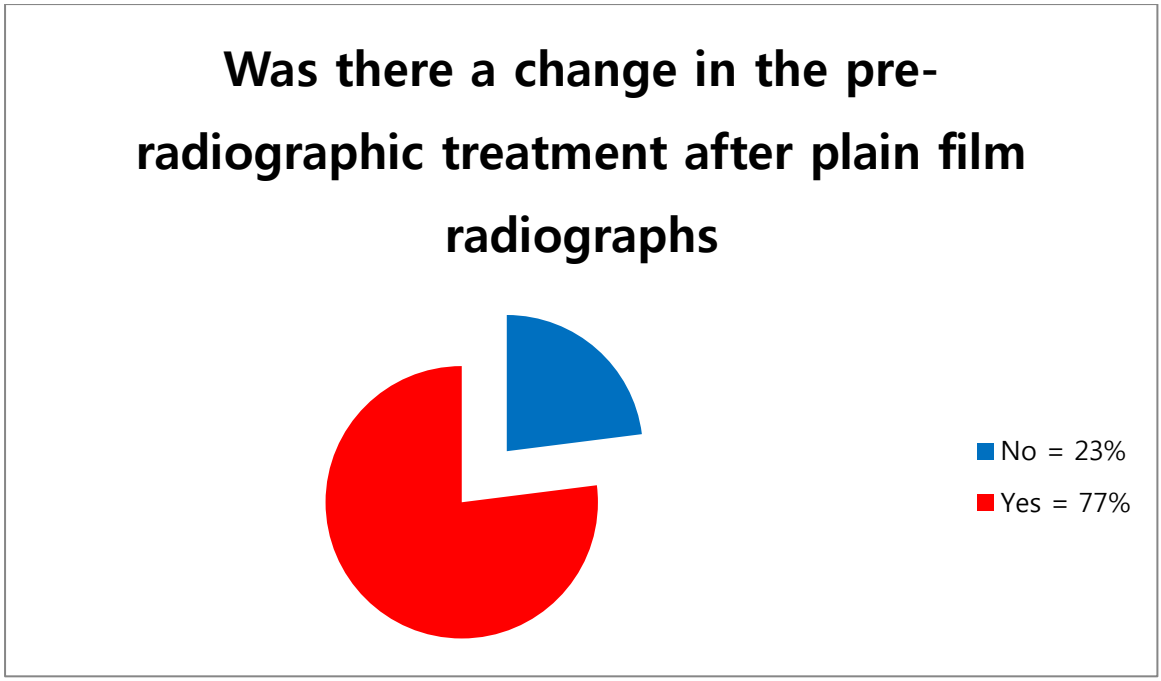

Figure 4.4: Change in management of the patients after cervical spine plain film radiographs were obtained

A total of 75% (*n=55*) of patients had a change of treatment after plain film radiographs were performed (**Figure 4.4**) and spinal manipulative therapy was the most common treatment added in 41% followed by stretching added at 17.8% and electro modalities at 13.7%. It is interesting to note that the treatment plan remained constant in 23% of the patients sent for plain film radiography (**Figure 4.4**).

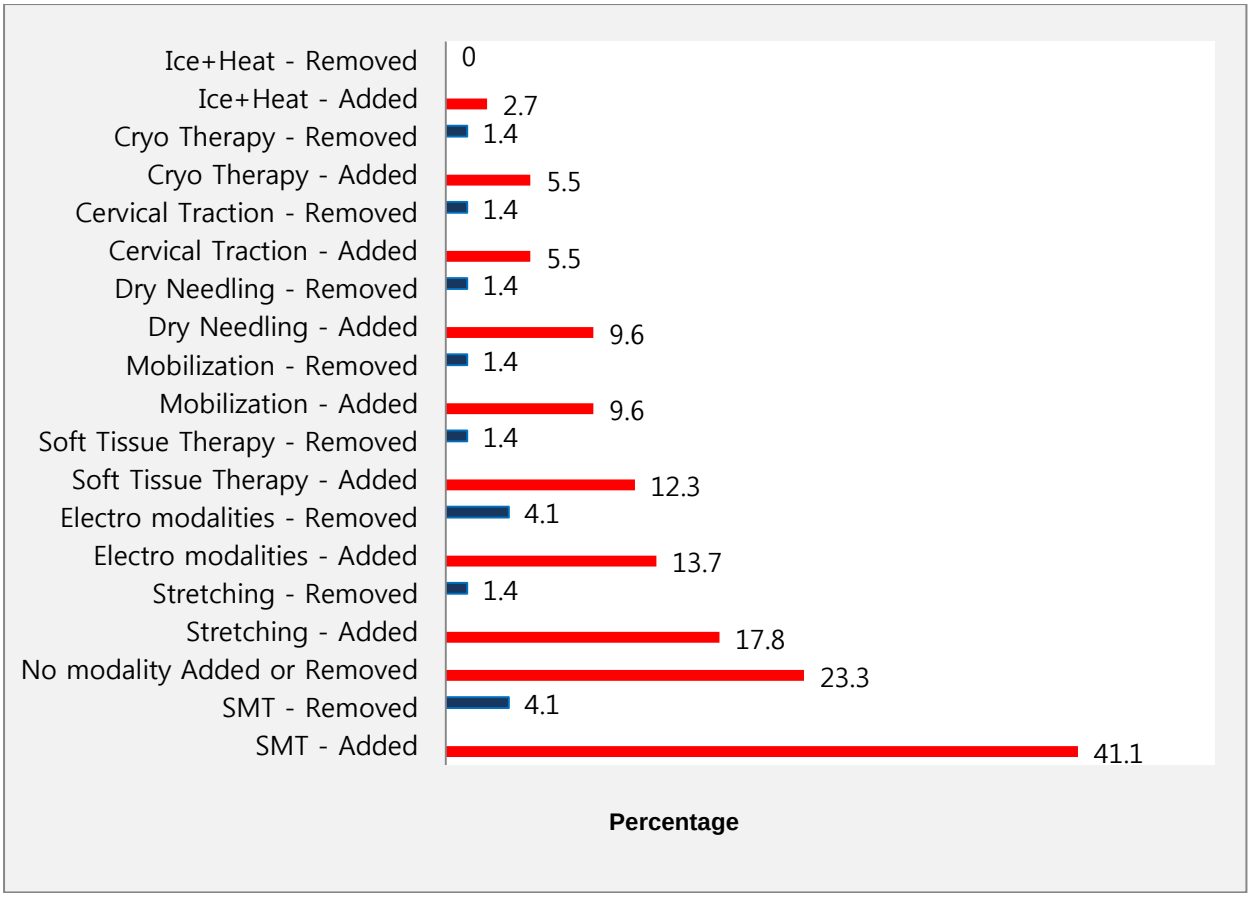

Figure 4.5: Change in management of the patients after cervical spine plain film radiographs were obtained

4.7 INCIDENTAL RADIOLOGICAL FINDINGS

Table 4.7 depicts the incidental findings and their related suspected clinical diagnoses and treatment. The results revealed that there was more than one incidental finding present in some patients (**Table 4.7**). It was found that a total of 58.9% (*n=43*) of patients had incidental findings present. In 58.1% (*n=25*) of patients there was no change in initial clinical diagnosis with incidental findings (**Table 4.7**). Incidental findings were most commonly found in patients with a post-radiographic primary clinical diagnosis of cervical facet syndrome at 48.8% (*n=21*) followed by whiplash injury at 11.6% (*n=5*) and cervical radiculopathy at 7.0% (*n=3*) (**Table 4.7**). The most common incidental findings was a posterior ponticle at 25.6% (*n=11*) followed by calcified hyoid cartilage at 14.0% (*n=6*). Calcified carotid artery, cervical ribs and elongated transverse processes presented in 9.3% (*n=4*) (**Table 4.7**).

Table 4.7: Incidental radiological finding and related suspected post-radiographic clinical diagnoses and management

Incidental findings	Pre-radiographic primary clinical diagnosis	Post-radiographic primary clinical diagnosis	Post-radiographic treatment	Count	Percentage
Abnormal 1st rib	Whiplash injury	No change in initial primary diagnosis	Stretches Mobilization Ice	1	2.3%
			Total	1	2.3%
Agenesis of posterior arch C1	Cervicogenic Headaches	Cervical Facet syndrome	Soft tissue therapy Mobilization	1	2.3%
			Total	1	2.3%
Calcified carotid artery	Cervical Facet syndrome	No change in initial primary diagnosis	Electro modalities Soft tissue therapy Stretching Mobilization	1	2.3%
	Cervicogenic headaches	Cervical Facet syndrome	Electro modalities Soft tissue therapy Stretching	1	2.3%
	Cervical disk herniation	Cervical Radiculopathy	No treatment	1	2.3%
	Cervical Radiculopathy	Cervical myelopathy	Electro modalities Soft tissue therapy Stretching Ice Cervical traction	1	2.3%
			Total	4	9.3%
Calcified hyoid cartilage	Whiplash injury	No change in initial primary diagnosis	Soft tissue therapy Stretching Mobilization SMT Electro modalities	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	SMT Soft tissue therapy	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	Stretching Soft tissue therapy SMT	1	2.3%
	No Diagnosis	Mechanical neck pain	SMT	1	2.3%
	Adhesive capsulitis	No change in initial primary diagnosis	Electro modalities Soft tissue therapy	1	2.3%
	Cervical facet syndrome	Cervical myofasciitis	SMT Stretching Soft tissue therapy	1	2.3%
			Total	6	14.0%
Calcified intervertebral	Mechanical neck pain	No change in initial primary	SMT Stretching	1	2.3%

disks		diagnosis	Soft tissue therapy		
			Total	1	2.3%
Cervical ribs	Spondylosis	No change in initial primary diagnosis	SMT Soft tissue therapy Electro modalities	1	2.3%
	No Diagnosis	Spondylosis	Electro modalities	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	Electro modalities	1	2.3%
	Whiplash syndrome	No change in initial primary diagnosis	Soft tissue therapy SMT Ischæmic compression	1	2.3%
			Total	4	9.3%
Cervical scoliosis	Cervical radiculopathy	Cervical Facet syndrome	SMT Dry needling Electro modalities	1	2.3%
			Total	1	2.3%
Compression fracture	Cervical facet syndrome	No change in initial primary diagnosis	Stretching Soft tissue therapy Ice Mobilization SMT	1	2.3%
	Thoracic outlet syndrome	Cervicogenic Headache	SMT Electro modalities Dry needling Soft tissue therapy	1	2.3%
	Cervical facet syndrome	Cervical Myofaciitis	SMT Stretching Soft tissue therapy	1	2.3%
			Total	3	7.0%
Elongated cervical transverse processes	Cervical facet syndrome	No change in initial primary diagnosis	SMT Stretching Soft tissue therapy	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	SMT Dry needling Stretching Soft tissue therapy Ischemic compression Ice	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	SMT Stretching Electro modalities Soft tissue therapy	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	SMT Dry needling Stretching Soft tissue therapy	1	2.3%
			Total	4	9.3%
Laryngeal calcification	Ulnar nerve neuritis	Cervical Radiculopathy	SMT Dry needling Soft tissue therapy	1	2.3%

			Total	1	2.3%
Occipitalisation C1 & occiput	Tension type headache	No change in initial primary diagnosis	SMT	1	2.3%
	Cervical facet syndrome	Spondylosis	Stretching Soft tissue therapy	1	2.3%
			Total	2	4.6%
Odontoid peg tilted in AP-view	Cervical facet syndrome	No change in initial primary diagnosis	SMT	1	2.3%
			Total	1	2.3%
Partial agenesis of posterior arch C1	Cervical myofascitis	Cervical facet syndrome	Soft tissue therapy	1	2.3%
	Cervicogenic headaches	Cervical facet syndrome	Stretching Soft tissue therapy	1	2.3%
			Total	2	4.6%
Posterior ponticle	Cervical facet syndrome	No change in initial primary diagnosis	Dry needling	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	SMT Soft tissue therapy	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	SMT Stretching Electro modalities Soft tissue therapy	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	Stretching Electro modalities	1	2.3%
	Whiplash syndrome	No change in initial primary diagnosis	SMT Stretching Mobilization	1	2.3%
	Adhesive capsulitis	No change in initial primary diagnosis	Soft tissue therapy Electro modalities	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	SMT Stretching Soft tissue therapy	1	2.3%
	Cervical facet syndrome	No change in initial primary diagnosis	Stretching Soft tissue therapy Ischemic compression Mobilization	1	2.3%
	Cervical facet syndrome	Cervical myofacsiitis	SMT Stretching Soft tissue therapy	1	2.3%
	Torticollis	Cervical facet syndrome	SMT Stretching Soft tissue therapy Electro modalities Ice	1	2.3%
	Ulnar nerve neuritis	Cervical Radiculopathy	Dry needling Soft tissue therapy	1	2.3%

			SMT		
			Total	11	25.6%
Pronounced osteoporosis	Whiplash injury	No change in initial primary diagnosis	Stretching Mobilization Soft tissue therapy	1	2.3%
			Total	1	2.3%
Total				**43**	**100%**

SMT= Spinal manipulative therapy; STT= Soft tissue therapy

CHAPTER 5 : DISCUSSION OF RESULTS

5.1 INTRODUCTION

This chapter provides an interpretation of the results chapter and aimed to draw meaningful conclusions from the results as per the objectives of this study.

5.2 AGE AND GENDER

Of the 73 clinical files and corresponding plain film radiographs that were assessed, the mean age of patients was 44 years with a range of 17 to 87 years. The gender distribution was 64.4% females as shown in **Figure 4.1**. These figures were consistent with research conducted by Skillgate *et al.,* (2012) where they surveyed 23,794 individuals with neck pain using a self-administered questionnaire. They concluded that the mean age of neck pain was between ages 30-59 years with higher incidence reported in females. Hoy *et al.* (2010) also concluded that woman had a greater incidence of neck pain especially seen in ages 35-49 years. In a study conducted by Manchikanti (2004) 500 patients with non-specific, chronic neck pain were evaluated and they found that 59% of these patients were female with an average age of 47 years. Research conducted in a similar chiropractic college teaching clinic to the DUT CDC revealed that the cervical spine was second to lumbar spine plain film radiographic referral with a mean age of patients at 46 years and 48% being female (Lew and Snow, 2012). This figure may differ due to the fact that the sample size of the study done by Lew and Snow (2012) had a sample size of *n=101* versus this research sample size of *n=73* and the number of females were 51% versus 64.4% in this study.

5.3 THE RELATIONSHIP BETWEEN THE CLINICAL AND THE RADIOLOGICAL DIAGNOSES OF PATIENTS THAT PRESENTED WITH NECK PAIN

The researcher attempted to find a correlation between the clinical and radiological diagnoses but these were incomparable since the diagnostic categories utilised were too different in each case and as a result too many variables were obtained for any

statistical testing to be done. As a result it appeared that the clinical and radiological diagnoses did not have any correlation; this may be due to the initial clinical diagnosis being incorrect, or the radiological report not being intended to diagnose but only to report on the salient radiological features present. The researcher cross tabulated the pre-radiographic primary clinical diagnoses with the primary and secondary radiological diagnoses of the radiologist respectively to depict a descriptive assessment of the radiological diagnoses for each clinical diagnosis. The results revealed that the most frequent primary clinical diagnosis was cervical facet syndrome (56.2%) and of those patients the most frequent primary radiological diagnosis was spondylosis (39%) (**Table 4.1**).

The results obtained from this study (**Table 4.1**) were consistent with research conducted by Manchikanti (2004) where 500 patients with non-specific, chronic neck pain were evaluated and it was found that 55% of the group's neck pain was due to facet joint pain. Spondylosis of the facet joints can cause neck pain due to the close proximity of nerve fibres and nociceptive nerve endings to the intervertebral disks and facet joints (Rao *et al.*, 2007). Research conducted by Rao *et al.* (2007) also revealed that cervical spondylosis was a frequent radiological finding in 85% of individuals over 60 years of age, 50% of individuals over 40 and 25% of individuals younger than 40 years of age. Thus due to the fact that the majority of patients with neck pain that visit the CDC at the DUT are in their middle age, they are likely to have a degree of cervical spondylosis present contributing to their neck pain diagnosed as a cervical facet syndrome. Another prominent finding in these patients was evidence of hypertonic muscles. This is consistent with facet joint syndromes which may cause hyper tonicity of the regional muscles as a result of arthrogenic muscle inhibition (Travell and Simons, 1999; Rao *et al.*, 2007). The excessive use of cervical facet syndrome as the primary clinical diagnosis at the CDC at the DUT may be deemed a "diagnosis of convenience" or may reflect what the patient was treated for rather than reflecting their full clinical picture since the CDC at the DUT is a Chiropractic teaching clinic.

The second most common clinical diagnosis was acceleration-deceleration injury and the most frequent radiological finding found in these individuals was a loss of lordosis (**Table 4.1**). In an acceleration-deceleration or hyper flexion-hyper-extension

injury the C5-7 vertebrae are over stressed and as a result can cause a thoraco-cervical myospasm due to a neuromuscular spinal reflex that occurs in response to damage to pain sensitive structures in the region (Opper, 1999). This also explains the presence of hypertonic cervical musculature and the presence of a flexion injury in 40% and 60% respectively of acceleration-deceleration diagnoses (**Table 4.1** and **Table 4.2**). Cervical radiculopathy presented in four out of the 73 patients in this study and of these, three patients had spondylosis and one patient had a spinal curve disturbance on their plain film radiographs (**Table 4.1**). Radiculopathy is very poorly visualized on plain film radiographs and is commonly present with only degenerative changes that may or may not cause a radiculopathy, especially in instances where osteophytes compress the spinal nerve roots exiting the inter-vertebral foramina (Rao *et al.*, 2007). A MRI scan would be needed to better assess the stage and extent of nerve root compression and is needed to diagnose this condition (Olivero and Dulebohn, 2002) but nowhere in the clinical records of these patients was it recorded that they were referred for a MRI. This may be due to the fact that MRI's are very expensive and many of the patients visiting the CDC at the DUT do not have medical aid. This may also be a result of students diagnosing a radiculopathy from plain film radiographs which research has shown to be impossible (Olivero and Dulebohn, 2002).

In patients that presented with a pre-radiographic clinical diagnosis of thoracic outlet syndrome at 4.1%, the most frequent primary radiological diagnosis was loss of lordosis (66.6%) and old cervical trauma (33.3%) (**Table 4.1**). This correlates to findings by Demondion *et al.* (2006) where they found TOS to be related to whiplash injuries and poor postures.

Only one patient had a pre-radiographic primary clinical diagnosis of "intervertebral disk herniation" and the main radiological finding in this case was a loss of lordosis which is not specific to the diagnosis (**Table 4.1**). It is impossible to visualize an intervertebral disk on a plain film radiograph (Yocum and Rowe, 2005) and therefore it is not possible to definitively diagnose a patient clinically with an intervertebral disk herniation without the use of a MRI (Olivero and Dulebohn, 2002). It would have been indicated to refer this patient for a MRI scan which better visualises soft tissue structures; there was however no record of such a referral in the clinical records. It is

not known if this patient was referred for a MRI prior to their initial visit to the CDC at the DUT and may have mentioned a diagnosis given to them by a specialist that they consulted.

For the less frequent pre-radiographic clinical diagnoses the results revealed that patients were sent for plain film radiography with diagnoses such as mechanical neck pain, ulnar nerve neuritis, headaches, rotator cuff dysfunction, supraspinatus tendonitis and torticollis. Most of these clinical diagnoses do not require referral for plain film radiographic examination since most of them are of a non-specific mechanical nature and can be diagnosed clinically or orthopaedically (Ferrari and Russell, 2003; Murphy and Freeman, 2004; Yocum and Rowe, 2005). In cases where a torticollis was present the main radiological finding was loss of lordosis; thus, it may have been ordered to monitor the progression of it (Yocum and Row, 2005). With instances where ligamentous or tendon damage or pathology were suspected, diagnostic ultra-sound may be better for visualization of these structures as soft tissue structures are poorly visualized on plain film radiographs (Yocum and Rowe, 2005); however, there was no record of such a referral in the clinical records.

It is interesting to note that one patient's plain film radiograph was normal and the pre-radiographic clinical diagnosis was "cervical facet syndrome" (**Table 4.1**). The reason for plain film radiographic referral for this patient was "neck pain with radicular symptoms" (**Table 4.3**) which is a valid reason for plain film radiographic referral (Bussieres *et al*., 2008). The student may have used cervical facet syndrome as a diagnosis of convenience, especially since the presence of radicular symptoms suggest a radiculopathy. The patient's lateral and oblique plain film radiograph may have been normal due to the fact that the cause of radiculopathy may have been due to compression as a result of intervertebral disk bulge or herniation which one won't be able to visualize on plain film radiographs and a MRI would be indicated (Olivero and Dulebohn, 2002).

The most prominent radiological findings in most of the plain film radiographs studied were the presence of spondylosis and loss of lordosis which have been associated with facet joint pain, loss of lordosis and myofascial pain but many of these

radiological findings are clinically silent and are a common finding in the asymptomatic population (Rao *et al.*, 2007). In 4.1% of initial clinical diagnoses, no pre-radiographic primary clinical diagnoses were given and were pending the results of the plain film radiographs (**Table 4.1**). These patients presented with valid reasons for plain film radiographic referral ranging from positive orthopaedic tests (33.3%) and neck pain with radicular symptoms (33.3%) to DMR abnormalities (33.3%) (Bussieres *et al*., 2008) (**Table 4.3**). Radiological findings in these patients revealed spondylosis (66.6%) and loss of lordosis (33.3%) which is mechanical in nature (**Table 4.1**). Students report to experienced clinicians, one may wonder why the student was allowed to record no pre-radiographic clinical diagnosis.

In summary, even though the diagnostic categories were different between the pre-radiographic clinical diagnosis and the primary and secondary radiological diagnosis, there was still a correlation with respect to common radiological findings present in certain pre-radiographic clinical diagnoses which also correlates to findings in literature. There were some pre-radiographic clinical diagnoses that suggested non-specific mechanical conditions but were still referred for plain film radiography with valid reasons for plain film radiographic referral. This may point out the variable reliability of orthopaedic tests conducted during the clinical examination especially in patients with yellow flags that tend to exaggerate the extent of their pain and related symptoms. In patients where no pre-radiographic primary clinical diagnoses were recorded their plain film radiographs revealed non-specific findings of spondylosis and loss of lordosis. This may highlight the low sensitivity of plain film radiographs in early stages of soft tissue pathologies and trauma or it may have been a non-specific mechanical condition from the start but misinterpreted as a red flag condition.

5.4 THE CONSULTATION WHEN A CERVICAL SPINE PLAIN FILM RADIOGRAPH WAS REQUESTED AND THE REASONS THEREFORE

Evidence based practise suggests that the clinical decision to send a patient for special investigations should only be made when the best evidence is obtained and that it is indicated to do so (McKibbon, 1998; Bussières, 2008; Thiruganasambandamoorthy *et al*., 2015). Diagnostic imaging practice guidelines set

forth by Ferrari and Russell (2003), Yocum and Rowe (2005), Bussières *et al.* (2008) and the CDC's guidelines at the DUT suggest that the primary role of diagnostic plain film radiographs is to confirm or reject any clinical impression after a thorough patient history and physical examination to identify red flags (Clinic Manual, 2013). It is also of the utmost importance that the benefit of exposure outweighs the risk since unnecessary exposure to radiation needs to be avoided (Wyatt and Lawrence, 2004; Herbst and Fick, 2012).

Table 4.3 depicts the consultation and reasoning for cervical spine plain film radiographic referral as recorded in the referral letter by the student. Reasons that were not considered relevant indications for plain film radiographic referral were present in 46.2% of cases and described non-specific mechanical factors of concern (**Table 4.3**). Research has shown plain film radiographs to have little diagnostic yield in neck pain without red flags present or a non-specific mechanical cause (Bussieres *et al*., 2008). The results revealed that a total of 64.4% of cervical spine plain film radiographs were performed after the initial clinical consultation (**Table 4.3**). These results are similar to results from a study conducted in the Netherlands that revealed a rate of plain film radiographic referral in 80% of patients that visit a Chiropractor as part of their initial examination (Ernst, 1998). Even though the percentage in the Netherlands were a lot higher, both of these results were in the higher spectrum of plain film radiographic referral and the difference may be attributed to sample size and conditions seen that may vary.

Research has shown that some Chiropractors in practice tend to over utilize plain film radiographs with most referrals occurring after the initial patient consultation, especially and not adhering to research based guidelines (Wyatt and Lawrence, 2004; Bussieres *et al*., 2014), which is the case at the CDC at DUT as well. At the CDC at the DUT the student reports to the clinician on duty in every phase of patient examination and they will ultimately sign and approve the referral letter if they think it is indicated to do so. The clinicians only advise on findings reported by the student thus if these clinical findings are incorrect then there is no way for the clinician to know any different (Clinic Manual, 2013).

The most common reason for plain film radiographic referral overall was due to orthopaedic tests that were positive during the clinical assessment at 57.5% (*n=42*) (**Table 4.3 and Table 4.4**).This figure was especially high in the initial clinical consultation at 35.6% (*n=26*) and was also the main reason for plain film radiographic referral seen in visit number six at 54.5% (*n=3*) (**Table 4.3 and Table 4.4**). A positive orthopaedic test is considered a red flag and it may reveal contra-indications to conservative therapy used, especially SMT (Ferrari and Russell, 2003; Bussieres *et al*., 2008). Literature has shown that orthopaedic tests are very non-specific and have a variable reliability when trying to establish a diagnosis due to the fact that patients with serious pathology may present with minimal regionalised pain on the one hand and on the other hand patients with non-specific mechanical cause for chronic neck pain may exaggerate the pain felt during these tests (Bogduk, 1995; Nordin *et al*., 2008).

The Students may have interpreted the latter as being a true positive result for orthopaedic testing, i.e. the patient's response to pain, but this may in fact be a false positive finding. More clinical experience assists an examiner to determine the difference between true positive and false positive findings. Thus a patient with positive orthopaedic tests is not a sufficient reason for plain film radiographic referral on its own, but when it is in conjunction with other red flags suggestive of pathology or instability then plain radiographic referral is recommended (Nordin *et al*., 2008).

The second most common reason for plain film radiographic referral seen in 35.6% (*n=26*) of cases was neck pain with associated radicular symptoms (**Table 4.3 and Table 4.4**). Plain film radiographs are indicated even though disk lesions cannot be visualized on plain film radiographs. Literature has shown that prominent causes of radicular symptoms are caused by hypertrophy of facet joints or uncinate processes and lateral canal stenosis which one may visualize with plain film radiographs (Bussieres *et al*., 2008). The third most common reason for plain film radiographic referral was past history of MVA or neck trauma with myofascial symptoms seen in 32.9% (*n=24*) (**Table 4.3 and Table 4.4**). Literature has shown that plain film radiographs have little diagnostic yield in cases where there is an absence of red flags and the patient presents with a negative CCSR or NEXUS questionnaire following MVA or trauma (Ferrari and Russell, 2003; Bussieres *et al*., 2008).

Most neck pain cases are not due to an underlying pathology especially when they present with headaches, history of smoking, and history of whiplash (Ferrari and Russell, 2003). The same applies to other mechanical non-specific reasons for referral provided; neck pain associated with myofascial symptoms, recent MVA with associated myofascial symptoms, Cervicogenic headaches, nausea with cervical extension and rotation, headache constant throbbing of five year duration, cervical crepitus with chronic sub occipital cervicogenic headaches, neck pain with associated headache, past history of MVA or neck trauma with associated headache, fibromyalgia, patient on hormone replacement therapy (HRT), decreased cervical ROM and smoker for ten or more years (**Table 4.3 and Table 4.4**).

The significance of postural deformity and spinal curve disturbance in neck patients as the pain generator remains controversial since literature has shown the presence of these conditions in asymptomatic individuals; however it is clear that it is not considered a red flag unless it is a progressive manifestation (Bussieres *et al*., 2008). As a result the reasons that were provided (such as postural abnormality (*n=1*) (**Table 4.3 and Table 4.4**), were not sufficient for plain film radiographic referral unless combined with a progressive disorder with additional red flags associated with pathology (Bussieres *et al*., 2008). In patients with chronic neck pain, plain film radiographs are not routinely recommended if there is an absence of red flags or arm pain (Yochum and Rowe, 2005; Bussieres *et al*., 2008). For this reason "Constant neck pain for two or more weeks" (n=16) is not a sufficient reason for referral (**Table 4.3 and Table 4.4**). A patient not responding to conservative treatment for four or more weeks and worsening is indicative for plain film radiographic referral to rule out underlying pathology (Bussieres *et al*., 2008). It is not known if the reason "No/ little relief of pain after three or more treatments" involved treatment over a 4 week period but if it did then plain film radiographic referral is indicated as opposed to less than 4 weeks in which case it would not be (**Table 4.3 and Table 4.4**). It is interesting to note that reasons such as positive orthopaedic tests, neck pain with radicular symptoms and DMR abnormalities were provided in visits following the initial consultation (**Table 4.3**). Most of these features are investigated during the initial examination thus one may wonder why this was not

detected during the initial visit. This may be due to progression of symptoms which is why they were sent for plain film radiographs at a later stage.

Studies has shown that it is reasonable to refer for plain film radiographs in neck pain with associated red flags since there may be an underlying pathology present in these individuals (Ferrari and Russell, 2003; Yochum and Rowe, 2005; Bussieres *et al*., 2008). Some red flag reasons for plain film radiographic referral found in this study were neck pain with ominous symptoms (*n=1*), family history of tumours (*n=1*), history of recent malignancy (*n=1*), past history of MVA or neck trauma associated with ominous symptoms (*n=1*), DMR abnormalities (*n=9*), and numbness in arms for more than three or more months (*n=1*) (**Table 4.3 and Table 4.4**). Plain film radiographs are recommended in patients with acute neck injury and positive CCSR for radiography in alert and stable trauma patients thus the reason “recent MVA with associated ominous symptoms” (*n=10*) is indicated for plain film radiography (**Table 4.3 and Table 4.4**).

Plain film radiographic referral is indicated to monitor spinal structural changes as a result of inflammatory conditions such as rheumatoid arthritis (RA) (which may be contra-indicated in SMT) thus patients with a history of RA (*n=1*) are indicated for plain film radiographic referral (**Table 4.3 and Table 4.4**). Patients with previous cervical spinal plain film radiographs with evidence of spondylotic changes are not a sufficient reason for re-evaluation since there is a poor relationship between spondylotic changes seen on cervical spinal plain film radiographs and neck pain (Bussieres *et al*., 2008; Clarke *et al*., 2011), Thus, the reason *“*Previous cervical spine plain film radiographs showing advanced disc narrowing” (*n=1*) is not a sufficient reason for radiographic referral (**Table 4.3 and Table 4.4**). Even though a “history of hypertension” is a red flag it is not a sufficient reason on its own for plain film radiographic referral since the cardio-vascular changes that it may produce are poorly visualized on plain film radiographs (Ferrari and Russell, 2003) (**Table 4.3 and Table 4.4**).

In summary, most of the patients were sent for plain film radiographs after the initial visit. Some of the reasons for plain film radiographic referral seen in follow up visits

would have been detected after a thorough initial examination thus one may only speculate whether the symptoms developed or worsened over time or the reason may have been that the student did not conduct a thorough enough initial clinical examination. 46.2% of reasons for plain film radiographic referral were not considered appropriate reasons for referral and were suggestive of a mechanical diagnosis. This may highlight students not adhering to or being aware of the evidence based guidelines for plain film radiographic referral.

5.5 SUSPECTED CLINICAL DIAGNOSES AND MANAGEMENT PRIOR TO REFERRAL FOR CERVICAL SPINE PLAIN FILM RADIOGRAPHS

At the CDC at the DUT the student has access to a variety of treatment modalities in the treatment of their patients. The most frequent modality utilised was soft tissue therapy (STT) followed by stretching and spinal manipulative therapy (SMT) respectively (**Figure 4.2**). These results are in contrast to findings by Carlesso *et al.,* (2014) where they studied modality usage preferences amongst Chiropractors of neck pain management in a cross-sectional international survey in 19 countries. Their results revealed that manual and exercise therapy was the core of chiropractic neck treatment followed by thermal application and dry needling. The preference to utilize soft tissue therapy by the students at the CDC prior to plain film radiographic referral may be due to them being cautious and employing a more conservative approach. Cervical facet syndrome was the only condition where all of the modalities available to the students were utilized with the exception of cervical traction (**Table 4.4**). This observation may show that whenever a patient presents with non-specific neck pain there may be a tendency to diagnose it as a facet syndrome and make use of a multitude of therapeutic modalities. Thus one may ask why a specific diagnosis is needed when it is treated in a non-specific manner. Literature has shown spinal manipulative therapy to be the most effective conservative treatment when treating a facet syndrome (Tsakitzidis *et al*., 2013). This may cause the researcher to question whether or not the students were employing a diagnosis specific management strategy as opposed to utilizing as many modalities as possible in a non-specific manner with the hope that the patient will get better. No treatment was given in 5.5% of cases in pre-radiographic clinical diagnoses; cervical facet

syndrome (2.7%), thoracic outlet syndrome (1.4%) and where “no primary diagnosis” was recorded. These pre-radiographic clinical diagnoses are all non-specific mechanical causes and do not contraindicate conservative therapy (Bussieres *et al*., 2008). It is interesting to note that in cases where there was a pre-radiographic clinical diagnosis of “no primary diagnosis”, two patients received conservative therapy ranging from electro modalities to soft tissue therapy (**Table 4.5**). The student may have employed these modalities to provide some relief of pain as opposed to treating for a specific condition until they receive the plain film radiographic results. It is interesting to note that a total of 25 patients (34.2%) received spinal manipulative therapy as a pre-radiographic treatment (**Table 4.5**). Many contra-indications exist for SMT due to the fact that a high velocity low amplitude force is applied to a spinal segment (Bussieres *et al*., 2008); thus, one may question why these patients were sent for plain film radiographs if they felt that the SMT was not contra-indicated.

In summary, the pre-radiographic treatments ranged primarily from soft tissue therapy to stretches and SMT. The utilization of soft tissue therapy, stretches, heat and ice and dry needling may highlight students being over cautious to cause injury. SMT was utilized in 25 patients as a pre-radiographic treatment and one may question why these patients were sent for plain film radiographs since they were treated for a mechanical condition and the student did not feel that SMT was contra-indicated in those patients. Five patients received no treatment but were given mechanical non-specific diagnoses and cases where no pre-clinical diagnoses which do not preclude conservative therapy were given received soft tissue therapy and electro modalities.

5.6 INCIDENTAL RADIOLOGICAL FINDINGS

The total incidental findings were 58.9% (*n=43*) (**Table 4.7**). Results from a similar Chiropractic teaching clinic revealed a total of 28.5% incidental findings were discovered out of the 2814 cervical plain film radiographs that they studied (Jenkins *et al.,* 2010). The study conducted by Jenkins *et al*., (2010) screened the cervical plain film radiographs of their study group for incidental findings that may have been contra-indicated to SMT whereas in this study the researcher recorded all incidental

findings regardless of its significance in patient management. This may explain why the total incidental findings in this study were almost double the results found by Jenkins *et al*., (2010). Also the mean age of patients seen with neck pain at the CDC at the DUT had a higher mean age as compared to the study done by Jenkins *et al*., (2010) and an increase in age have been associated with more incidental findings (Opper, 1999; Rhee and Riew, 2005).

The most common post-radiographic clinical diagnosis associated with incidental findings was cervical facet syndrome at 48.8% (*n=21*) followed by whiplash injury at 11.6% (*n=5*) and cervical radiculopathy at 7.0% (*n=3*) (**Table 4.7**). Most incidental findings such as congenital anomalies are clinically silent and may not be the cause of pain (Rhee and Riew, 2005). In a study conducted by Koren *et al*., (2013) where they evaluated 356 cervical spine plain film radiographs of whiplash patients, it revealed a total of 8.1% incidental findings. The results by Koren *et al*., (2013) may have been a lot lower due to the fact that they screened their cervical spine plain film radiographs for clinically significant incidental findings in patients with whiplash injury whereas the researcher in this study recorded all incidental findings without any preference to clinical significance.

The most common incidental finding in this study was posterior ponticles at 25.6% (*n=11*) followed by calcified hyoid cartilage at 14.0% (*n=6*) and calcified carotid artery, cervical ribs and elongated transverse processes all at 9.3% (*n=4*) (**Table 4.7**). These results were consistent with a study conducted by Jenkins et al. (2010) where they found that 21.3% of their study group had posterior ponticles and 5.1% cervical ribs. Of the 11 patients in the current study with posterior pontcles, a total of seven received SMT and out of the four patients with cervical ribs, two received SMT as a post-radiographic treatment (**Table 4.7**). Jenkins *et al*., (2010) stated that posterior ponticles and cervical ribs are a contra-indication to SMT. Beck et al. (2004) also described it as a contra-indication to SMT and felt it may alter chiropractic intervention strategies, but these are not included in the World Health Organization (2012) list of contra-indications to SMT. The posterior ponticle may only be contra-indicated in SMT of the upper cervical segments but it is not known if patients that received SMT with a posterior ponticle received SMT to the upper segments. This is a limitation of this study since it was impossible for the researcher acquire this information.

Patients with an abnormal first rib (*n=1*), cervical ribs (*n=4*) and elongated transverse processes of C7 (**Table 4.7**) may cause thoracic outlet syndrome (Demondion *et al*., 2006) but no pre or post-radiographic clinical diagnoses reflected a thoracic outlet syndrome. In patients with occipitalization of the C1 vertebrae, non-specific post-radiographic clinical diagnoses was provided and in one patient SMT was applied as a post- radiographic treatment (**Table 4.7**). Occipitalization of the C1 vertebrae is contra-indicated in SMT (World Health Organization, 2012) but this was still applied in this patient. The student may have missed this incidental finding or may have picked it up but did not consider it as a contra-indication. The researcher did not record the specific level at which SMT was applied so it's not known if a lower spinal level was treated (in which case it would not have been contra-indicated) or if the upper cervical spinal levels received SMT (in which case it would have been contra-indicated to SMT) (World Health Organization, 2012).

The one patient that was diagnosed radiologically with a tilted odontoid peg revealed a pre-radiographic clinical diagnosis of cervical facet syndrome and a post-radiographic clinical diagnosis that did not change (**Table 4.7**). This patient also received SMT even though this condition is considered a contra-indication to SMT due to the close proximity of the spinal cord to the odontoid peg (Beck *et al*., 2004; Jenkins *et al*, 2010; World Health Organization, 2012). It is a policy of the CDC at the DUT to always "diagnose" or "record" significant radiological findings in the SOAPE note but this was not done in this case and it's not known if this incidental finding was missed or just not recorded in the SOAPE note. The researcher did not record the specific cervical spinal level and the vector of SMT thus it's not known whether the application of SMT in this case was contra-indicated or not.

One patient presented with a calcified intervertebral disk and the pre-radiographic clinical diagnosis was mechanical neck pain with no change in diagnosis after plain film radiographs were performed (**Table 4.7**). Calcified intervertebral disks are very rare and usually occur in paediatric patients but may persist to well into early adulthood especially when associated with sequestration of the nucleus pulposis which may cause radiculopathy or myelopathy (Park *et al*., 2005). The pre-radiographic clinical diagnosis was mechanical neck pain with no change after plain film radiographs (**Table 4.7**). There was also no evidence in the patient's file of any sinister signs or symptoms that may suggest a systemic pathology as seen with

hyperparathyroidism as a cause for the calcification (Park *et al*., 2005). The student may not have considered it as a significant finding thus did not reflect the possibility of a pathological cause in the post-radiographic clinical diagnoses.

In summary, 58.9% (*n=43*) of the 73 cervical spine plain film radiographs showed incidental findings. The most common pre-radiographic clinical diagnosis with incidental radiographic findings present was cervical facet syndrome but the incidental findings in these were considered to be clinically silent in most cases. The most common incidental finding was a posterior ponticle (25.6%), followed by calcified hyoid cartilage (14.0%), calcified carotid artery, cervical ribs and elongated transverse process all at 9.3%. Elongated transverse processes and cervical ribs have been shown to cause thoracic outlet syndrome but this was not reflected in the pre-radiographic clinical diagnoses. A posterior ponticle, cervical ribs and occipitalization of C1 vertebrae are considered contra-indication to SMT but still SMT was utilized in some instances. The researcher did not record the specific spinal levels and vector that was applied in these cases thus it's not known if SMT was contra-indicated in these instances.

5.7 CHANGES IN CLINICAL DIAGNOSIS AND MANAGEMENT AFTER PLAIN FILM RADIOGRAPHS

A total of 27.4% (*n=26*) of clinical records reviewed had a change in their initial clinical diagnosis and 72.6% (*n=53*) of patients had no change in diagnosis (**Figure 4.3**). All the pre-radiographic clinical diagnoses were of a non-specific mechanical nature with the exception of ulnar nerve neuritis (**Table 4.6**). This may explain why the majority of post-radiographic diagnoses did not change. Literature has shown that plain film radiographs have little diagnostic value in non-specific mechanical neck pain without red flags (Bussieres *et al*., 2008). The 27.4% post-radiographic diagnoses that changed were also of a non-specific mechanical nature (**Table 4.6**). This may highlight that students at the CDC at the DUT may not adhere to evidence based guidelines for plain film radiographic referral since literature has shown similar findings in cases were these guidelines were not followed (Ferrari and Russell, 2003; Yocum and Rowe, 2005; Bussieres *et al*., 2008; Clarke *et al*., 2011).

The most frequent primary plain film radiographic diagnoses were loss of lordosis (41.2%) and spondylosis (35.6%) (**Table 4.1**). The most frequent secondary radiographic diagnoses ranged from old cervical spinal trauma and spondylosis (both *n=20*) to loss of lordosis (*n=19*) and evidence of hypertonic muscles (*n=18*) (Table 4.2). Literature has shown there to be a poor correlation between degenerative changes seen on plain film radiographs and neck pain (Bussieres *et al*., 2008). Ferrari and Russell (2003) stated that it is irresponsible to attribute the spondylosis found to be the cause of neck pain. Non-specific mechanical causes of neck pain are primarily associated with whiplash related cervical spinal injury in acute cases and cervical spinal degenerative changes in chronic cases (Friedenberg and Miller, 1963; Opper, 1999; Rao, 2002). This may explain the high frequency of primary and secondary radiological diagnoses such as old cervical spinal trauma since it may be a direct result of old whiplash injury (Rao, 2002).

Loss of lordosis and evidence of hypertonic muscles may be a direct result of whiplash injury or as an indirect result of irritation caused by spondylitic changes in structures such as the facet joint capsule (Rao *et al*., 2007). There was only one patient diagnosed with spinal stenosis (**Table 4.2**) but this was not reflected in the

post-radiological diagnosis (**Table 4.6**) and this patient was not referred for appropriate special investigations such as a MRI (**Figure 2.2**). Findings of osteoporosis did not affect any of the post-radiographic clinical diagnoses (**Table 4.6**) and a conservative approach was followed with utilization of mobilization, stretches and soft tissue therapy (STT) (**Table 4.7**). Literature has shown that osteoporosis is important to take note of especially in conservative therapy such as spinal manipulative therapy but plain film radiographs do not adequately yield the degree of pathology thus a bone density scan is more appropriate (Yocum and Rowe, 2005).

A change of treatment occurred in 77% of cases after plain film radiographs were performed (**Figure 4.4**). There was a general increase in the usage of all modalities after plain film radiographs were performed (**Figure 4.5**) with spinal manipulative therapy as the modality most frequently added after plain film radiographs (41.1%) followed by stretching (17.8%) and soft tissue therapy (12.3%) (**Figure 4.5**).

Spinal manipulative therapy utilized by the Chiropractor may cause unwanted injury to the region receiving treatment if an underlying pathology was present thus explaining the higher utilization of plain film radiography as compared to other health care providers (Peterson and Hsu, 2004). The increased utilization of spinal manipulative therapy after plain film radiographs were performed may indicate students at the CDC to be over cautious about causing damage even though they are supervised by the clinician on duty (**Figure 4.5**). The increase in soft tissue therapy and stretching may be modalities used in conjunction with SMT to achieve the fastest pain relief possible since literature has shown all three to be effective treatment options for non-specific mechanical neck pain (Tsakitzidis *et al*., 2013).

In summary, the majority of pre-radiographic diagnoses did not change after plain film radiographs were performed and of those that changed, these reflected non-specific mechanical diagnoses. This may be attributed to the fact that all the pre-radiographic clinical diagnoses were of non-specific mechanical nature with the exception of ulnar nerve neuritis. SMT was the most frequent modality added after plain film radiographs and there was a general increase in all treatment modalities after plain film radiographs were performed.

CHAPTER 6 : CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Of the 73 clinical records that were evaluated, 64.4% (*n=47*) were sent for cervical spine plain film radiographs after their initial clinical consultation. The referral rate progressively decreased to 1.4% (*n=1*) at visit number 16. The majority of the pre-radiographic clinical diagnoses were of a non-specific mechanical nature with the most common being cervical facet syndrome in 57.5% (*n=42*) of cases. The radiological findings had little impact on pre-radiographic clinical diagnoses with 72.6% (*n=53*) showing no change; the remaining 27.4% (*n=20*) post-radiographic clinical diagnoses showed a non-specific mechanical diagnosis. Research has shown plain film radiographs to have little diagnostic value in non-specific mechanical neck pain without red flags and may highlight that students at the CDC at the DUT may over rely on the diagnostic value of plain film radiography. Reasons that are not considered relevant indications for plain film radiographic referral were present in 46.2% (*n=34*) of cases; these described non-specific mechanical disorders. This may indicate that evidence based guidelines for plain film radiographic referral are not always adhered to in patients that present with neck pain to the CDC at the DUT. It was however found that in 53.8% (*n=39*) of cases, plain film radiographic referral included legitimate red flags indicated by evidence based guidelines even though the majority of the pre-radiographic clinical diagnoses were non-specific mechanical conditions. This may indicate that students may have misinterpreted mechanical signs and symptoms found during the clinical examination as red flags. Alternatively there may have been red flags present that the student failed to investigate radiologically but did not reflect this in the pre-radiographic clinical diagnosis. It was shown that soft tissue therapy was most commonly used as a pre-radiographic treatment in 63.0% (*n=46*) of cases and spinal manipulative therapy increased from 34.2% (*n=25*) to 75.3% (*n=55*) after plain film radiographs were performed. This highlights that the students at the CDC are cautious to cause

injury and feel more comfortable to employ manual therapy, especially with spinal manipulative therapy after radiological results deem it safe to do so. Some authors also stated that Chiropractors may over utilize plain film radiographs due to caution regarding causation of injury (Bussieres *et al*, 2008). The most common incidental finding was a posterior ponticle at 25.6% (*n=11*) and students correctly excluded spinal manipulative therapy from all the incidental finding cases which were contra-indicated to spinal manipulative therapy. The exception was in the case of posterior ponticle and cervical rib cases, in which 63.6% of the patients with a posterior ponticle and 50% of patients with a cervical rib continued to be manipulated. These incidental findings have been described by some authors as being contra-indicated to spinal manipulative therapy (Jenkins *et al*., 2010). The researcher did not record the specific spinal segment receiving SMT and also the vectors that were applied, thus it may have been contra-indicated if the student employed SMT to a spinal segment in close proximity to the incidental finding with a rotational vector but it's not known if this was the case in these instances. Plain film radiographs are primarily used to exclude pathology or trauma but the results of this study revealed

Thus it has been shown that cervical spine plain film radiographs have little impact in the diagnosis of patients with non-specific mechanical neck pain without the presence of red flags at the CDC at the DUT. Plain film radiographs had an impact on the management in majority of cases, and it was shown that SMT was employed more commonly after radiological results deem it safe to do so. However, it is important to adhere to research based guidelines when referring patients for plain film radiography. Not all these patients required plain film radiography to deem it safe to employ SMT and a thorough clinical examination would have been sufficient to do so.

6.2 RECOMMENDATIONS

The following recommendations are proposed for the CDC based on the results of this study:

- Over reliance of mechanical non-specific clinical diagnoses needs to be avoided (such as cervical facet syndrome) and only used if the results from the clinical examination warrant it.

- Cases in which no pre-radiographic clinical diagnosis was recorded with a reason; “pending the radiological results”, need to be avoided. Clinicians on duty need to encourage students to at least write a suspected or differential pre-radiographic clinical diagnosis.
- Adherence of research based guidelines and clinic manual guidelines for plain film radiographic referral at the CDC needs to be monitored more effectively since adherence to these guidelines have been shown to reduce unnecessary exposure (Bussieres *et al*., 2008). In particular those that pertain to non-specific mechanical neck pain and whiplash injuries since these cases are the most commonly seen at the CDC. The CCSR or NEXUS criteria for low risk cervical spinal trauma need to be implemented since research has shown that adherence reduces unnecessary plain film radiographic referral (Bussieres *et al*., 2008). These guidelines will be made available to the clinic directors after this research is completed and the researcher will present to them the results of this study and the potential benefit of implementing these at the CDC at the DUT. Students need to be encouraged to only write relevant red flag signs and symptoms that were detected during the full patient history and clinical examination on the plain film radiographic request form and reasons such as decreased range of motion, postural abnormality are not sufficient reasons for referral. Previous plain film radiographs showing spondylosis should not be included since these are not proper indications for plain film radiographic referral. Furthermore, students’ need to be made aware of the limited diagnostic value of plain film radiography in cases where red flags are not present, early stages of pathology and minor trauma.
- Incidental findings on plain film radiographs that may have a clinical significance or that may contra-indicate certain treatment modalities must always be recorded on the SOAPE note.
- The CDC at the DUT need to ensure that more attention is paid to incidental findings on the patients plain film radiographs that may be contra-indication to conservative modalities, especially spinal manipulative therapy.
- Clinicians need to challenge the students on their choice and reasoning of proposed treatment for each patient for both pre- and post-radiographic clinical diagnoses and the clinician needs to make sure treatment is in line

with evidence based practice recommendations for future studies include the following:

- Conducting similar research in a South African private practice setting as to compare results from this study and international studies.
- Conducting this study at the University of Johannesburg chiropractic clinic and comparing results.
- The specific cervical spinal levels and vector of SMT that was applied as a post-radiographic treatment must be recorded when conducting a similar study. This is important since certain incidental findings found radiographically are only contra-indicated in patients where SMT were applied to cervical spinal segments in close proximity to the incidental finding and/or a rotational force applied.

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APPENDICES

<u>Appendix A</u>: **Patient details coding list**

Patient name	Date of birth	File number	Code

Appendix B: Data sheet

Patient Information from patient file

Code		
Age		
Gender	**Male**	**Female**

Patient's Initial Clinical Consultation from patient file

Date							
Clinical Diagnosis							
Treatment	**SMT**	**Dry Needling**	**Stretching**	**Electro-Modalities**	**Soft Tissue Therapy**	**Refer**	**Other (specify)**
Reason for Radiographic Referral							
Number of treatments before referral for plain film radiographs							

Radiologist Report/ Radiograph

Date radiograph Performed		
Researchers Diagnosis		
Radiologist Diagnosis		
Incidental Findings	**Yes**	
	No	

Appendix C: Permission form from clinic director to access clinical records

16

Appendix C:

RE: Permission to go through the patient files at the DUT chiropractic day clinic

The information needed from the patient files:

- The number of patients that presented to the clinic with neck pain(Stefan) and upper back pain (Henri) (period yet to be determined since we need to determine the availability of those files)
- Clinical diagnosis and management of the patients with neck (Stefan) and upper back pain (Henri) by the intern/clinician prior to x-ray referral
- To view motivation by intern/ clinician to send patient for those x-rays
- The x-rays of relevant neck and thoracic spine regions that was performed
- Diagnosis of the radiologist of relevant x-rays
- Soap notes
- The incidental findings that was reported
- The clinical diagnosis and management after x-rays was noted

Reason for the need of this information

We need the information since we are in process of completing our PG-1 document and we are interested to do a retrospective study on:

"The role of cervical x-rays (Stefan) and thoracic x-rays (Henri) on the diagnosis and management of patients that presented with neck pain and upper back pain respectively"

We need to be sure that the necessary information are available in the patient files before we submit our PG-1 since if it's not then will jeopardize our research at a later stage in the research process.

Declaration

We, **Stefan Eloff** (21009716) and **Henri Myburgh** (21020470) hereby declare that we will keep the information in the patient files confidential and we will only use the information that is relevant to our investigation.

Stefan Eloff [redacted]

Henri Myburgh [redacted]

Head of department

Dr. A. Docrat .....

Clinic Directors:

Dr. D. Varatharajullu [redacted]

Dr. C. Korporaal [redacted]

Appendix D: Indemnity form where it states that the clinical info may be used for research

Medical Aid schemes pay in varying degrees for coverage of Chiropractic Services. This coverage is therefore medical aid dependant and we request that you check with your medical aid in this respect. **The DUT Chiropractic Day Clinic is contracted out of medical aid**, which means that we run on a **strictly cash only basis**, whereby you are requested to pay cash in advance of services rendered. You will be sent a monthly statement which you must submit to your medical aid for them to refund you directly. This statement will be sent out at the **end of each month.**

Charges are **not** applicable to **research patients**

Medico-Legal Reports:
As the Chiropractic Day Clinic is a teaching facility we are not in a position to generate any reports required for medico-legal purposes, claims that relate to injury on duty (IOD) or workman's compensation

Report of findings:
It is imperative that the student treating you explains fully your diagnosed condition, both as an educational requirement for the student but also, **and more importantly**, such that you are able to make an informed decision about the type of treatment that you wish to receive.

Treatment options:
It is imperative that the student explains all treatment options that are available for you based on the diagnosed condition/(s) that was/were given to you in respect of the above.

Risks/Benefits:
The student must explain to your satisfaction/understanding all risks and benefits in relation to treatment of your reported diagnosis/condition(s).

As a Patient at this, the Chiropractic Day Clinic, I understand that I am attending an educational facility and I give my permission to allow observation, and if necessary the video recording of supervised examination and treatment by Doctors of Chiropractic and Students. In addition I, as the patient note, that information generated through my attendance of the clinic, may be used for research purposes (either through my direct participation in the research or alternatively through data collected in my patient file).

By signing this form I agree that

a) I understand and take full financial responsibility for consultations.
b) I understand that I cannot request records for medico legal reasons.
c) I understand that should I be on medical aid, that my diagnosis and treatment information will be shared for the purposes of medical aid reimbursing me according to that which I am contractually bound in terms of my medical cover (and that only a written request or instruction from myself will be accepted in terms of discontinuing this practice by my health care provider – the Chiropractic Day Clinic).
d) Should I need to be referred that my medical information (pertinent to my condition) will be shared with the doctor / specialist to whom I have been referred.
e) I understand that with my attendance at the Chiropractic Day Clinic, that my medical information will be discussed between the student responsible for my care and the supervising clinician who is responsible for overall oversight of my care.

Date:		**Patient Signature:**	
Parent/legal guardian signature: (in the case of patient's who are under the age of 12 years and those requiring assistance between the ages of 12-18 years)			
Relationship of guardian to the minor:			
Date:		**Student Signature:**	
Date:		**Clinician Signature:**	

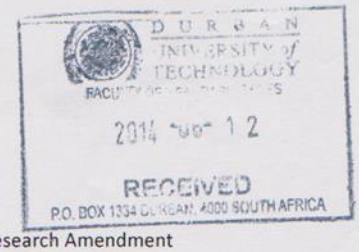
By signing this section of the form I agree that (to be completed after you have been assessed and prior to your treatment / referral):

a) The student has discussed with me to my satisfaction, and I fully understand, my / my minor child's diagnosed condition(s) that I have.
b) The student has discussed with me to my satisfaction, and I fully understand all treatment and/or non treatment options and their relative successes and/or failures as applicable to the diagnosed condition(s).
c) I am making an informed decision with regard to, and will submit to / consent to my minor child being submitted to, the treatment protocol as explained.

Based on the above I therefore give consent for the treatment of my named complaint by signing the form hereunder:

Date:		**Patient Signature:**	
Parent/legal guardian signature: (in the case of patient's who are under the age of 12 years and those requiring assistance between the ages of 12-18 years)			
Relationship of guardian to the minor:			
Date:		**Student Signature:**	
Date:		**Clinician Signature:**	

Appendix E: Permission from Prof. Puckree



Dear Prof Puckree

RE: Louis Stephanus Eloff Research Amendment

I, Louis Stephanus Eloff have recently received full approval for my research topic: **The impact of cervical spine radiographs in the diagnosis and management of patients that presented with neck pain at the Chiropractic Day Clinic at Durban University of Technology (Rec 31/14).**

When data collection was started, it was discovered that the older patient files pre dating the year 2001 in the Chiropractic Day Clinic (CDC) at the Durban University of Technology did not state in their patient consent forms that the clinical information may be used for research purposes and merely stated that they know and understand that the CDC is a teaching clinic and consent to treatment and observation from chiropractic students. The researcher need the clinical information in these patient files to conduct the research and thus requests that you may act as gatekeeper to allow the researcher (Louis Stephanus Eloff) to do so.

Confidentiality of the clinical data used in this research will be ensured by the following means:

- Permission was acquired from the Head of department (Chiropractic) and the CDC clinic directors to access the clinical records needed for the research,
- The Clinical records used in the research will be kept under lock and key and only the researcher, supervisor and co-supervisor will be allowed access to it,
- The patients personal details will be kept confidential as it will be coded with alpha numerical codes to ensure confidentiality,
- The research data collection will be done in a research room in the CDC.

Researcher: [redacted] 12/08/2014

Louis Stephanus Eloff

Supervisor: [redacted] 12/8/2014

Dr. G Harpham

Head of Department Chiropractic: [redacted] 12/8/2014

Dr. A Docrat

Executive Dean: Faculty of Health Sciences: [redacted] 13/8/14

Prof. L Puckree

Appendix F: IREC approval

DUT
DURBAN
UNIVERSITY OF
TECHNOLOGY

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

22 July 2014

IREC Reference Number: **REC 31/14**

Mr L S Eloff
18 Paradise Place
Cowies Hill
Pinetown

Dear Mr Eloff

The impact of cervical spine radiographs in the diagnosis and management of patients that presented with neck pain at the Chiropractic Day Clinic at the Durban University of Technology

I am pleased to inform you that Full Approval has been granted to your proposal REC 31/14.

The Proposal has been allocated the following Ethical Clearance number **IREC 046/14**. Please use this number in all communication with this office.

Approval has been granted for a period of one year, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

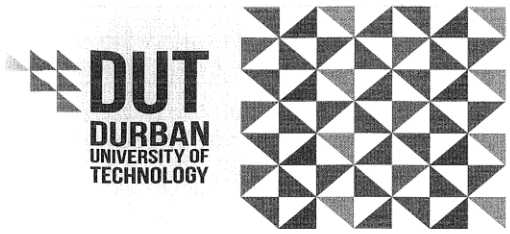
Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Prof J K Adam
Chairperson: IREC

Appendix G: IREC amendment approval



Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

8 September 2014

Mr L S Eloff
18 Paradise Place
Cowies Hill
Pinetown

Dear Mr Eloff

Application for Amendment of Approved Research Proposal

The impact of cervical spine radiographs in the diagnosis and management of patients that presented with neck pain at the Chiropractic Day Clinic at the Durban University of Technology

I am pleased to inform you that your application for amendment to your research proposal has been Approved.

Yours Sincerely

[redacted]

Prof J K Adam
Chairperson: IREC