THE CORRELATION BETWEEN THE SUSPECTED CLINICAL DIAGNOSES AND THE RADIOGRAPHIC DIAGNOSES FOR PATIENTS WITH SHOULDER PAIN

By

Jade Lee Redman

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Durban University of Technology

I, Jade Lee Redman, do declare that this dissertation is representative of my own work in both conception and execution (except where acknowledgements indicate to the contrary)

_____ Date _____

Jade Lee Redman

Approved for Final Submission

_____ Date_____

Dr J. Shaik
M.Tech: Chiro., M.Med.Sci. (SM), MCASA
Supervisor

DEDICATION

I dedicate this dissertation to:

My parents Jimmy and Mandy Redman, my brothers Ryan and Brad, my boyfriend and friends.

Thank you for all your support and guidance throughout this entire process and in everything I do. Thank you for all the opportunities you have given me.

"Every accomplishment starts with the decision to try"
-Gail Devers

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LIST OF DEFINITIONS

Conservative management: A clinician's approach to the treatment of a patient which does not involve surgery (Pandya, 2011).

Plain film radiographs: A traditional type of radiograph in which the image is specifically produced on a plain film (Bontrager and Lampignano, 2010).

Radiograph: An image produced by the action of x-rays on a receptor (Bontrager and Lampignano, 2010). Radiographs can be viewed either on plain film or digitally on a computer (Yochum and Rowe, 2005).

Radiographic diagnosis: The diagnosis stated on the radiographic report from the radiologist.

Radiographic red flags: Features on radiographs which may suggest an ominous underlying pathology or abuse (Mutsaers and Van Dolder, 2008; Jenny, 2011).

Suspected clinical diagnosis: The diagnosis suspected by the student and/or the clinician at the initial consultation (i.e. the suspected clinical impression) which was recorded on the Subjective, Objective, Assessment, Plan and Education (SOAPE) note prior to the ordering of special investigations (e.g. radiographs).

ABSTRACT

Background:

The association between the radiographic and clinical findings of shoulder pain is unclear and it is not fully understood how plain film radiographs of the shoulder influence the suspected clinical diagnosis and conservative management of shoulder pain at the Chiropractic Day Clinic (CDC) at the Durban University of Technology (DUT). Previous research at the CDC reported that plain film radiographs did not significantly influence the suspected clinical diagnosis and conservation management of the lumbar spine and knee conditions. This study was conducted in order to determine if a similar trend was observed for plain film radiographs of the shoulder and the suspected clinical diagnosis and conservative management of shoulder pain.

Objectives:

Objective 1: To determine the association between the suspected clinical diagnosis and radiographic diagnosis of shoulder pain.
Objective 2: To describe the type of incidental radiographic findings in the selected plain film radiographs of the shoulder.
Objective 3: To determine the proportion of change in the suspected clinical diagnosis and the conservative management of shoulder after obtaining the radiographic report.

Method:

The archives of the CDC at the Durban University of Technology were searched for plain film radiographs of the shoulder and corresponding patients' records from 4 April 1992 to 19 September 2011. These were collected, examined and evaluated, and the relevant data was extracted. Statistical analysis included the use of percentages, mean, standard deviation, range and frequency counts for the descriptive objectives. The suspected clinical diagnoses were categorized into groups (trauma, mechanical conditions, muscular or tendon dysfunction, capsular syndromes, neurological conditions, arthritides and other). These were then constructed using two-by-two tables for the absence or presence of radiographic diagnoses versus the suspected clinical diagnosis. The McNemars chi square test was used to determine any association between the radiographic and suspected clinical diagnosis.

Results:

The mean age of the patients whose clinical and plain film radiographic records were examined was 43.5 years, with 53.7% male and 46.3% female patients. It was not possible to find an association between the suspected clinical and radiographic diagnoses as the categories were too different for statistical testing to be done. Thirty one (57.4%) plain film radiographs were requested at the first consultation. In 53.7% (29/54 radiographs) of cases, no specific suspected clinical diagnosis was given and “suspected pathology” was the reason given for referral. Of the 54 patients, 21 had a change in the suspected clinical diagnosis; however, in many of these cases (13/21) it was not a direct result of the radiographic findings. A wide range of treatments were used both before and after plain film radiographs, including soft tissue therapy, manipulation and electrotherapy. There was no significant change in the frequency of use of any of the modalities post-radiographs.

Conclusion:

The reasons provided for ordering plain film radiographs were sometimes vague or even invalid. Although there was a change in 21 of the 54 suspected clinical diagnoses it was not conclusively as a result of the radiographic findings. The management of shoulder complaints did not change appreciatively following plain film radiographs. These findings suggest that the current use of plain film radiographs in the clinical and management context at the CDC needs to be reviewed.

LIST OF SYMBOLS AND ABBREVIATIONS

=:	Results are equal to those of other studies
≈:	Approximately
>:	Greater than
<:	Less than
+:	Positive
/:	Or
&:	And
✓:	Present
°:	Degree
%:	Percentage
AC:	Acromioclavicular
ADL:	Activities of daily living
AP:	Antero-posterior
AVN:	Avascular necrosis
C:	Chiropractor
CDC:	Chiropractic Day Clinic
cm:	Centimeter
CT:	Computed tomography
CTJ:	Costotransverse joint
DEXA	Dual Energy X-ray Absorptiometry
DJD:	Degenerative joint disease
DUT:	Durban University of Technology
e.g.	For example
etc.	Et cetera
F:	Female
GH:	Glenohumeral
H_a:	Alternate hypothesis
i.e.:	That is
IFC:	Interferential current
IREC:	Institutional Research Ethics Committee
IVD:	Intervertebral disc
LBP:	Low back pain
M:	Male
MD:	Medical doctor

MRI:	Magnetic resonance imaging
MVA:	Motor vehicle accident
NAD:	No abnormality detected
NRE:	Nerve root entrapment
NSAIDs:	Non-steroidal anti-inflammatories
OA:	Osteoarthritis
ORIF:	Open reduction internal fixation
PA:	Postero-anterior
PNF:	Proprioceptive neuromuscular facilitative
PT:	Physical therapy
RA:	Rheumatoid arthritis
RC:	Rotator cuff
RIM:	Resisted isometric movements
ROM:	Range of motion
Rx:	Treatment
SC:	Sternoclavicular
SD:	Standard deviation
SOAPE:	Subjective, objective, assessment, plan and education
SPSS:	Statistical Package for the Social Sciences
TENS:	Transcutaneous electrical nerve stimulation
US:	Ultrasound
USA:	United States of America
viz.:	Namely

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION TO THE STUDY

The shoulder joint has several degrees of freedom which permit a large range of movement such as flexion, extension, abduction and adduction, internal and external rotation. These movements allow the shoulder joint to facilitate the many activities of daily living (ADL) (Bickley and Szilagyi, 2009). Aberration in the functions of the shoulder can affect ADL such as grooming, bathing and dressing (Roy, 2012). Painful shoulder complaints are second only to low back pain as a cause of occupational injury claims (Hains, 2002).

A specific diagnosis of shoulder pain is often difficult to generate and can vary between clinicians possibly due to differences in the assessment of the same shoulder between clinicians (Burbank et al., 2008). Factors such as extreme pain, swelling and limited range of motion (ROM) may restrict the clinical evaluation leading to a possible misdiagnosis. It is often in these cases that radiographs of the shoulder are requested (Abdulkadir et al., 2011).

Radiographs were discovered accidentally by Roentgen in 1895 (Yochum and Rowe, 2005). The clinical application of this discovery was almost immediately recognised as it enabled one to visualise the bony, and to some extent, the soft tissue anatomy of the area of interest. The primary goal of the radiographs is to detect pathology (Moore and Dalley, 2006) and factors such as the quality of the radiograph, appropriate radiographic exposure factors, correct radiographic views and patient positioning; and clinically appropriate examination are pivotal to arriving at a correct diagnosis (Bontrager and Lampignano, 2010). Radiographs of the shoulder are not only important in the general diagnosis of clavicular fractures, humeral fractures, glenohumeral dislocation and acromioclavicular (AC) sprains, but also in allowing the practitioner to further specify the sub-type of injury (Estephan, 2012; Quintana, 2012). Each diagnosis has a classification system which determines the more specific type of injury and with the help of radiographs the factors which determine the extent and nature of the injury can be seen. Despite their diagnostic importance, there is radiation exposure to the patient during the taking of the

radiograph which a clinician should consider. Therefore, the request for radiographs must be justified before use (Ammendolia et al., 2002; Wyatt, 2005). Chiropractors are often criticized for the overuse of radiographs. Reasons such as identifying degenerative changes, patients' education and routine office procedure, that in some cases may not be considered ethically justified (Ammendolia et al., 2002). On the other hand, medico-legal considerations are often stated as the reason for unnecessary radiographic examinations as the physician or chiropractor wishes to avoid being sued if certain findings are not documented (Helms, 2014).

Radiographic findings or reports also have an important role in determining the type of management of many shoulder conditions. The most effective management, either conservative care or orthopaedic referral, can be determined following the radiographic report. Conservative care consists of immobilisation, ice, rehabilitation and pain control. Orthopaedic referral on the other hand, may involve surgery in order to correct any neurovascular injury, fractures, or to relocate the shoulder joint (Quillen et al., 2004).

At the Chiropractic Day Clinic (CDC), which is an outpatient clinic of the Durban University of Technology (DUT), radiographs are requested by the student at the instruction of the attending clinician based on the case presentation. Although guidelines are prescribed in the Clinic Manual (Chiropractic Clinic Manual, 2015), it is not known whether these are adhered to in practice. Kandhai (2007) reported that at the CDC, radiographs were the most frequently-used investigation when treating patients with upper limb conditions. It is also not known what spectrum of suspected clinical and radiographic diagnoses of shoulder conditions are observed in the CDC and how these conditions are managed by the supervised students and whether conservative management is influenced by the radiographic diagnosis or not. Therefore, the aim of this study was to determine the impact of the radiographic report of plain film radiographs on the suspected clinical diagnosis and conservative management of shoulder pain at the CDC.

1.2 AIM AND OBJECTIVES OF THE STUDY

1.2.1 The Aim of the Study

The aim of this study was:
To determine the impact of the radiographic report of plain film radiographs on the suspected clinical diagnosis and conservative management of shoulder pain at the CDC.

1.2.2 The Objectives of the Study

The objectives of this study were:

- Objective 1: To determine the association between the suspected clinical diagnosis and radiographic diagnosis of shoulder pain.

- Objective 2: To the describe the type of incidental radiographic findings in the selected plain film radiographs of the shoulder

- Objective 3: To determine the proportion of change in the suspected clinical diagnosis and the conservative management of shoulder after obtaining the radiographic report.

1.3 HYPOTHESES OF THE STUDY

The general hypothesis (set as an Alternate Hypothesis (H_a)) of the study stated that a profile of the suspected clinical and radiographic diagnoses of shoulder conditions observed in the CDC and their management would be developed. The H_a was also set for the first objective and stated that there would be a significant association between the suspected clinical and the plain film radiographic diagnosis of the patients with shoulder pain.

1.4 SCOPE OF THE STUDY

This study included plain film radiographs and the respective clinical records of patients that presented with shoulder pain and had plain film shoulder radiographs taken at some point during their management at the CDC. A total of 94 plain film shoulder radiographs of patients who presented at the CDC with shoulder pain, from 24 April 1992 to 19 September 2011, were located in the CDC archives and from these a total of 54 plain film shoulder radiographs satisfied the requirements of the inclusion criteria. The plain film radiographs and corresponding clinical records of these 54 plain film radiographs were then examined for the radiographic and clinical diagnoses and the relevant data was recorded on the Data sheet **(Appendix A)**. All patients' details were coded to maintain patient confidentiality **(Appendix B)**.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Shoulder pain is recognised as a disabling problem and is a common reason for consultation with a clinician. This chapter will present an overview of the relevant anatomy of the shoulder and its examinations, pathologies, treatment options and the role of plain film radiographs in shoulder pain diagnosis and management.

2.2 SUMMARY OF THE RELEVANT ANATOMY OF THE SHOULDER COMPLEX

The shoulder joint is comprised of both bony (humerus, glenoid, scapula, acromion and clavicle) and soft tissue components (e.g. rotator cuff muscles, glenohumeral ligaments, subacromial bursa) (Woodward and Best, 2000). The shoulder complex is comprised of three articulations viz. the glenohumeral, AC and scapulothoracic. The glenohumeral joint is primarily secured by the muscles which attach to it due to the relatively small size of the socket in relation to the size of the humeral head (Di Giacomo et al., 2008). The AC joint is a plane-type synovial joint formed by the lateral aspect of the clavicle and acromion (Moore and Dalley, 2006). The scapulothoracic joint is a sliding junction between the scapula and the ribcage at the level of ribs two to seven; it is stabilised by various muscles which help position the glenoid and, therefore, assist in the functioning of the glenohumeral joint.

The main muscle group involved in the dynamic stability of the glenohumeral joint is the rotator cuff. This is comprised of four muscles viz. subscapularis, supraspinatus, infraspinatus and teres minor which all have different origins but a common attachment to the joint capsule (Di Giacomo et al., 2008). Other muscles also contribute to the stability and movement of the shoulder and upper limb. These include the anterior muscles: pectoralis major and minor, subclavius and serratus anterior; posterior muscles: trapezius, latissimus dorsi, levator scapulae and rhomboid major and minor, as well as the biceps brachii, triceps brachii, coraco-brachialis and brachialis muscles (Moore and Dalley, 2006). Static stability is provided by the superior, middle and inferior glenohumeral ligaments, the

coracohumeral ligament and the coracoacromial ligament (Moore and Dalley, 2006). The glenohumeral joint is largely innervated by the C4, C5, C6 and C7 nerve roots as well as those nerves which cross the joint. These include the axillary, suprascapular, subscapular, musculocutaneous nerves and to some extent the posterior cord of the brachial plexus (Rockwood and Matsen, 2009). Arterial supply to the glenohumural joint is from the anterior and posterior circumflex humeral arteries and branches of the suprascapular artery (Moore and Dalley, 2006). There are many bursae located in the shoulder girdle which are important in the functioning of the shoulder as they allow for gliding between adjacent structures. The two main bursae are the subacromial bursa, below the acromion and coracoacromial ligament and above the supraspinatus muscle, and the subscapular bursa between the subscapular tendon and the neck of the scapula (Moore and Dalley, 2006). The coracoacromial arch is formed by the inferior aspects of the coracoid process and the acromion and prevents superior translation of the humerus. It also forms part of the supraspinatus outlet; narrowing of this outlet can lead to impingement syndrome (De Berardino, 2012). For further details of the anatomy of the shoulder joint the reader is advised to consult reputable texts such as Gray's Anatomy (Standring, 2005) and Clinically Oriented Anatomy (Moore and Dalley, 2006).

2.3 THE AETIOLOGY AND DIAGNOSIS OF SHOULDER PAIN

2.3.1 Aetiology of Shoulder Pain

A clinician should be aware of the several causes of shoulder pain and that the site of pain may not necessarily be its source. The aetiology of shoulder pain may be classified as either intrinsic or extrinsic **(Table 2.1)**.

Table 2.1 Intrinsic and extrinsic causes of shoulder pain

Intrinsic	Extrinsic
Disorders of the rotator cuff	Trauma
Bicipital tendonitis	Cervical spine disorders
Capsulitis	Nerve disorders
Glenohumeral and AC joint arthritis	Inflammatory arthritides
Gout	Regional pain syndrome
Inflamed bursae	Myofascial pain syndrome
Tumour	Scapulothoracic articulation
AVN	Rib and thoracic injuries
	Visceral disorders
	Dislocation

AC = Acromioclavicular; AVN = Avascular necrosis
Data summarised from Harrington et al. (1996); Benzel and Connolly (2012)

Rotator cuff lesions may include tendonitis, strains and calcific deposits. These are usually very painful and prevent full use of the shoulder (Quintana, 2012). Prolonged guarding by the patient may result in adhesive capsulitis (frozen shoulder). This often manifests as severe pain, stiffness and local muscle atrophy. It may last for about two years even with treatment (Roy, 2012). Arthritis of the glenohumeral and AC joints may include three types: 1) degeneration, 2) inflammatory e.g. rheumatoid arthritis and 3) crystal deposition disease e.g. gout. Pain, stiffness and inflammation are the hallmarks of arthritis especially in the latter two types. Investigations such as radiographs and blood tests may be required to confirm the type of arthritis (Castro et al., 2001). Entrapment of the subacromial bursa in the coracoacromial arch results in a painful and debilitating bursitis which may mimic or be associated with rotator cuff lesions (Benzel and Connolly, 2012). Tumours in the shoulder complex may include secondary metastases to the humerus, clavicle or scapula or primary bone tumours e.g. osteosarcoma of the humerus. It is vital that a clinician is able to diagnose these tumours as a delay in the diagnosis or treatment is associated with a poor prognosis (Khatri, 2006). In rare cases, disruption of the arterial supply to the humeral head may result in avascular necrosis.

Trauma to the shoulder region may result in bony and soft tissue injuries. Bony injuries include fractures of the humerus, clavicle or glenoid while soft tissue injuries include ligamentous sprains, muscle and tendon strains or tears (Estephan, 2012; Quintana, 2012). Glenohumeral or AC joint dislocations may also result from trauma to the shoulder complex. Due to the close proximity to the shoulder complex, injuries to the ribs (especially the superior ribs), scapular and thoracic spine may also refer pain (Hertling and Kessler, 2006). Cervical spine disorders resulting in shoulder pain include degeneration, spinal cord tumours, tuberculosis, and radiculopathy due to ruptured intervertebral discs (Benzel and Connolly, 2012). Nerve disorders include brachial plexus compression or tears which are often consequences of major trauma to the shoulder complex (Fiebach et al., 2007). Active myofascial trigger points in rotator cuff muscles, pectoralis major and minor muscles and trapezius often refer pain to the shoulder region (Hains, 2002). These are usually diagnosed by determining pain referral patterns in response to palpation and are usually treated conservatively. Disorders of the viscera in the chest and abdomen may result in referred pain to the shoulder region. Myocardial ischaemia (angina) often refers pain to the left shoulder while gallbladder disease may refer pain to the right shoulder (Acalovschi and Paumgartner, 2001; Vassallo, 2008). Regional pain syndrome is continuing pain which is not proportionate to the inciting event, with no other conditions that would account for the pain. It can occur in the extremities after an injury or spontaneously (Harden et al., 2007).

2.3.2 The Clinical Evaluation of Shoulder Pain

The shoulder is prone to several pathologies which present a diagnostic challenge to clinical evaluation (Andrews and Wilk, 1994; Silva et al., 2008) and obtaining a specific diagnosis of shoulder pain is difficult and can vary between clinicians. Moreover, assessment of the same shoulder movement can vary considerably amongst clinicians (Burbank et al., 2008). There are difficulties associated with diagnosing shoulder pain due to the highly mobile nature of the shoulder joint, as well as the possibility that there is more than one lesion which may influence the outcome of specific tests. The history is the first step in the evaluation of any patient's chief complaint as a good clinical history supplemented by the examination findings will often lead the physician to the correct diagnosis (Wyatt, 2005). The key points in the history and examination findings are summarised in **Table 2.2**.

Table 2.2 General approach to history and examination of the shoulder joint

History	Examination	Equipment required
Pain, tenderness and swelling	Observation, palpation, orthopaedic tests	Usually none but occasionally an algometer
Restriction on specific movements	ROM (passive and active)	A goniometer may be useful
Effect on ADL	Mimic ADL	Examples include weights, brushes, shoes (patient to mimic ADL using these)
Associated conditions	Examination of the cervical spine, chest and abdomen	Reflex hammer, stethoscope

ADL = Activities of daily living; ROM = Range of motion

Data summarised from Andrews and Wilk (1994); Woodward and Best (2000); Wyatt (2005); McFarland (2006); Vassallo (2008); De las Penas et al. (2013) and Magee (2014).

A detailed case history would include the patient's age, sex, dominant hand, occupation and sporting activity. Increased age may predispose to arthritis, while stiffness and locking can be indicative of adhesive capsulitis (Woodward and Best, 2000). Occupations such as cashing, hair dressing, construction, and information technology (prolonged use of computers) as well as sports involving repetitive arm movements and high impact (cricket, rugby, swimming etc.) all increase the risk of shoulder trauma (Vassallo, 2008).

Specific questions about the pain also need to be enquired viz. location, onset and nature, duration, aetiology, if there is any nocturnal pain, and aggravating and relieving factors. Pain that radiates down the arm can be a sign of a cervical disorder; pain with throwing may suggest instability; pain that relieves as the day progresses can indicate arthritis

while nocturnal pain may suggest impingement of the rotator cuff tendon, calcific tendonitis or a more ominous cause such as cancer (Woodward and Best, 2000; Vassallo, 2008). It is important to enquire if there was any recent or past trauma to the area. For example, a history of recent trauma with the arm abducted and externally rotated may suggest dislocation or labral tear (Woodward and Best, 2000). Next, one would inspect both shoulders for any swelling, discolouration, scars and muscle wasting and compare the two sides. Manual palpation is required for the assessment of any tenderness or temperature variations, and noting any change in the bony or soft tissue anatomy (Vassallo, 2008). Swelling may be caused by a variety of conditions including trauma, bursitis and sepsis. Some clinicians may utilise an algometer to determine the pressure pain threshold and tolerance of different tissues and monitoring the response to treatment (De las Penas et al., 2013).

The shoulder joint has many degrees of freedom which allows for a large range of mobility **(Table 2.3)**. These movements allow the shoulder joint and, hence, the arm to engage in many activities with the ultimate purpose of the shoulder complex being the placement and full use of the hand (Andrews and Wilk, 1994). Range of motion is assessed both actively with the patient performing the movements and passively with the clinician moving the patient's shoulder and upper limb through the movements with each side being compared relative to the other. Range of motion assessment is an important aspect of the orthopaedic exam as a major goal of most cases is the restoration of the joint's normal ROM (Wyatt, 2005) **(Table 2.3)**.

Table 2.3 Reported normal active range of motion of the shoulder

Motion	ROM (˚)
Abduction	170-180
Adduction	40-50
Extension	40-50
Flexion	170-180
Internal rotation	80-90
External rotation	70-90
Circumduction	360

From Wyatt (2005)

Pain on active movement that is absent on passive movement may be indicative of a structural problem involving the muscles or tendons rather than a joint-related pathology (Woodward and Best, 2000; Vassallo, 2008). Muscles support the shoulder and control movement during active ROM whereas ligaments provide stability and are relatively inflexible and limit movement at the end ROM. Range of motion testing may be hindered

by extreme pain or stiffness limiting the information that could be gained from it. Resisted isometric movements are then tested by adding resistance to the active movement. This evaluates the contractile tissue (muscles and tendons) that may be injured. By performing this in different positions and use of different movements and correlating the results with the pain and/or restriction noted on active and passive ROM, it is possible to determine the likely soft tissue-related cause (Magee, 2014). Limitations in the ROM of the shoulder may lead to compensatory movements e.g. shrugging of the shoulder, increased trunk rotation and lateral flexion, and increased movement at the scapulothoracic articulation which in turn may exacerbate the pain.

Range of motion is important in many ADL. Normal ROM is used for combing hair, eating, reaching the perineum for hygienic care and general dressing and washing. By enquiring from a patient which activities are limited, it may indicate in which direction movement is affected and, hence, the involved structures (McFarland, 2006).

After a general examination of the shoulder complex, orthopaedic testing may commence. Some tests are reportedly specific for certain conditions e.g. Speed's test for bicipital tendonitis. The findings of the orthopaedic tests may aid the clinician in arriving at a specific diagnosis **(Table 2.4)**. It is, however, important that the clinician is aware of false-positive or false-negative tests as these may influence the diagnosis, follow-up investigations and treatment. Moreover, the reliability and validity of several of these tests have not yet been established so their overall impact in arriving at a diagnosis is debatable (Magee, 2014).

Table 2.4 Some of the orthopaedic tests conducted during physical assessment of the shoulder

Test	Pathology/specific muscle
Neers	Impingement
Hawkins Kennedy	Rotator cuff tendonitis Subacromial bursitis
Drop arm test Empty can test	Supraspinatus tears or tendonitis
Pectoralis major contracture test	Tight pectoralis muscle
Apley's scratch	Infraspinatus Rotator cuff pathology
Gerber's lift off	Subscapularis
Yergason's test Speed's test	Bicep tendonitis
Ludington's test	Biceps tendon rupture
Apprehension test Anterior drawer test The clunk test	Glenohumeral instability (anterior)
Posterior apprehension test Posterior drawer test Jerk test	Glenohumeral instability (posterior)
Sulcus sign Faegin test	Multidirectional instability

Data summarised from Woodward and Best (2000); Magee (2014); Vassallo (2008)

Other regions apart from the shoulder also need to be assessed to rule out referred pain. These include the cervical spine, chest and abdomen **(Table 2.5)**. These may be visceral such as from the heart, lungs and gallbladder; degenerative from the cervical spine or may be tumour-related in the case of metastases from pancoast tumours (Vassallo, 2008). Clinicians should always examine these organs and exclude pathology before a diagnosis of a primary shoulder complaint is reached.

Table 2.5 Causes of referred pain to the shoulder

Area	Examples of condition	Signs and symptoms in brief
Cervical spine	Degeneration	Pain related to neck movement Extends below the elbow Associated neurological signs
	Radiculopathy	Electric shock-like pain radiating down the arms Associated neurological signs
Chest Wall	Costochondritis	Pain on deep inspiration Tenderness over ribs
Heart	Pericarditis	Sharp chest pain related to exertion Fever
	Myocardial ischemia	Sweating, nausea and palpitations Pallor and fever Tachycardia Abnormal heart sounds
Lungs	Pneumonia	Fever, cough and chest pain
	Tumour	Weight loss Cough, haemoptysis and shortness of breath
Gallbladder	Cholestasis	Steatorrhea Diarrhoea Muscle fatigue
Liver	Abscess	Jaundice
	Cirrhosis	Nausea, vomiting, weakness, fatigue and muscle cramps
	Hepatitis	Weight loss Pruritis
Stomach	Peptic ulcer	Fever Guarding Abdominal pain

Data summarised from Vassallo (2008); Acalovschi and Paumgartner (2001); Khatri (2006)

2.3.3 The Clinical Diagnosis of Shoulder Pain

The correct diagnosis is required for effective treatment of shoulder pain (Burbank et al., 2008) but due to the anatomical structure and wide ROM of this joint, it can be challenging (Woodward and Best, 2000). Classification of disorders, including those of the shoulder, is one possible system utilised by clinicians to arrive at a diagnosis. The diagnostic classification of primary shoulder complaints is tabulated in **Table 2.6**.

Fractures and dislocations are often associated with a fall onto an outstretched hand or a direct trauma to the area as a result of a motor vehicle accident or sporting activities (Vassallo, 2008). The patients tend to avoid movement of the limb which may show deformity (i.e. the attitude of the limb) and swelling. Impingement syndrome can occur at any age and is characterised by a painful arc of motion when the arm is raised above shoulder height (De Berardino, 2012). Patients with instability usually have history of injury or repetitive microtrauma and tend to avoid certain movements due to fear of pain

(apprehension) or dislocation (Vassallo, 2008). Superior labral lesions can be difficult to diagnose as the symptoms can be non-specific and overlap with other conditions (Hasan, 2011). The mechanism of injury identified through history-taking may alert the clinician to the possibility of this diagnosis.

Muscular pathologies include rotator cuff injury characterised by pain, weakness and decreased ROM and are found in young athletes and more commonly in patients older than 40 years of age (Quintana, 2012). Bicipital tendonitis is characterised by local tenderness and pain on movement which is exacerbated by lifting objects and can be tested with simple orthopaedic tests such as the Speed's test (Durham, 2012). Patients with supraspinatus tendonitis often have an athletic history or an occupation involving repetitive overhead work and it can be associated with impingement syndrome. Adhesive capsulitis has a slow onset and is indicated by a gradual decrease in ROM and an increase in pain with the inability to sleep on the affected side (Vassallo, 2008). Suprascapular neuropathy can mimic the symptoms of rotator cuff tendinopathy. However, these patients often have a history of loading the shoulder in an abducted and externally rotated position and painless atrophy of the infraspinatus muscle (Reeser, 2011). Bursitis can occur at any age but more frequently occurs in older patients due to inflammatory joint disease, repetitive injury or infection. It is characterised by decreased ROM, swelling and nocturnal pain (Harold, 2009).

The key challenges to arriving at a successful clinical diagnosis include patient apprehension, muscle spasm due to pain, swelling, vague clinical features which often overlap with several other conditions, and lack of sensitivity or specificity of orthopaedic tests. The clinician's knowledge of the underlying anatomy, shoulder movements and exposure or familiarity to the several disorders involved in shoulder pain are other factors that need to be taken into consideration.

Table 2.6 Diagnostic classification of primary shoulder disorders

Condition	Examples	Age affected	Sex	Key history	Key examination findings	Difficulties in reaching a clinical diagnosis
Trauma	Clavicle fracture	Children <7, Men <30	M:F = 2:1	Fall or MVA	Deformity, guarding, exquisite tenderness, swelling, adducted arm held close to body	Patient not allowing doctor to examine; Muscle spasm; Swelling
	AC joint dislocation/ injury			Fall, MVA, sports tackle	Asymmetry Local tenderness, decreased abduction, bruising, prominent clavicle	
Mechanical	Impingement syndrome	Stage 1:<25, Stage 2: 25-40, Stage 3: >40		Repetitive microtrauma; athletic history; Lateral, superior & anterior pain	Stiffness, painful arc, pain on palpation	
	Instability			Athletic history; catching, locking; relieved with rest	Generalised pain, bilateral findings, guarding, apprehension, no passive limit, sulcus sign	May only present with pain, concomitant impingement
	Superior labral lesion	≈ 38	M > F	History of throwing, difficulty with overhead activities; fall, direct blow; popping/clicking	Poorly defined pain, loss of internal rotation, 'dead arm'	Non-specific physical, overlap with other aetiologies
Muscular/ tendon dysfunction	Rotator cuff injury	Most commonly 55-85		Pain anterolaterally & superiorly; fall, heavy lifting; crepitus, stiffness; overhead work	At least one positive resisted test, mild pain, weakness (moderate to severe), decreased ROM	
	Bicipital tendonitis			Anterior shoulder pain; Exacerbated with lifting, worse on movement & relieved on rest	Normal passive ROM, local pain, no/slight weakness, +Speed's test	
	Supraspinatus tendonitis			Athletic history; repetitive overhead motion & throwing; pain on overhead motion	Weakness, local pain, +Hawkins-Kennedy & drop arm tests	Associated with impingement syndrome

Capsular syndrome	Adhesive capsulitis	F: ≈ 52, M: ≈ 55	F:M = 1.4:1	Insidious onset; history of trauma; night pain	Pain in C5 dermatome, limited ROM, painful RIM	Initially only finding is pain at end ROM, poor sensitivity/ specificity of diagnostic tests
Nerve dysfunction	Suprascapular neuropathy	Young athletes	M > F	Athlete, Unilateral (dominant side), history of load on shoulder,	Deep dull ache/ discomfort, Atrophy of infraspinatus & supraspinatus muscles	Diagnosis of exclusion, under reported
Bursitis	Acute			Acute onset	No evidence of trauma, restricted abduction, severe pain in C5 dermatome	

AC = acromioclavicular; F = Female; M = Male; MVA = motor vehicle accident; ROM = range of motion; RIM = resisted isomeric movements;
Data summarised from De Winter et al. (1999); Hasan (2011); Seade (2011); Reeser (2011); De Berardino (2012); Durham (2012); Estephan (2012); Quintana (2012); Roy (2012); Wnorowski (2012)

2.3.4 Red Flags

During the case history and physical examination, the clinician should be alert for the presence of “red flags”. These are clinical features which suggest an ominous underlying pathology (Mutsaers and Van Dolder, 2008). They may be general e.g. unexplained weight loss, night sweats and lymphadenopathy or they may be more specific to the shoulder such as unexplained deformity/swelling, significant weakness not due to pain, failed attempt at reduction of dislocated shoulder, large tear of the rotator cuff (> 5cm), severe dislocation of the glenohumeral, AC and sternoclavicular joints and undiagnosed severe shoulder pain (Colledge et al., 2010). Radiographic red flags such as long bone fractures in children who are not ambulatory; spiral fractures in infants and multiple, differently-aged fractures may suggest child abuse (Jenny, 2011). It should be noted that red flags in isolation may not always point to a serious underlying pathology, but when observed in combination with other factors/symptoms they should always be investigated further. The presence of clinical or radiographic red flags can influence the diagnosis as well as the management of the patient. Further investigations (e.g. blood tests and advanced diagnostic imaging such as magnetic resonance imaging (MRI)) may be required and the patient will require referral to a medical specialist for management. If no red flags are present one can proceed with conservative management (Collins-Bride and Saxe, 2013).

2.4 THE ROLE OF PLAIN FILM RADIOGRAPHS IN THE DIAGNOSIS OF SHOULDER PAIN

2.4.1 Utilization of Radiographs in Clinical Practice

Conventional radiographic procedures (plain film radiographs) are the most frequently-used imaging modalities in the evaluation of the skeletal system for the diagnosis and appropriate management of a wide variety of conditions treated by health professionals, including chiropractors (Reinus, 2014). The role of radiographs also include providing information which may suggest if any additional imaging modalities should or should not be used and can refine the diagnosis or provide a differential diagnosis (Estephan, 2012; Quintna 2012). As radiographs provide two-dimensional views of three-dimensional structures, at least two views are usually needed, preferably perpendicular to each other, in order to obtain an accurate representation of the structure imaged (Yochum and Rowe, 2005; Moore and Dalley, 2006).

For the shoulder region, the most common views include antero-posterior (AP), lateral, neutral, internal and external rotation and abduction (Yochum and Rowe, 2005). These typically show fractures, dislocations, arthritis and osteoporosis, as well as calcium deposits in muscles, tendons and bursae (Bontrager and Lampignano, 2010). If required, other views may include supero-inferior postero-anterior (PA) which additionally shows shoulder impingement. A posterior oblique view shows fractures or erosion of the glenoid labrum/brim, a Bankart lesion and the integrity of the scapulohumeral joint. The intertubercular groove projection may show disruption to the course of the biceps tendon such as bony projections. In traumatic cases a scapular Y-lateral radiograph is taken. This allows a true lateral view of the scapula to be shown as the scapula is separated from the ribs unlike that in a standard lateral. A tangential projection shows the supraspinatus outlet which is useful in determining shoulder impingement. An AP oblique can also be done to determine scapulohumeral dislocations, glenoid fractures and Hill-Sachs lesions (Bontrager and Lampignano, 2010).

2.4.2 Chiropractic and Radiographs

Radiographs have been used in chiropractic since its inception and are the most widely-used diagnostic imaging modality in modern practice (Hildebrandt, 2010). The taking of radiographs and their interpretation, especially with respect to musculoskeletal radiology, has always been included in most chiropractic curricular (Yochum and Rowe, 2005). In

the United States, chiropractors may specialise, undergoing residencies and board certification examinations to become chiropractic radiologists specialising in neuromusculoskeletal radiology (Hildebrandt, 2010). The chiropractic curriculum at DUT also includes radiography related to the musculoskeletal system and the interpretation of these radiographs. These are included in Anatomy I and II (Radiology component), Chiropractic Principles and Practice III (Radiology component), Radiology IV and Clinical Biomechanics V (Radiology component) of the curriculum at DUT (2015 Handbook: Chiropractic and Somatology, 2015). The intended aim of these curricula is to ensure that chiropractic students are competent in taking and interpreting musculoskeletal radiographs.

2.4.3 Indications and Non-indications to Radiographs

There are several factors a clinician needs to consider when deciding on ordering radiographs. These are summarised in **Table 2.7**.

Table 2.7 Reported indications and non-indications for radiographic medical imaging

Indications	Non-indications
Severe pain	Soft tissue and IVD disease
Suspected fracture or dislocation	Patient education
Non-response to treatment	Screening
History of trauma (macro or repetitive micro)	Habit
Decreased ROM	Financial gain
Suspicion of instability	Pregnancy
Unexplained, progressive neurological abnormalities	
Suspected arthritis	
Evaluation of bone tumours and bone destruction	

ROM = Range of motion; IVD = Intervertebral disc
Data summarised from Stevenson and Trojian (2002); Wyatt (2005); Yochum and Rowe (2005); Catanzano (2009)

Severe shoulder pain and suspected fracture especially with a history of recent trauma is an indication for radiographs. For a long bone (e.g. the humerus) the joints above and below the possible fracture site should be included in the films to rule out any concomitant dislocation and additional fracture (Stevenson and Trojian, 2002; Cantazano, 2009). These radiographs are then used to determine whether conservative (invasive or non-invasive care) or surgical management will be used (Paz and West, 2014). Radiographs are used to diagnose suspected arthritis, but this is debatable as in an elderly patient with joint pain the suspected clinical diagnosis of arthritis is usually correct and exposure to

radiation is unnecessary. On the other hand, radiographs are required in severe rheumatoid arthritis when the patient is considering shoulder replacement surgery (Stewart and Kelly, 1997). Radiographs are also important for diagnosing ominous conditions such as bone tumours and destructive lesions such as osteomyelitis, septic arthritis and Charcots joints (Catanzano, 2009). Wyatt (2005) reported that plain film radiographs should be requested when there is a suspicion of fracture, dislocation, if the patient is over 40 years of age, when surgery is being considered as a management option and when a patient does not respond to appropriate treatment.

Soft tissue and intervertebral disc disease (IVD) are not indications for radiographs as they have a limited value (in the diagnosis of these conditions) and other imaging studies such as computed tomography (CT) and MRI are more beneficial (Catanzano, 2009). Other non-indicators are patient education and general screening as these factors do not out-weigh the risk of radiation exposure to the patient (Yochum and Rowe, 2005). Screening may be useful to determine the progression in scoliosis (Richards and Vitale, 2007), but in an elderly patient with clinical signs of arthritis or who has previously been diagnosed with arthritis it usually is not worth screening for progression. Some doctors form a habit of sending patients for radiographs and although it might be useful in ruling out serious diagnoses, with a proper history and clinical exam the same conclusion can be made in most cases (Catanzano, 2009). Some chiropractors have purchased and installed expensive radiographic equipment in their practices. Sending patients for radiographs to offset the financial burden and/or increase income (Hildebrandt, 2010), is considered unethical.

Exposure of pregnant women to radiation (x-rays) is generally avoided due to the risk of exposing the foetus to radiation and only advised if absolutely necessary (Thomas, 2002). It is thought that with extra lead shielding the risk to the foetus is low especially later in the pregnancy; however, informed consent must be obtained from the patient after all risks have been explained (Catanzano, 2009).

2.4.4 Advantages and Disadvantages of Radiographs in Diagnosing Shoulder Pain

Radiographs have both advantages and disadvantages **(Table 2.8)** that need to be taken into consideration, along with the relevant indications when choosing the correct imaging study for the patient (Yochum and Rowe, 2005).

Table 2.8 Advantages and disadvantages of radiographs

Advantages	Disadvantages
Readily available	Lack of soft tissue discrimination
Relatively inexpensive	Diminished sensitivity detecting bone density
Non-invasive	change, resolution of small lesions
Good bone definition	Radiographic latent period
	Exposure to ionizing radiation
	Difficulty in positioning in some conditions

Adapted from Yochum and Rowe (2005); Cantazano (2009)

The non-invasive nature of the radiographic procedure reduces patient anxiety. It is readily available to most patients in both public and private health care settings. Radiographs are also relatively inexpensive in comparison to other imaging studies (e.g. CT or MRI scans) and are easier to interpret (Yochum and Rowe, 2005).

There are limitations/disadvantages to the use of radiographs. The main disadvantage associated with radiographs is the hazard of exposing the patient (and radiographer) to ionizing radiation which may cause malignancy (Yochum and Rowe, 2005; Cantazano, 2009). Muscle, ligamentous and cartilaginous injury are not visible due to a lack of soft tissue discrimination (Yochum and Rowe, 2005). Some fractures especially un-displaced fractures are not readily seen at first and require follow-up radiographs seven to ten days later (Yochum and Rowe, 2005). This further increases the exposure of the patient to ionization radiation. Depending on the size and location of the pathology, specific views are required for it to be visualised. Incorrect views may not show the pathology and as a result the diagnosis may be missed. There is also a 10-14 day latent period for conditions such as osteomyelitis before manifestations are visible on radiographs as 40% of bone destruction is needed for a lesion to be apparent (Yochum and Rowe, 2005). In some cases, due to the nature of the patient's injury, radiographic positioning may be difficult and in obese patients the images may be sub-optimal due to the increased soft tissue penetration required.

2.4.5 Incidental Findings

Incidental findings are any abnormalities or previously undiagnosed conditions that are not related to the condition currently being investigated or treated (Lumbreras, 2010). They may be diagnostically important or non-pathological; often the radiologist determines the significance of these findings and provides recommendations to the clinician. These can then lead to further investigations and testing (e.g. blood tests, CT scans, etc.) which can sometimes be controversial as they may not always be necessary especially in cases where the patient undergoes further investigation but it is not clinically followed-up.

However, the correct strategy when faced with incidental findings is unclear and requires further study (Lumbreras, 2010).

Incidental findings can be located in any area of the body and examples of this include intra-uterine contraceptive devices in the abdomen, pleural effusion, solitary pulmonary nodules in the lungs (Goroll and Mulley, 2009) and adrenal masses on the kidneys (Lumbreras, 2010). Fibrous cortical defects in the distal metaphysis of long bones (Thomas et al., 2012), bone islands (Greenspan, 1995), bony exostoses (Hennekam, 1991), calcification of local ligaments or muscles (Chan et al., 2004), lytic or blastic lesions (Sapir, 2005) (which may be either benign or pathological) are examples specific to the musculoskeletal system.

There are also incidental findings on shoulder radiographs that may or may not influence the diagnosis and management of shoulder pain. For example. a rib fracture was an incidental finding on a shoulder radiograph in a patient with shoulder pain, no history of trauma and a normal shoulder examination (Trauma X-ray- Axial Skeleton, 2013). This finding might necessitate further investigations for the possibility of pneumothorax or haemothorax (Trauma X-ray- Axial Skeleton, 2013). Calcium deposits in the rotator cuff tendons can also be found on routine radiographs of asymptomatic patients. When these lesions increase in size and become inflamed, management may include either conservative or surgical intervention (Wittenberg et. al., 2001). Abramson et al. (2001) reported an incidental finding of a benign metastasizing leichyoma (a rare condition with only 75 reported cases) seen in a shoulder radiograph in a trauma investigation. This indicates that lung pathologies may also be identified as incidental findings in routine shoulder radiographs. Bony exostoses of the shoulder may be associated with impingement syndrome of the shoulder (Cone et al., 1984). They could occur as single lesions or as multiple exostoses (hereditary) which could be either symptomatic or asymptomatic (Hennekam, 1991).

2.5 THE ASSOCIATION BETWEEN THE CLINICAL AND PLAIN FILM RADIOGRAPHIC FINDINGS

Radiographic findings may include degeneration or pathology may be commonly found in asymptomatic patients (Kent and Keating, 2004). Conversely, patients with relatively little or no signs of degeneration or pathology may present with severe pain (Ullrich, 2000). Most types of soft tissue cannot be visualised on plain film radiographs and since many conditions of the shoulder have a soft tissue origin, they will not appear on radiographic

examination (Yochum and Rowe, 2005). A few studies have attempted to determine the value of radiographs in different clinical settings **(Table 2.9)**. Two major trends arise from the findings of these studies viz. over-utilization of radiographs (Fraenkel et al., 1998; McPhail, 2011; Damon, 2012) and lack of association between clinical and radiographic diagnoses (Bedson and Croft, 2008; McPhail, 2011; Damon, 2012).

Table 2.9 The reported relationships between the clinical and radiographic diagnoses in selected studies

Reference	Setting	Sample size	Key findings
Fraenkel et al. (1998)	Emergency Department, Boston	312	20% therapeutically-informative Radiographs were over-utilized in initial evaluation
Moosikasuwan et al. (2005)	None (literature review)	Unknown	Physical and radiographic findings can suggest rotator cuff tear
Kahn and Mehta (2007)	Emergency Department, Boston	55	No persistent dislocations,16 new fractures No change in management
Bedson and Croft (2008)	None (literature review)	20	Discordance between clinical and radiographic knee OA
McPhail (2011)	Outpatient clinic, DUT	74	Little agreement between clinical and radiographic diagnoses of LBP Over-reliance on radiographs
Abdulkadir et al. (2011)	Medical centre and teaching hospitals, Nigeria	72	Change in diagnosis in 52 cases
Damon (2012)	Outpatient clinic, DUT	146	55.5% overall agreement between clinical and radiographic diagnoses of knee pain Knee radiographs over-utilized

DUT = Durban University of Technology; OA = Osteoarthritis; LBP = low back pain

Radiographs that identified conditions which required a specific management protocol were considered as “therapeutically-informative” (Fraenkel et al., 1998) **(Table 2.9)**. The same author reported that 80% of the radiographs taken at the emergency department did not identify conditions that required specific treatment and concluded that at the initial evaluation i.e. when first presenting to the emergency department, radiographs are over-utilized. In a similar setting, Kahn and Mehta (2007) reported no persistent dislocation and although 16 fractures were shown on post-relocation radiographs that were missed on the pre-relocation radiographs, they did not change the management of the patient as they were not significant enough to require orthopaedic intervention. Although the findings of these studies imply overuse of radiographs, trauma to a region and severe pain are valid indicators for ordering radiographs **(Table 2.7)**. It is important to consider the implications of missing a fracture and/or dislocation in patients presenting to an emergency department. After conducting a systematic search and summary of the literature, Bedson and Croft (2008) reported discordance between the clinical and radiographic knee osteoarthritis. The proportion of patients that presented with knee osteoarthritis that had

associated pain ranged from 15%-81% and those that presented with knee pain that had associated osteoarthritis ranged from 15%-76%. It was concluded that there is a weak association between symptoms of knee osteoarthritis and the radiographic findings. It was recommended that radiographs should not be used in isolation when investigating knee pain.

Moosikasuwan et al. (2005) reported that although the clinical evaluation of rotator cuff tears is highly sensitive, it is, however, not very specific. Plain film radiographs are usually normal in acute tears, but may show impingement due to skeletal abnormality encroaching on the supraspinatus outlet. These findings suggest that plain film radiographs should, therefore, not be the first investigation for a suspected rotator cuff tear. A diagnostic ultrasound (US) or a MRI scan would be indicated in these cases (Moosikasuwan et al., 2005). Abdulkadir et al. (2011) reported that cases of clavicular and humeral fractures were diagnosed clinically but the type of fracture and the presence of scapula fractures had to be diagnosed with radiographs. As a result, a change in the specific diagnosis was made in 52 of the 72 cases after radiographs. In clavicular fractures the type can directly influence the management as the different types are treated differently.

Two studies conducted at the CDC at DUT concluded that plain film radiographs are over-utilized for investigating low back pain (McPhail, 2011) and knee pain (Damon, 2012). McPhail (2011) reported that there was no association between the suspected clinical diagnoses of low back pain and the radiographic diagnoses and plain film radiographs changed the suspected clinical diagnosis in 40.5% of cases. The management of the patients did not differ significantly pre- and post-plain film radiographs. With the exception of an increase in the use of manual therapy (39% to 62%), the plain film radiographs did not significantly alter the management of patients with low back pain at the CDC. It was also found that the suspected clinical diagnosis was not always given and no suitable reason was provided for radiographic referral in 14.6% of plain film radiographs and 20.7% were requested for unspecified pathology. Although Damon (2012) observed an overall agreement of 55.5% between the suspected clinical and radiographic diagnoses of knee pain, it was concluded that plain film radiographs did not significantly influence the diagnosis of patients with knee pain. The use of manual treatment increased from 67.8% to 82.9%. The increase in manual therapy observed in both studies could be explained by a lack of radiographic red flags which ruled out contraindications to spinal or knee joint manipulation or mobilisation. Many plain film radiographs were requested for unspecified pathology suggesting that students and clinicians requested plain film radiographs

unnecessarily when diagnosis could have been made on the clinical findings. The ordering of plain film radiographs in these cases suggest that the chiropractic students lack confidence in their diagnostic abilities and, therefore, have become reliant on plain film radiographs to reach a diagnosis. There may also be a fear of "missing something" of clinical significance, a red flag or a contraindication to manipulation.

In summary, the use of radiographs for diagnosis and assistance in the management of patients should be seen in the context of the clinical setting. A high number of requests for radiographs is to be expected in an emergency setting but in outpatient clinics, their over-utilization is questionable. Nonetheless, radiographs are important investigative tools when correctly indicated as shown in **Table 2.7** and discussed in **Section 2.4.3**.

2.6 AN OVERVIEW OF THE MANAGEMENT OF SHOULDER PAIN

The treatment of shoulder pathology depends on the clinical and/or the radiographic diagnosis and usually involves conservative, medical or surgical care (Vassallo, 2008). Conservative treatment does not involve surgical intervention and is aimed at preventing the progress of a disease process, controlling symptoms, pain management and activity modification (Pandya, 2011). Surgical treatment is a more invasive form of treatment for diseases or injuries that involve operative procedures (e.g. soft tissue release, tenosynovectomy, synovectomy, osteotomy etc.) to provide pain relief and restore function (Colledge et al., 2010). Surgery also has higher risks than conservative treatment ranging from infection of surgical site, adverse reaction to medication or anaesthesia to more rare complications such as wrong site or even the wrong patient (Mulholland and Doherty, 2011). Medical management refers to the whole system of care of a patient usually involving pharmacological agents and can encompass both conservative and non-conservative methods.

2.6.1 Conservative Management

The principles of passive and active care may be utilised for conservative patient management. Passive care is effective in the acute phase of the injury but ultimately active care is preferred. The two types of care differ in the degree to which the patient is involved in decision-making and in implementing the therapy (Mootz and McCarthy, 1999). Passive care involves the practitioner conducting therapeutic procedures on the patient; for example massage, manipulation and therapeutic ultrasound. The advantage of this

approach is that it is dependent on the practitioner who is able to monitor the treatment. On the other hand, it reduces the role of the patient in his/her own care. Active care includes stretching, strengthening and biofeedback (Mootz and McCarthy, 1999) where the patient assumes a more active role in his or her treatment and, hence, greater responsibility. However, the practitioner then loses a degree of control over the treatment as patients may not perform the prescribed home care (i.e. poor compliance).

Non-invasive conservative care refers to the use of modalities and techniques which do not penetrate the skin such as manipulation and mobilisation, US, transcutaneous electrical nerve stimulation (TENS), ischemic compression, stretching etc. Invasive care refers to dry needling, acupuncture and injection which penetrate the skin (Kalichman and Vulfsons, 2010). Invasive techniques are riskier than non-invasive methods due to the possibility of introducing infection into the body. The use of sterile needles that have not been utilised before and the practice of aseptic techniques (e.g. wiping relevant area with alcohol swab) minimises this risk (Dommerholt and De las Penas, 2013). Conservative treatment may involve rest, inflammation and pain control, soft tissue therapy (massage and ischemic compression), ROM and proprioception exercises as well as stretching and strengthening exercises to increase functioning of the shoulder (Burbank et al., 2008; Gonzalez, 2011). Cryotherapy (e.g. ice), heat, mobilization, physiotherapy, manipulation and home care can also be used in the treatment (Hains, 2002). Modalities are chosen by the practitioner according to the desired outcome e.g. single application or combination of TENS, interferential current (IFC), US and heat for pain control; cryotherapy (ice) to decrease inflammation and soft laser to promote wound healing (Wyatt, 2005). A follow-up appointment may be scheduled to determine the response to treatment and to reassess the diagnosis (by further history and examination, and investigations (e.g. radiographs) if required) and the treatment plan (Vear, 1992).

It is common for a patient to present with several concomitant conditions of the shoulder. The approach to the management of pathologies such as degeneration and minor muscle strains may not require a significant change in the treatment, irrespective of the specific clinical diagnosis, as conservative treatment is preferred in these cases. However, orthopaedic referral and surgery may be required if conservative treatment fails (Mitchell et al., 2005) or if there is development of red flags.

2.6.1.1 Chiropractic Management of Shoulder Pain

Chiropractic, a neuro-muscular-skeletal-based practice, means ‘by hand’ (Trivieri and Anderson, 2002). The management focus is on a hands-on and non-invasive conservative care approach to patient care (Hains, 2002). The goals of chiropractic care are to decrease pain, increase ROM and improve functioning of the affected area (Hains, 2002; Wyatt, 2005). The treatment approach involves joint and soft tissue manipulation (either by hand or instrument-assisted e.g. activator) and mobilisation with or without the addition of non-invasive or invasive modalities which depend on the diagnosis and preference of the practitioner. Chiropractic also involves patient education, lifestyle advice and ergonomic assessment (Hains, 2002). Joint manipulation and mobilisation may be regional (i.e. the affected joint) or may include both extremity and spinal joints. Manipulation of the cervical spine may be used in the treatment of shoulder pain as the cause may be related to the cervical nerves and/or nerve roots that innervate the shoulder (Moore and Dalley, 2006). Follow-up consultations for determining the response to treatment and for patient re-assessment may be required during chiropractic care but these must be justified by the chiropractor (Vear, 1992).

A summary of studies reporting on the conservative, including chiropractic, management of shoulder pain is tabulated in **Table 2.10**.

Table 2.10 A summary of studies on conservative treatment of shoulder pain

Reference	Setting	Sample	Radiograph use	Treatment	Duration of Rx	Outcome
Burkhead and Rockwood (1992)	Health Centre (MD)	115	Yes	Exercise programme	Variable	Variable-improvement in 15% (traumatic) and 87% (atraumatic)
Polkinghorn (1995)	Private Clinic (C)	1	No	Activator adjusting instrument	Not mentioned	Resolution of symptoms
Hanten et al. (2000)	Private Clinic (PT)	40	No	Ischemic compression and stretch Active ROM	5 days	Ischemic compression & stretch showed greater pain improvements
Green et al. (2003)	None (literature review)	26	No	Exercise Mobilization Laser therapy Ultrasound	Not mentioned	Variable
Edwards and Knowles (2003)	Private Clinic (PT)	40	No	Dry needling Stretching	6 weeks	Dry needling & stretching combined showed greater improvement (decreased pain) than stretching alone
Senbursa et al. (2007)	University Clinic (PT)	30	No	Soft tissue/joint manipulation Self training programme	4 weeks	Decrease in pain and increased function
Hains et al. (2010)	Private Clinic (C)	41	No	Ischemic compression	5 weeks	Reduced symptoms of shoulder pain

Rx = Treatment; MD = medical doctor; C = Chiropractic; PT = Physical therapy; ROM = Range of motion

The success of an exercise programme in the management of shoulder pain may be related to the aetiology. Burkhead and Rockwood (1992) assessed the effectiveness of an exercise programme to strengthen the deltoid and rotator cuff musculature in the treatment of shoulder dislocation after reduction in 115 patients between the ages of 12-54 years. The patients were assessed at six-to-eight-week intervals and if no improvement was shown after three to four months they were referred for surgery. The results varied depending on the nature of the dislocation (traumatic and atraumatic) and the direction (anterior, posterior or multidirectional) with overall good results in 15% of traumatic dislocation and 87% of atraumatic patients. In a case study report, Polkinghorn (1995) described the effectiveness of activator manipulation in the treatment of adhesive capsulitis in a 53-year-old woman. There was a resolution of symptoms following activator manipulation after other treatments (non-steroidal anti-inflammatories (NSAIDs) and physical therapy) had failed. This result needs to be substantiated by well-designed,

controlled, clinical trials before firm conclusions can be made on the effectiveness of this modality.

A combination of ischemic pressure and stretching may be beneficial as part of a home care programme for the treatment of myofascial trigger points in the neck and upper back (Hanten et al., 2000). A sample of 40 patients aged between 23-58 years with one or more myofascial trigger points received a five-day programme of ischemic pressure and stretching or a control treatment of active ROM of the neck or upper back. The results showed that the ischemic pressure and stretching programme was effective in decreasing the pain and sensitivity of the trigger points. Green et al. (2003) reviewed a total of 26 trials on a variety of treatment approaches. These trials were on adults (> 18 years) and treatments included NSAIDs, intra-articular and subacromial glucocorticosteroid injection, oral glucocorticosteroid medication, physiotherapy interventions, manipulation under anaesthesia, hydrodilation and surgery. They reported that there is a lack of uniformity in the diagnosis of shoulder disorders and a large variation in the assessment of trial outcomes. The only conclusion that could be made was that NSAIDs and subacromial glucocorticosteroids are more effective than placebo in improving rotator cuff, and by inference, shoulder ROM.

Edwards and Knowles (2003) studied the effectiveness of dry needling (an invasive approach) and active stretching of the muscles containing trigger points, in the treatment of 40 patients over the age of 18 in a private practice. These patients were placed in one of three groups: Group One received dry needling and active stretching; Group Two received active stretching alone and Group Three received no treatment. After three-weeks there were no significant differences amongst the three groups. However, after a further three weeks there was a significant improvement in the pain pressure threshold of Group One compared to the other groups. This study also suggests that treatment responses may not always be apparent immediately and sometimes require follow-ups which may extend to several weeks.

Senbursa et al. (2007) compared conservative treatment with and without manual therapy at the Clinic of Physiotherapy and Rehabilitation at Hacettep University, Turkey. Patients were allocated to two groups. A total of 30 patients were included in the study, with the average ages being 50 and 48 years respectively for each group. Those in Group One were treated with stretching, strengthening and ROM exercises and those in Group Two were treated with soft tissue and joint manipulation, ice, stretching and strengthening. Both groups showed a significant improvement over the four-week period. Despite the

positive result, the small sample size and selection of combination treatment approaches with no control are significant limitations of this study.

The study by Hains et al. (2010) was set in a private clinic in Canada and patients, aged between 30-60 years, underwent three treatments a week over five weeks. It was observed that ischemic compression at sites surrounding the shoulder resulted in a decrease of the symptoms of patients' suffering from chronic shoulder pain. The results of the studies in **Table 2.10** show that conservative treatment, including chiropractic, has a role in the management of shoulder pain but these require confirmation in future trials with larger samples sizes and robust methodologies.

2.6.2 Medical Management

Medical management is a very broad category encompassing many treatments that may overlap into both conservative and surgical management. It usually precedes surgical management and patients are often referred to a specialist during medical management. Medical management and conservative management are both provided at a first contact primary care level (Goroll and Mulley, 2009), depending on where the patient presents for treatment (i.e. a medical doctor or chiropractor). Patients may be treated medically and later referred for conservative treatment either by the doctor if he is of the opinion that conservative management is the best approach or when medical management fails and the patient seeks additional/alternative treatment. The opposite is also true; patients may be referred for medical treatment by a practitioner if he is of the opinion it would be best for the patient or after no response to conservative treatment (Mitchell et al., 2005).

Pain control is a significant part of medical management, often involving the prescription of NSAIDs, paracetamol and even short-term opiate medication. Corticosteroids can be injected directly into the affected area and have been found to be effective in rotator cuff tendonitis and arthritis (Burbank et al., 2008).

2.6.3 Surgical Management and Post-Surgical Rehabilitation

Patients are often referred to an orthopaedic specialist when there has been a poor response to non-operative treatments, disabling pain or have an unknown diagnosis (Burbank et. al., 2008). Surgery may also be indicated by radiographs (in the case of fractures and dislocations). This can include resection of the clavicle in AC arthritis, arthroplasty or debridement in glenohumeral arthritis, surgical manipulation or

arthroscopic release in adhesive capsulitis and arthroscopic decompression and repair in rotator cuff disorders (Burbank et al., 2008).

Invasive and non-invasive care can be used in the management of fractures depending on the type and location of the fracture. Non-invasive approaches include closed reduction techniques by manipulation or traction and are immobilised with casts or splints. Invasive care uses open reduction with internal fixation (ORIF) and immobilisation is obtained with the use of screws, plates, pins, rods and external fixations (Paz and West, 2014). The goals of fracture management are bone union, limitation of further damage, normalization of function, maintenance of ROM and limitation of muscle atrophy. Invasive methods are used when non-invasive methods are not effective in providing support and the fixation is not adequately maintained throughout the healing process.

Pain management after surgery is often managed medically in the acute phase and later managed conservatively. Savoie et al. (2000) reported that the bupivacaine pain control infusion pump is effective in decreasing pain post-shoulder surgery; however, systemic opioids are still the most commonly-used analgesia whether intravenous or intramuscular (Kavanagh et al., 1995). Unfortunately, opioids have side-effects such as nausea, vomiting and respiratory depression and their therapeutic window is short (Kavanagh et al., 1995). Conservative pain control becomes a factor after the acute phase and helps manage the pain during rehabilitation. Rehabilitation can be complex and both physical and emotional factors need to be considered in chronic and post-surgical treatment. General goals of treatment include increasing function and quality of life and decreasing pain and dependence on caregivers. Joint manipulation can aim in the transition from passive to active care and help resolve symptoms that arise during treatment (Triano et al., 1997).

2.7 CONCLUSION

Plain film radiographs have an important role in reaching a definitive diagnosis or confirming a suspected clinical diagnosis (especially when radiographic indicators are present) (Castro et al., 2001). They also play a role in the development of a management protocol i.e. whether conservative or surgical management is required (Paz and West, 2014). Plain film radiographs have many advantages as diagnostic imaging tools and can be used in various clinical settings (Fraenkel et al., 1998; Kahn and Mehta, 2007; McPhail, 2011; Abdulkadir et al., 2011; Damon, 2012).

At the CDC of the DUT radiographs are requested by the students at the instruction of the attending clinician based on the case presentation. According to the Clinic Manual (Chiropractic Clinic Manual, 2015) and other reported guidelines in the literature (Bamji et al., 1996; Ammendolia et al., 2002), the appropriate indicators for radiographic referral **(Table 2.7)** must be considered when requesting radiographs. However, there is uncertainty as to whether these guidelines are adhered to in practice at the CDC for shoulder complaints. It is not known whether the radiographic diagnosis influences the initial suspected clinical diagnosis. Moreover, it is also not known what types of suspected clinical and radiographic diagnoses of shoulder conditions are observed in the CDC and how these conditions are managed by the students. Therefore, the aim of this study was to determine the impact of the radiographic report of plain film radiographs on the suspected clinical diagnosis and conservative management of shoulder pain at the CDC.

CHAPTER THREE

MATERIALS AND METHODS

3.1 STUDY DESIGN AND APPROVAL TO CONDUCT THE STUDY

This was a quantitative, retrospective, non-experimental study. The data for this study was collected from the plain film radiographs and corresponding clinical records of patients who presented to the CDC with shoulder pain between the periods of 24 April 1992 to 19 September 2011. The dependent variables were stated as the suspected clinical diagnoses and the conservative managements and the independent variable was stated as the radiographic report (Esterhuizen, 2015). Ethical clearance and approval to conduct the study was obtained from the Institutional Research Ethics Committee (IREC) of DUT (**Ethical clearance certificate number 003/14**) **(Appendix C)**.

3.2 POPULATION, SAMPLING METHOD AND SAMPLE SIZE

3.2.1 Population:

The population was all the plain film radiographs of the shoulder and clinical records of patients who presented with shoulder pain of the shoulder stored in the CDC archives between April 1992-September 2011.

3.2.2 Sampling method and sample size:

No sampling method was required as the entire population of plain film radiographs of the shoulder were used (Esterhuizen, 2015). Not all plain film radiographs stored at the CDC archive (i.e. those of other conditions e.g. lumbar, knee, elbow, and other regions) were considered for this study, only the plain film radiographs of the shoulder. All data collected was recorded on the data sheets **(Appendix A)**. A total of 94 plain film shoulder radiographs were located in the CDC archives at the beginning of this study. In 2011 there was a change in the CDC procedure and plain film radiographs were no longer stored at the CDC but given to the patient to take home. There were no plain film radiographs of the shoulder in the CDC archives dated between September 2011 and February 2014. Patient

files and plain film radiographs that did not satisfy the inclusion criteria were excluded. The final sample size was, therefore, 54 plain film radiographs of the shoulder and related clinical files.

3.3 INCLUSION AND EXCLUSION CRITERIA

3.3.1 Inclusion Criteria

1. Plain film radiographs of the shoulder taken during treatment for shoulder pain at the CDC.
2. The availability of at least one radiographic view of the shoulder taken for each patient.
3. Clinical records of files of any patients* who presented to the CDC with shoulder pain.

***** The clinical records were of patients who had plain film radiographs taken during treatment at the CDC

3.3.2 Exclusion Criteria

1. Plain film radiographs of the shoulder taken before the consultation at the CDC.
2. Files of patients with shoulder pain with a completed Subjective, Objective, Assessment, Treatment Plan and Education (SOAPE) but the plain film radiographs were taken prior to the patient presenting to the CDC.
3. Patient files with a missing case history/physical/orthopaedic/SOAPE note.

3.4 RESEARCH PROCEDURES

This research took place in 3 steps:

Step 1:

Plain film radiographs from the CDC archives were obtained and sorted (to separate the plain film radiographs of the shoulder from the rest of the plain film radiographs). The patient's name and date of birth were recorded on a Patient Confidentiality Coding Sheet **(Appendix B)**. This was done to locate the corresponding patient files using the CDC computer archive system. A code was assigned to each patient's name. The coding sheet with the patients names was destroyed once a code had been assigned to each patient. These codes were used on all data sheets that followed.

Step 2:

All plain film radiographs and patient files were evaluated briefly to determine if they met the inclusion criteria. In cases where there was no radiographic report (by a radiologist), the plain film radiograph was evaluated for the diagnosis by both the researcher and supervisor (16 years clinical experience).

Step 3:

Each plain film radiograph and the corresponding patient file were evaluated. The relevant data which is shown in **Table 3.1** was then transcribed on a Data Sheet **(Appendix A)** and then entered on an Excel Spreadsheet (Microsoft Excel 2002), which was then sent to a statistician. No instruments were utilised for this study except a radiograph viewing box to evaluate the plain film radiographs.

Table 3.1 The type and source of the data

Data	Source
Age, sex, race of patients	Case history form
Date of the initial consultation	Case history form and SOAPE note
History of shoulder pain with/without referral	Case history form
Treatment plan before plain film radiographs*	SOAPE note
Reason for radiographic referral/suspected clinical diagnosis	SOAPE note and/or radiology request form
Date of plain film radiographs	Radiology report and/or identification marker on plain film radiograph
Radiographic diagnosis	Radiology report
Radiographic incidental findings	Radiology report
Clinical diagnosis after plain film radiographs	SOAPE note
Change (or no change) in treatment outlines after plain film radiographs	SOAPE note

SOAPE = Subjective, objective, assessment, plan, education

* Plain film radiographs refer to the plain film radiographs of the shoulder

Table adapted from McPhail (2010) and Damon (2012)

3.5 ETHICAL CONSIDERATIONS

Before a patient presents at the CDC and undergoes any examination or treatment, he/she signs an informed consent form. Besides providing consent for examination and treatment, the consent also allows for the use of clinical and radiographic data for research purposes provided that the confidentiality of the patient is strictly maintained.

Therefore, the patient names were coded and do not appear on any data sheets, in this dissertation or in publications that may arise from this study.

3.6 STATISTICAL ANALYSIS

A qualified and experienced biostatistician was consulted for all the statistical tests and analyses (Esterhuizen, 2014). The Statistical package for the Social Sciences (SPSS) Version 21 (SPSS Inc, Chicago, Illinois, USA) was used in the analyses of the data in this study. The association between the radiographic diagnosis and the suspected clinical diagnosis were determined using McNemar's chi square tests for binary paired proportions. A *P*-value of <0.05 was considered as statistically significant. Diagnoses were categorised into specific groups and indicator variables were used to construct two-by-two tables of absence or presence of radiographic versus suspected clinical diagnosis for each specific diagnosis. This way, the associations between radiographic and suspected clinical diagnoses were assessed for each condition separately. Objectives Two and Three were purely descriptive and were analysed and the outcomes reported using frequency counts and percentages in the case of categorical variables, or summary statistics such as mean, standard deviation and range in the case of quantitative variables (Esterhuizen, 2014).

CHAPTER FOUR

RESULTS

4.1 AGE, RACE AND SEX OF PATIENTS WHOSE RECORDS WERE EXAMINED

The selected clinical and radiographic data of 54 patients are presented in this chapter. The mean, standard deviation and range of age of the patients whose records were examined are shown in **Table 4.1**. The predominant sex was male (54%) as shown in **Figure 4.1**. Most patients were White followed by Indians while Coloureds (i.e. mixed race) were the least represented **(Table 4.2)**.

Table 4.1 Mean, standard deviation, minimum and maximum age of the patients whose clinical files and plain film radiographs were examined

Parameter	Value
Mean (years)	43.5
Standard deviation	17.6
Maximum	82.0
Minimum	18.0
Range	54.0

Table 4.2 Race distribution of the patients whose clinical files and plain film radiographs were examined

Race	Number	Percentage
White	33	61.1
Black	3	5.6
Indian	17	31.4
Coloured	1	1.9
Total	**54**	**100.0**

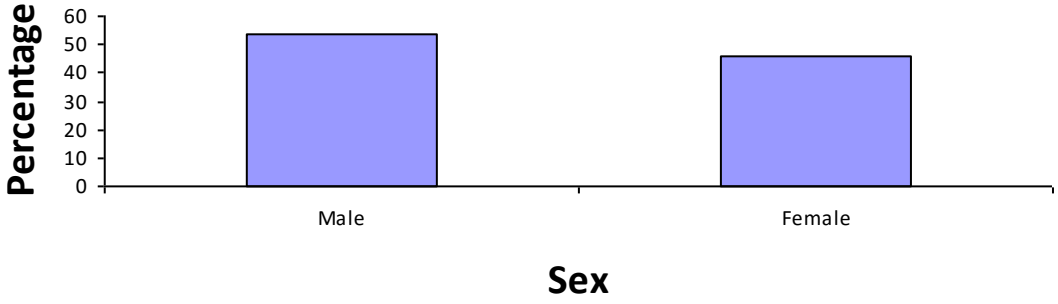

Figure 4.1 Sex distribution of the patients

4.2 THE ASSOCIATION BETWEEN THE SUSPECTED CLINICAL AND RADIOGRAPHIC DIAGNOSES OF PATIENTS WITH SHOULDER PAIN

The suspected clinical diagnoses (before plain film radiographs were taken and in most cases before management) and their corresponding radiographic diagnoses are tabulated in **Table 4.3**. An association could not be determined because there were too many categories of both suspected clinical and the radiographic diagnoses; therefore, this is presented descriptively rather than statistically (Esterhuizen, 2014). Some suspected clinical diagnoses had more than one radiographic diagnosis; for example AC joint sprain with associated myofasciitis.

In the case of a suspected clinical diagnosis of adhesive capsulitis, the main radiographic diagnosis was degenerative joint disease (DJD) **(Table 4.3)**. For bicipital tendonitis, a spectrum of conditions were observed on the plain film radiographs. These included arthritis, both degenerative and inflammatory, osteoporosis, joint subluxation and no abnormalities detected. There were no significant radiographic lesions seen on the plain film radiographs of patients with suspected rotator cuff conditions. The suspected clinical diagnosis of bursitis did not specify the specific bursa involved and no abnormalities were detected on the plain film radiographs.

There were 21 suspected clinical diagnoses of myofasciitis of which only four cases were specified. In these four cases the six muscles specified were the trapezius, infraspinatus, trapezius, rhomboid, supraspinatus and posterior cervical. In three unspecified cases, two were diagnosed as acute myofasciitis and in one as chronic myofasciitis, but the muscles were not specified. The other 14 cases were only described as myofasciitis which was often associated with a concomitant condition. “No abnormalities detected” and “DJD” were the two most common radiographic diagnoses in cases of suspected myofasciitis. In

addition, there were some significant conditions identified radiographically in these cases viz. clavicle fracture, rheumatoid arthritis, calcific tendonitis, periosteal reactions of the humerus and deformities of the clavicle and scapula. The radiologist suspected bursitis due to “slight fullness in the region of the acromial bursa”.

It was interesting to note that plain film radiographs of the shoulder were ordered for cervicogenic headaches and for thoracic facet syndrome. Generally no abnormalities were detected in the cases of cervical and thoracic facet syndromes, but in one case of thoracic facet syndrome, the plain film radiographs revealed an incomplete clavicular fracture which was related to a rugby injury. In this particular case, the student requested the radiologist to consider “pathology, fracture and trauma” on the radiographic request form but the suspected clinical diagnosis on the SOAPE stated “thoracic facet syndrome”. The suspected clinical diagnosis of “joint dysfunction” was vague as it did not specify which joints were involved nor what dysfunction meant in these cases. Plain film radiographs were requested for a suspected clinical diagnosis of a pectoralis major tear. As it was traumatic in nature the plain film radiographs were requested to evaluate for any related fracture or a Bankart lesion and none were found.

In the suspected clinical diagnosis of dislocation, both cases referred to acute dislocation of the glenohumeral joint. In one case plain film radiographs showed reduction of the dislocation and in the other it showed only degeneration of the AC joint. In the two cases of an unknown diagnosis, one stated “pending radiographs” and simply “pathology” on the radiographic request form. In the other case, the SOAPE note stated that the suspected clinical diagnosis was unknown, but the radiographic request form stated fracture as the reason for referral. Degenerative joint disease was mentioned in the SOAPE note but the actual joint was not specified. The radiographic diagnosis of capsular tear in the case of a suspected AC joint sprain was not a definitive diagnosis but was suspected by the radiologist because of the elevation of the distal clavicle that may indicate a small capsular tear or stretch. Elbow tendonitis was not specified but described as “chronic tendonitis of the lateral aspect of the elbow” and could refer to a number of tendons located in the area. The associated radiographic diagnosis of “cortical thickening” referred to cortical thickening of the humerus above the lateral epicondyle. Most clinically-suspected cases of glenohumeral joint sprain were normal radiographically. The periosteal reaction, observed in the one case of glenohumeral joint sprain, was located in the upper humerus at the junction of the middle and upper deltoid muscles. There was no other pathological lesion seen in this particular case.

"Nerve root entrapment" in this case referred specifically to that of C5 and C6 nerve roots and no abnormalities were observed in the shoulder. A pathological fracture of the humerus was observed concomitant with osteoporosis. This patient was then referred to hospital for further assessment and treatment. The radiographic diagnosis of a "tug lesion" (small protuberance representing bone formation at muscle attachment sites (Van Gelderen, 2004) was stated as being due to muscle attachment on the right humerus. There was only one suspected clinical diagnosis (DJD of the sternoclavicular joint) for which the radiographic diagnosis was in agreement. The agreement between the suspected clinical and radiographic diagnosis for fractures was 33.3% and for AC sprain the agreement was 20%. In summary, there was little to no agreement between the suspected clinical and radiographic diagnosis for the other conditions mentioned.

Table 4.3 The suspected clinical diagnoses of shoulder pain and other regional pain and their corresponding radiographic diagnoses

Suspected clinical diagnosis	Radiographic diagnosis	Count	Percentage
Adhesive capsulitis	DJD	4	66.6%
	NAD	1	16.7%
	Osteoporosis	1	16.7%
	Total	**6**	**100.0%**
Bicipital tendonitis	AC subluxation	1	7.7%
	DJD	4	30.7%
	Glenohumeral subluxation	1	7.7%
	NAD	5	38.5%
	Osteoporosis	1	7.7%
	Rheumatoid arthritis	1	7.7%
	Total	**13**	**100.0%**
RC tendonitis	Deformity and suspected shortening of lateral clavicle	1	33.3%
	NAD	2	66.7%
	Total	**3**	**100.0%**
Bursitis	NAD	1	100.0%
	Total	**1**	**100.0%**
Myofasciitis	Suspected bursitis	1	4.3%
	Calcific tendonitis	1	4.3%
	Capsular tear	1	4.3%
	Clavicular fracture	1	4.3%
	DJD	6	26.4%
	Deformity of clavicle	1	4.3%
	NAD	8	34.9%
	Osteoporosis	1	4.3%
	Sub-periosteal reaction of humerus	1	4.3%
	Rheumatoid arthritis	1	4.3%
	Scapular deformity	1	4.3%
	Total	**23**	**100%**
Cervical facet syndrome	DJD	1	25.0%
	NAD	3	75.0%
	Total	**4**	**100.0%**

Cervicogenic headaches	NAD	1	100.0%
	Total	**1**	**100.0%**
Thoracic facet syndrome	Clavicular fracture	1	33.3%
	NAD	2	66.7%
	Total	**3**	**100.0%**
Joint dysfunction	DJD	1	33.3%
	Osteoporosis	1	33.3%
	Sub-periosteal reaction of humerus	1	33.4%
	Total	**3**	**100.0%**
Impingement syndrome	DJD	1	25.0%
	Glenohumeral subluxation	1	25.0%
	NAD	1	25.0%
	Osteoporosis	1	25.0%
	Total	**4**	**100.0%**
Pectoralis major tear	NAD	1	100.0%
	Total	**1**	**100.0%**
Dislocation	Bursitis	1	50.0%
	DJD	1	50.0%
	Total	**2**	**100.0%**
Supraspinatus tendonitis	AC subluxation	1	16.7%
	DJD	1	16.7%
	Glenohumeral subluxation	1	16.7%
	NAD	2	33.3%
	Osteoporosis	1	16.6%
	Total	**6**	**100.0%**
DJD SC joint	DJD	1	100.0%
	Total	**1**	**100.0%**
Unknown	NAD	2	100.0%
	Total	**2**	**100.0%**
AC joint sprain	AC subluxation	1	20.0%
	Capsular tear or stretch	1	20.0%
	NAD	3	60.0%
	Total	**5**	**100.0%**
Costochondritis	NAD	1	100.0%
	Total	**1**	**100.0%**
SC joint sprain	NAD	2	100.0%
	Total	**2**	**100.0%**
DJD	DJD	1	50%
	Osteoporosis	1	50%
	Total	**2**	**100.0%**
RC strain	NAD	2	100.0%
	Total	**2**	**100.0%**
Spinal joint dysfunction	DJD	1	100.0%
	Total	**1**	**100.0%**
CTJ dysfunction	NAD	1	100.0%
	Total	**1**	**100.0%**
Brachial plexus injury	Deformity of clavicle	1	100.0%
	Total	**1**	**100.0%**
Glenohumeral fixation	NAD	1	100.0%
	Total	**1**	**100.0%**
Capsular strain	AC subluxation	1	33.3%
	NAD	2	66.7%
	Total	**3**	**100.0%**
Elbow tendonitis	Cortical thickening of humerus above lateral epicondyle	1	100.0%
	Total	**1**	**100.0%**

Humeral bone lesion	Cortical thickening of humerus above lateral epicondyle	1	100.0%
	Total	**1**	**100.0%**
Glenohumeral joint sprain	DJD	1	14.3%
	NAD	4	57.1%
	Osteoporosis	1	14.3%
	Periosteal reaction of upper humerus	1	14.3%
	Total	**7**	**100.0%**
Nerve root entrapment	NAD	1	100.0%
	Total	**1**	**100.0%**
Humeral fracture	Osteoporosis	1	33.3%
	Pathological fracture	1	33.3%
	Tug lesion	1	33.4%
	Total	**3**	**100.0%**
Triceps strain	Tug lesion	1	100.0%
	Total	**1**	**100.0%**

NAD = No abnormalities detected; DJD = degenerative joint disease; AC = acromioclavicular; SC = sternoclavicular; RC = Rotator cuff; CTJ = Costotransverse joint

4.3 THE CONSULTATION AT WHICH THE PLAIN FILM RADIOGRAPH WAS REQUESTED AND THE REASONS THEREOF

The consultation at which a plain film radiograph of the shoulder was requested is presented in **Table 4.4**. The told number reasons (i.e. 74) id greater than the number of plain film radiographs because the clinician and student provided more than one reason when ordering plain film radiographs. Unsurprisingly, the majority of the plain film radiographs were requested at the first consultation. As the number of treatment sessions increased, the request for plain film radiographs decreased. However, at treatment sessions 10 and 11, there was a slight increase which tapered-off with subsequent consultations. Interestingly, a few plain film radiographs were requested as late as the 17th and 18th treatment sessions.

When referring for plain film radiographs, the student and clinician are required to complete a radiographic request form. On this form the student is required to state the reason for radiographic referral. This may include the suspected clinical diagnosis or to rule out other suspected diagnoses. Often the reasons provided in the referral form did not directly correspond with the suspected clinical diagnoses on the SOAPE note. There were 14 reasons plain film radiographs were ordered that were recorded on the radiographic request forms. These are tabulated in **Table 4.5**. The most common reason was “suspected pathology” (38.2%) followed by “fracture” (18.5%). “Suspected pathology” included any pathology that the clinician or the student suspected but did not record anything specific on the radiographic request form.

It is not possible to elaborate on what “skeletal abnormalities” were referring to as they were not specified by the student or the clinician. There were 14 cases of suspected fracture but in only two cases was the fracture specified viz. fracture of the glenoid rim and fracture of the acromion or clavicle. In four cases the reason for the radiographic request was not filled in and this was considered as “unknown” for this study. In all three cases of dislocation no specific details were given. Tumour and avascular necrosis (AVN) were both suspected in one patient. There were four cases of suspected instability of which only one specified the instability involving the AC joint.

Interestingly, plain film shoulder radiographs were requested in a case of cervicogenic headaches and a case of thoracic facet syndrome; both the patients were referred for plain film radiographs at treatment 11 with “suspected pathology” as the reason for the referral. The third case referred at treatment 11 had a suspected clinical diagnosis of bicipital tendonitis with myofasciitis. The reasons for referral at treatment number 10 included “unknown” and “suspected pathology” and at treatment number 11 all three cases were “suspected pathology”. Only one patient was referred for plain film radiographs at treatment 12 with both “calcific tendonitis” and “tumour/AVN” being the reasons for referral. The reasons provided for radiographic referral of the shoulder at treatments 17 and 18 were “suspected pathology” and “suspected pathology/fracture/dislocation”, respectively.

Table 4.4 Consultation at which the plain film radiograph was ordered

Consultation	Frequency	Percent
1	31	57.4
2	5	9.2
3	3	5.5
5	2	3.7
6	3	5.5
8	1	1.9
9	1	1.9
10	2	3.7
11	3	5.5
12	1	1.9
17	1	1.9
18	1	1.9
Total	**54**	**100.0**

Table 4.5 Reasons for radiographic referral

Reason for radiographic referral	Count
Skeletal abnormalities	2
Suspected pathology	29
DJD	8
Calcific tendonitis	3
RC tendonitis	2
Bankart lesion	2
Fracture	14
Unknown	4
AC/SC trauma	3
Dislocation	3
Tumour/AVN	1
Instability	4
Adhesive capsulitis	1
Total	**76**

AC = Acromioclavicular; SC = Sternoclavicular; AVN = Avascular necrosis; DJD = Degenerative joint disease; RC = Rotator cuff

4.4 SUSPECTED CLINICAL DIAGNOSIS AND MANAGEMENT PRIOR TO REFERRAL FOR SHOULDER PLAIN FILM RADIOGRAPHS

The frequency of the general management approach prior to obtaining the shoulder plain film radiographs is depicted graphically in **Figure 4.2**. This highlights the diversified approach to conservative management of shoulder conditions at the CDC. There were 125 individual treatments utilised before the plain film radiographs with the most common being soft tissue techniques (33.6%).

Soft tissue techniques refer to ischemic compression, dry needling and massage of the soft tissue of the shoulder complex. Electrotherapy included modalities such as US, TENS and IFC. Manual therapy included shoulder adjustments and mobilisation. Stretching and strengthening included static stretches, proprioceptive neuromuscular facilitative (PNF) stretches and strengthening exercises related to the shoulder. Heat therapy, cryotherapy (ice) and strapping were classified as 'Other'.

The management options for each suspected clinical diagnosis are shown in **Table 4.6.** No specific trend could be established for a specific diagnosis, but the results show that most diagnoses were treated with more than one approach. The treatment of shoulder conditions at the CDC essentially involves three main modalities viz. soft tissue therapy, manual and electrotherapies. Stretching or strengthening programmes together with heat, cryotherapy and strapping was added if required. In one case of adhesive capsulitis the patient was referred immediately for plain film radiographs with no treatment provided.

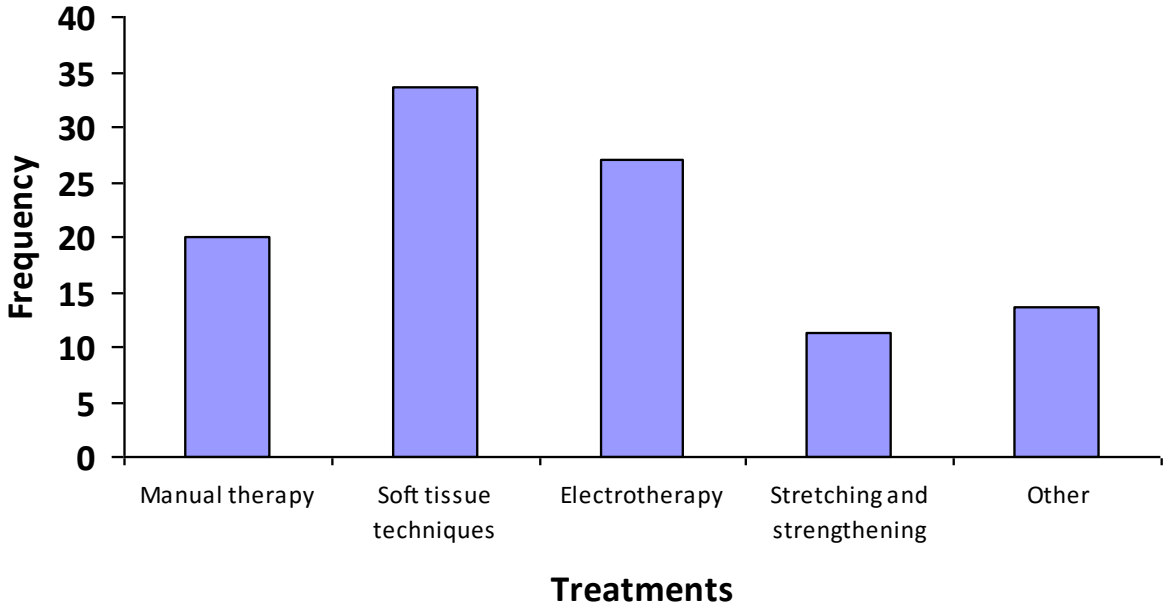

Figure 4.2 Frequency of treatments prior to plain film radiographs

Table 4.6 Suspected clinical diagnosis and management prior to plain film radiographs

Suspected clinical diagnosis	Manual therapy	Soft tissue techniques	Electrotherapy	Stretching /Strengthening	Other
Adhesive capsulitis	✓	✓	✓	✓	✓
Bicipital tendonitis	✓	✓	✓	✓	✓
RC tendonitis	✓	✓	✓		
Bursitis		✓	✓		✓
Myofasciitis	✓	✓	✓	✓	✓
Cervical facet syndrome	✓	✓	✓	✓	✓
Cervicogenic headaches	✓	✓		✓	
Thoracic facet syndrome	✓	✓	✓	✓	✓
Joint dysfunction	✓	✓	✓		
Impingement syndrome	✓	✓	✓		✓
Pectoralis major tear					✓
Dislocation		✓	✓		✓
Supraspinatus tendonitis	✓	✓	✓		
DJD SC joint		✓	✓	✓	
Unknown		✓	✓		✓
AC joint sprain	✓	✓	✓	✓	✓
Costochondritis		✓		✓	
SC joint sprain	✓	✓			
DJD	✓		✓		
RC strain		✓	✓		
Spinal joint dysfunction	✓	✓	✓		

CTJ dysfunction	✓	✓		✓	
Brachial plexus injury	✓	✓	✓	✓	
Glenohumeral fixation		✓		✓	
Capsular strain	✓	✓	✓		
Elbow tendonitis		✓		✓	
Humeral bone lesion		✓		✓	
Glenohumeral sprain	✓	✓	✓		✓
Nerve root entrapment	✓	✓	✓		
Humeral fracture					✓
Triceps strain					✓

SC = Sternoclavicular; AC = Acromioclavicular; DJD = Degenerative joint disease; RC = Rotator cuff; CTJ = Costotransverse joint

4.5 CHANGES IN THE SUSPECTED CLINICAL DIAGNOSIS AND MANAGEMENT AFTER PLAIN FILM RADIOGRAPHS

Of the 54 plain film radiographs and files examined there was a change in the suspected clinical diagnosis in 21 cases, no change in 22 and no information was available in 11 cases as the patients did not return to the CDC for a follow-up consultation **(Figure 4.3)**.

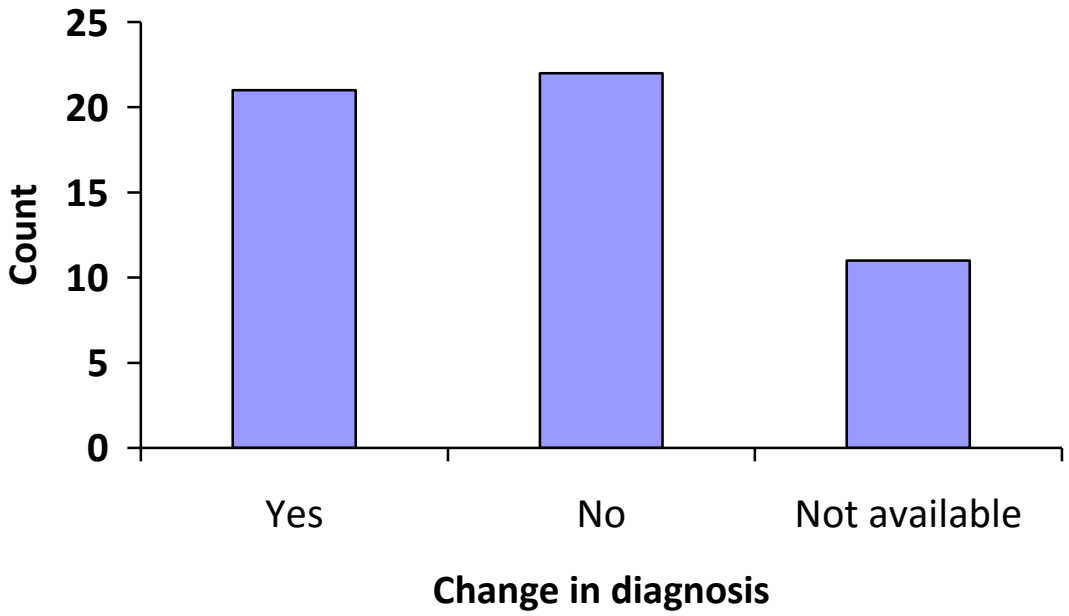

Figure 4.3 Change in diagnosis

Of the 21 changed suspected clinical diagnoses, 15 were a true change in diagnosis, five were an addition to the diagnosis and one was a deletion to the diagnosis **(Table 4.7)**. Additions to diagnoses were shown in the new diagnosis of adhesive capsulitis and DJD when degeneration was apparent on the plain film radiographs. This was also the case with bicipital tendonitis and DJD. However, the other cases of addition were not as simple and it was interesting to note that in most cases (13), the change in diagnosis was not directly related to the plain film radiographs. This was seen in the case of a plain film radiograph that showed no abnormalities, but the diagnosis changed from myofasciitis to thoracic facet syndrome with concomitant myofasciitis. In another case in which no abnormality was detected on the plain film radiographs, an addition of impingement syndrome was made to the suspected clinical diagnosis of rotator cuff strain and myofasciitis. There was also an addition of supraspinatus tendonitis to a diagnosis of AC joint sprain and myofasciitis although the suspected radiographic diagnosis was a capsular tear. A deletion in suspected clinical diagnosis was noted in the case of nerve root entrapment and bicipital tendonitis which changed to nerve root entrapment only. There were no abnormalities detected on the plain film radiographs in this case.

There were cases in which there were no abnormalities detected on plain film radiographs and there was a change in suspected clinical diagnosis. Costotransverse joint dysfunction and myofasciitis changed to bicipital tendonitis and myofasciitis, and thoracic facet syndrome and myofasciitis changed to AC joint sprain. In one case with the suspected clinical diagnosis of dislocation, plain film radiographs showed only degeneration of the AC joint and the diagnosis was changed to a contusion injury.

There was a case where the plain film radiographs showed DJD and osteoporosis and the suspected clinical diagnosis changed from glenohumeral joint sprain and DJD to myofasciitis. It was also interesting to note a change in diagnosis from glenohumeral joint sprain, thoracic and cervical facet syndrome and myofasciitis to a vague and unhelpful diagnosis of connective tissue disorder. The plain film radiograph in this case showed no abnormalities.

In the 59 individual treatments used, 40.7% treatments changed after obtaining plain film radiographs of the shoulder **(Figure 4.4)**. “Not available” refers to no follow-up treatment after plain film radiographs were taken. The most common treatment post-plain film radiograph was soft tissue techniques (32.2%) followed by electrotherapy (28.8%) (**Figure 4.5)**. There was a reduction in the utilization of manual therapy after plain film radiographs were obtained. It was interesting to note that although there may have been a change in

suspected clinical diagnosis there was not always a change in treatment and in a similar manner the suspected clinical diagnosis may have remained the same but there was a change in treatment. For example, sternoclavicular instability changed to AC instability and bicipital tendonitis with associated myofasciitis changed to rheumatoid arthritis with no change in treatment. Cervical facet syndrome had no change in suspected clinical diagnosis but the treatment changed from manual therapy and soft tissue to soft tissue, electrotherapy and stretching and strengthening and in the case of a pectoralis major tear, the treatment changed from no treatment to soft tissue and electrotherapy.

Table 4.7 Details of the change in suspected clinical diagnosis

Suspected clinical diagnosis	Radiographic diagnosis	Change, addition or deletion in diagnosis	New clinical diagnosis
Adhesive capsulitis	DJD	Addition	DJD and adhesive capsulitis
Bicipital tendonitis	DJD	Addition	DJD and bicipital tendonitis
Myofasciitis	Calcification of supraspinatus	Change	Supraspinatus calcification
Thoracic facet syndrome and myofasciitis	Clavicle fracture	Change	Clavicle fracture and myofasciitis
Bicipital and supraspinatus tendonitis	AC subluxation	Change	Adhesive capsulitis
Unknown	NAD	Change	RC strain
AC joint sprain	NAD	Change	Myofasciitis
Dislocation	DJD	Change	Contusion injury and myofasciitis
GH sprain, thoracic and cervical facet syndrome and myofasciitis	NAD	Change	Connective tissue disorder
GH sprain and DJD	DJD and osteoporosis	Change	Myofasciitis
Myofasciitis	NAD	Addition	Thoracic facet syndrome and myofasciitis
Impingement syndrome	NAD	Change	Myofasciitis
RC strain and myofasciitis	NAD	Addition	Impingement syndrome, RC strain and myofasciitis
AC joint sprain and myofasciitis	Capsular tear	Addition	Supraspinatus tendonitis, AC joint sprain and myofasciitis
Unknown	NAD	Change	DJD and supraspinatus tendonitis
Spinal joint dysfunction	DJD	Change	DJD

CTJ dysfunction and myofasciitis	NAD	Change	Bicipital tendonitis and myofasciitis
Bicipital tendonitis and myofasciitis	DJD and RA	Change	RA
Thoracic facet syndrome and myofasciitis	NAD	Change	AC joint sprain
Bicipital tendonitis and NRE	NAD	Deletion	NRE
Humeral fracture and triceps strain	Tug lesion	Change	Contusion injury

AC = acromioclavicular joint; CTJ = Costotransverse joint; NAD = No abnormality detected; DJD = Degenerative joint disease; RA = Rheumatoid arthritis; NRE = Nerve root entrapment; RC = Rotator cuff; GH = Glenohumeral

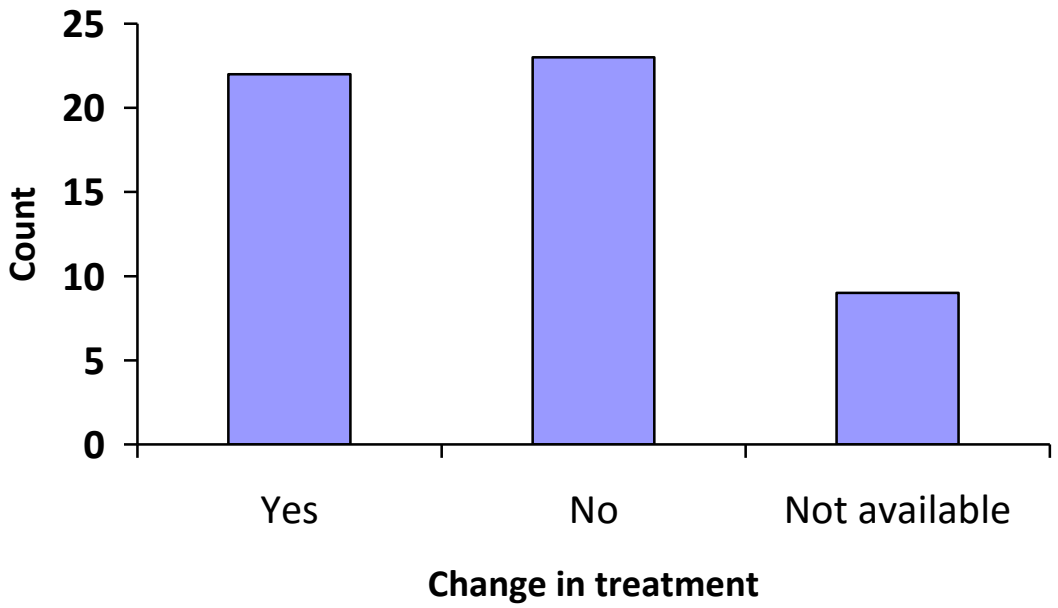

Figure 4.4 Change in treatment after plain film radiographs

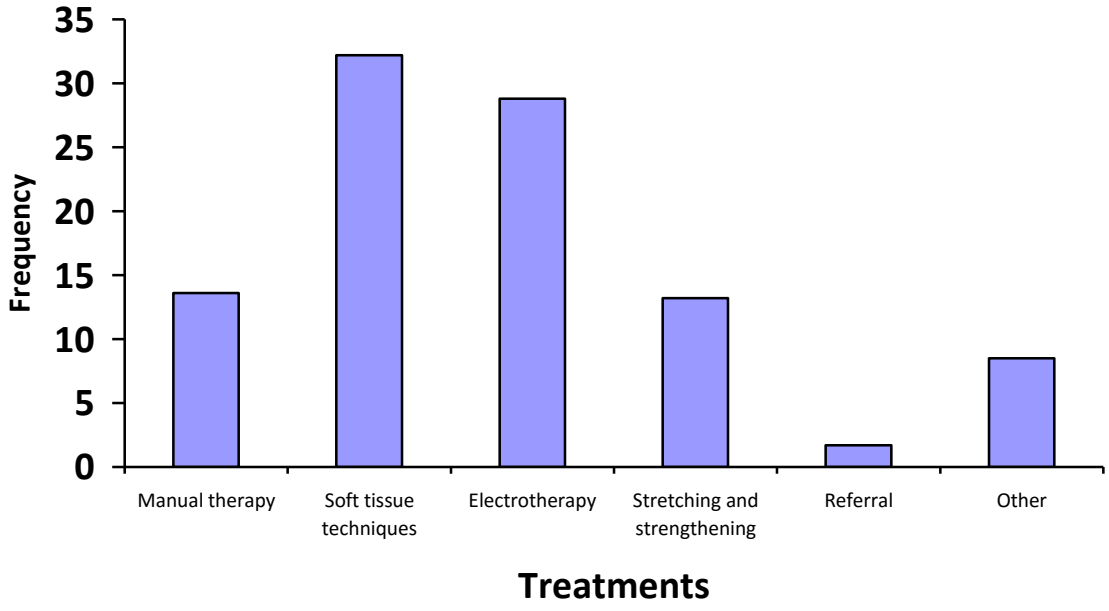

Figure 4.5 Frequency of the treatments after plain film radiographs

A comparison in the frequency of treatments before and after plain film radiographs is shown in **Table 4.8.** Soft tissue therapy was the most common treatment both before and after plain film radiographs although there was a slight decrease in frequency post-plain film radiographs **(Table 4.8)**. There was also a decrease in frequency in manual therapy by 6.4% and "Other" treatments by 4.3%. There was an increase in frequency of electrotherapy (7.4%), stretching and strengthening (4%) and referral (1.7%) post-plain film radiographs.

Table 4.8 Change in treatment prior and post-plain film radiographs

Treatment	Percentage pre-plain film radiographs	Percentage post-plain film radiographs	Percentage increase/ decrease
Manual therapy	20.0	13.6	-6.4
Soft tissue techniques	33.6	32.2	-1.4
Electrotherapy	21.6	28.8	7.2
Stretching and strengthening	11.2	15.2	4.0
Referral	0.0	1.7	1.7
Other	13.6	8.5	-5.1
Total	**100.0**	**100.0**	

4.6 INCIDENTAL FINDINGS

Of the 54 plain film radiographs examined, ten incidental findings were observed in nine plain film radiographs **(Figure 4.6)**. The most common incidental finding was previous fracture (four). This referred to fractures of the clavicle or humerus that occurred in the past. Old trauma included deformity of the clavicle or changes to the rotator cuff musculature. Calcific deposits were observed in the region of the rotator cuff tendon. Bone islands were observed in the region of the humeral head. A bony exostosis was located on the medial side of the surgical neck of the humerus.

The incidental findings and their related suspected clinical and radiographic diagnoses are shown in **Table 4.9.** The radiographic diagnosis was “no abnormalities detected” in four cases and DJD in another four cases and one was a deformity of the clavicle. In four of the clinically suspected cases viz. cervical facet syndrome, brachial plexus injury and myofasciitis, costochondritis and myofasciitis, and spinal joint dysfunction the incidental finding was not in the area related to the suspected clinical diagnosis.

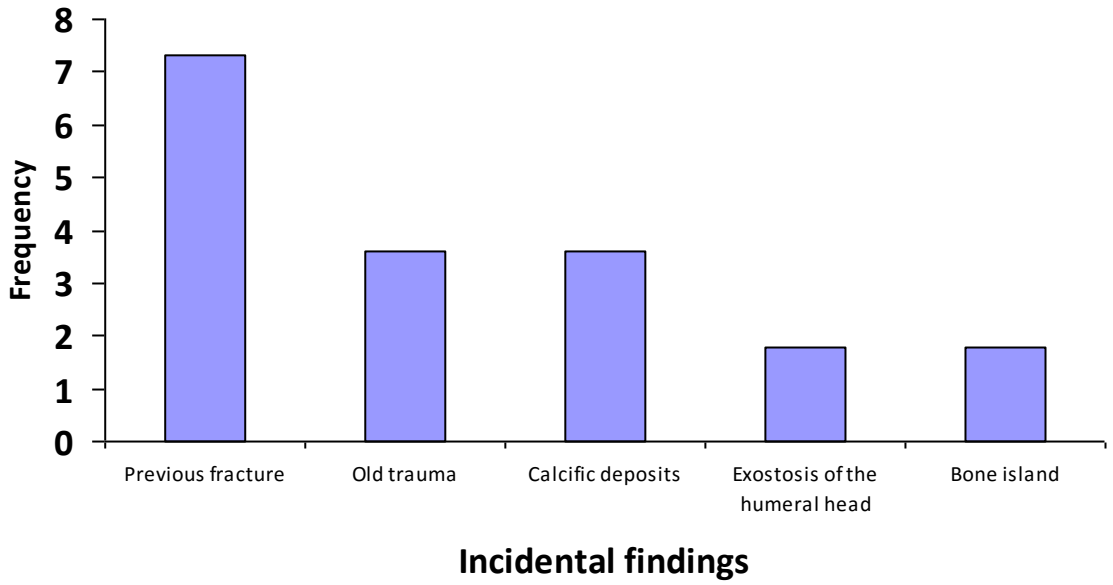

Figure 4.6 Incidental findings on shoulder plain film radiographs

Table 4.9 Incidental findings with corresponding suspected clinical and radiographic diagnoses

Incidental finding	Suspected clinical diagnosis	Radiographic diagnosis
Previous fracture and bone island	Cervical facet syndrome	NAD
Previous fracture	Brachial plexus injury and myofasciitis	Deformity of clavicle
Previous fracture	AC joint sprain	NAD
Previous fracture	Adhesive capsulitis and myofasciitis	DJD
Old trauma	Costochondritis and myofasciitis	NAD
Old trauma	GH sprain and RC tendonitis	NAD
Exostosis	Dislocation	DJD
Exostosis	Spinal joint dysfunction	DJD
Calcific deposits	Adhesive capsulitis	DJD

NAD = No abnormality detected; AC = Acromioclavicular; DJD = Degenerative joint disease; GH = Glenohumeral; RC = Rotator cuff

CHAPTER FIVE

DISCUSSION

5.1 AGE, SEX AND RACE OF PATIENTS WHOSE CLINICAL AND RADIOGRAPHIC RECORDS WERE EXAMINED

The mean (± SD) age of the patients whose plain film radiographs and clinical files were examined **(Table 4.1)** is in keeping with that reported by previous studies **(Table 2.6)**. The range of the age suggests that patients (with shoulder pain) with a large age spectrum visit the CDC. The minimum and maximum age does not mean that patients below the age of 18 or above the age of 82 do not get treated for shoulder pain at the CDC. The records of patients below 18 or above 82 years of age were excluded due to the patients presenting with plain film radiographs taken prior to the first consultation at the CDC. The mean age of 43.5 years in this study was similar to that of McPhail (2011) (43.9 years) but lower than that reported by Damon (2012) (52.7 years). There was a slight preponderance of male patients whose records were examined **(Figure 4.1)** which is consistent with the higher prevalence of shoulder pathology in males (Finley and Rodgers, 2004).

There were a greater number of white patients (61.1%) whose records were examined compared to the other three races. This is in agreement with the demographic findings of a chiropractic study in South Africa by Mahomed (2007) as well as a study of chiropractic teaching clinics in the USA in which the average patient was a white male (Kaeser et al., 2014). Traditionally, chiropractic services were available in predominantly white areas in South Africa (during the apartheid era) (Malani, 1993). Therefore, it is assumed that the awareness of chiropractic is higher in this race group compared to the others.

5.2 THE SUSPECTED CLINICAL DIAGNOSES

There was a wide spectrum of suspected clinical diagnoses which is in keeping with previous reports (Andrews and Wilk, 1994; Silva et al., 2008). There were 31 different suspected clinical diagnoses which are tabulated in **Table 5.1**, which is similar to the diagnostic classification proposed by previous authors **(Table 2.6)**.

Table 5.1 The classification of the suspected clinical diagnoses of shoulder complaints

Trauma	Mechanical	Muscular or Tendon Dysfunction	Capsular Syndrome	Neuro-logical	Arthritide	Other
Dislocation	Cervical facet syndrome	Bicipital tendonitis	Adhesive capsulitis	Brachial plexus dysfunction	DJD DJD of SC joint	Bursitis
Humeral fracture	Thoracic facet syndrome	RC tendonitis		Nerve root entrapment		Cervicogenic headaches
AC joint sprain SC joint sprain	Joint dysfunction	Supra-spinatus tendonitis				Unknown
GH sprain	CTJ dysfunction	Elbow tendonitis				Costochondritis
Capsular strain	GH fixation Spinal joint dysfunction	Myofasciitis				Humeral bone lesion
		Pectoralis major tear RC strain Triceps strain				Impingement syndrome

SC = sternoclavicular; AC = Acromioclavicular; GH = Glenohumeral; DJD = Degenerative joint disease; RC = Rotator cuff; CTJ = Costotransverse joint

A differential or definitive diagnosis of a shoulder complaint is reached after a thorough case history and clinical examination (Wyatt, 2005). Trauma, whether direct or indirect, often results in fracture, dislocation and various sprains or strains. A history of macro- or micro-trauma is often a key feature of sprains and strains (Yang et al., 2012). Mechanical syndromes such as thoracic and cervical facet syndromes, spinal joint dysfunction and costotransverse fixation may cause pain in the shoulder again due to the close proximity and pain referral patterns (Hertling and Kessler, 2006) and are diagnosed through history and orthopaedic testing.

An important characteristic of the shoulder joint is its many degrees of freedom which allow a large ROM **(Table 2.3)** (Andrews and Wilk, 1994.) This places a large load on the dynamic stabilisers of the shoulder i.e. the muscles and tendons (Di Giocomo et al., 2008; Moore and Dalley, 2006). Any alteration in the loading or prolonged repetitive loading may result in soft tissue dysfunction (Vassallo, 2008) such as tendonitis, myofasciitis and muscular tears or strains. These can often be diagnosed through history **(Table 2.2)** and simple orthopaedic tests **(Table 2.4)** (Durham, 2012).

Adhesive capsulitis can be caused by prolonged micro-trauma or one major inciting event and is characterised by severe pain, stiffness and atrophy of the local muscles (Roy, 2012). Brachial plexus injury is often due to traumatic injury to the shoulder complex

(Fiebach et al., 2007). Sharp, shooting, electric-type pain is a feature of this condition and the patient may be reluctant to move his arm. Nerve root entrapment is often due to foraminal encroachment (degenerative) or edema in the intervertebral foramina in the cervical spine. Radicular pain (which can refer to the shoulder area, depending on the levels involved), paraesthesia and, in severe cases, atrophy of the affected musculature result (Hakimi and Spanier, 2013). Arthritis of the shoulder may include both degenerative and inflammatory arthritides which may be suspected through case history and clinical findings of pain, stiffness, inflammation and possible deformities in other joints (e.g. ulnar deviation of the hand in rheumatoid arthritis) (Castro et al., 2001).

Subacromial bursitis is due to the entrapment of the subacromial bursa in the coracoacromial arch. Sudden, severe catching pain and decreased ROM are hallmarks of this condition (Harold, 2009; Benzel and Connolly, 2012). “Humeral bone lesion” is a vague clinical diagnosis as it refers to a variety of conditions, with the most important being bony metastases. In these cases a good case history is vital in leading the clinician to this suspected diagnosis (Woodward and Best, 2000). Confirmation of the diagnosis and commencing treatment without delay are essential in these cases (Khatri, 2006).

‘Unknown’ refers to cases where the student had not recorded a suspected clinical diagnosis and was awaiting radiographic results. Cervicogenic headaches originate from either the bony structures or soft tissues in the cervical region (Biondi, 2005) and can be associated with co-existing shoulder pain (Robert, 2010). Impingement syndrome is usually characterised by pain on lifting the arm above shoulder height and can occur at any age (De Berardino, 2012). It is associated with repetitive microtrauma and an athletic history.

5.3 THE RADIOGRAPHIC DIAGNOSES

There were 16 radiographic diagnoses of shoulder complaints **(Table 4.3)** which have been categorized in **Table 5.2**.

Table 5.2 The categories of the radiographic diagnoses of shoulder complaints

Arthritide	Metabolic	Deformity	Fracture	Periosteal and bone lesions	Soft tissue lesion	Subluxation
DJD (degenerative) RA (inflammatory)	Osteoporosis	Deformity of the clavicle Deformity of the scapula	Clavicle fracture Pathological fracture	Periosteal reaction of upper humerus Sub-periosteal reaction of the humerus Cortical thickening of the humerus Tug lesion	Suspected bursitis Calcific tendonitis Capsular tear	AC subluxation GH subluxation

AC = Acromioclavicular; GH = Glenohumeral; DJD = Degenerative joint disease; RA = Rheumatoid arthritis

Arthritides, whether inflammatory or degenerative, of the shoulder joint are commonly characterised by pain, stiffness and inflammation and may require further investigations such as radiographs or even blood tests (Castro et al., 2001). Osteoporosis is a metabolic disorder characterised by low bone mass and deteriorating bone tissue (Bartl and Frisch, 2004). Chronic pain due to microfractures may be present, but if sufficient bone loss occurs, pathological fractures may result. Osteoporosis is initially suspected on radiographs but a definitive diagnosis is based on the results of a Dual Energy X-ray Absorptiometry (DEXA) scan (Bartl and Frisch, 2004). Deformity of bony structures refer to the shortening, mal-union or non-union of a bone often due to a previous fracture or congenital malformations (Browner et al., 2015). This may lead to early degenerative changes as well as an alteration in the loads placed on the surrounding musculature (Browner et al., 2015).

Traumatic fractures may occur as a result of direct trauma to the shoulder or a fall onto an outstretched hand (Vassallo, 2008). Pathological fractures are caused by underlying disease such as osteoporosis (Bartl and Frisch, 2004) or more ominous disease such as bony metastases. The bone fractures in response to minimal trauma and advanced imaging such CT or MRI scans and biopsy may be required to determine the aetiology (Sim, 1994). Periosteal reactions indicate a response to a variety of conditions that can affect the long bone. These include traumatic, inflammatory conditions and, importantly, malignant bone disease (Burgener et al., 2008). The suspected underlying cause of the periosteal reaction will determine the type of investigations that will follow. Soft tissue pathologies are not usually discernable on radiographs unless calcification has occurred

(Bontrager and Lampignano, 2010). The radiographic finding of bursitis and capsular tear observed in this study were not definitive diagnoses but were inferred by the radiologist due to a “fullness in the region of the acromial bursa” and “elevation of the distal clavicle”, respectively. Subluxation refers to the translation of two articulate surfaces without separation i.e. between the humeral head and glenoid or the clavicle and acromion. It is often traumatic in origin and indicates instability in a joint (Wilk et al., 2006). This can lead to pain and apprehension (Rockwood and Matsen, 2009).

5.4 INCIDENTAL RADIOGRAPHIC FINDINGS

Ten incidental findings were observed in nine plain film radiographs **(Figure 4.6; Table 4.9)**. Bone islands, which have been previously observed in the shoulder region are benign, clinically silent and of no clinical relevance (Greenspan, 1995), but the sequelae of calcific deposits, old trauma and previous factures may contribute to or be responsible for shoulder pain. Calcific deposits in the rotator cuff become symptomatic when inflamed (Stetsom, 2010). Long-term rotator cuff lesions have been known to result in adhesive capsulitis (Siegel et al., 1999). Old trauma and previous fractures may lead to degenerative changes in the shoulder and related structures (Yochum and Rowe, 2005). Joint and soft tissue lesions may occur together with fractures and other traumatic injuries or may be a consequence of these types of injuries. This may explain the joint sprains, myofascial and tendon lesions which were clinically diagnosed in cases where the incidental finding was either previous fracture or old trauma **(Table 4.9)**. Bony exostoses of the shoulder were reported to be associated with impingement syndrome of the shoulder (Cone et al., 1984), but in this study the two cases of bony exostoses were not associated with impingement syndrome. There were no cases of metastatic or lung lesions observed in this study.

5.5 THE ASSOCIATION BETWEEN THE SUSPECTED CLINICAL AND THE RADIOGRAPHIC DIAGNOSES OF PATIENTS WITH SHOULDER PAIN

The suspected clinical diagnoses and their corresponding radiographic diagnoses are tabulated in **Table 4.3**. Unfortunately, an association could not be determined because there were too many categories of suspected clinical and the radiographic diagnoses. Therefore, this data was presented descriptively rather than statistically (Esterhuizen, 2014). This may be attributed to patients who had more than one diagnosis (as shoulder pain is often due to more than one lesion (Wyatt, 2005)) or suspected clinical diagnoses that had more than one radiographic diagnosis. The suspected clinical diagnoses

comprising of more than one diagnosis were split into two individual diagnoses **(Table 4.3)** e.g. “adhesive capsulitis with associated myofasciitis” to “adhesive capsulitis” and “myofasciitis”. A radiographic diagnosis of DJD would appear twice in the table for this suspected clinical diagnosis although only one patient was diagnosed with DJD. Therefore, although it may appear in **Table 4.3** more than 12 times, there were only 12 radiographic diagnoses of DJD. This also applies to the radiographic diagnosis of clavicular fracture which is discussed later in the chapter.

Out of the 54 plain film radiographs examined, the most common radiographic finding was “no abnormalities detected” (48.1%). This was higher than that observed by both McPhail (2011) with lumbar spine plain film radiographs and Damon (2012) with knee plain film radiographs. The next most common radiographic diagnosis was DJD (22.2%) which may not be a direct factor in the patients’ shoulder pain as they may have signs of DJD on plain film radiographs but minimal symptoms (Ullrich, 2000; Colledge et al., 2010).

The most common suspected clinical diagnosis was myofasciitis. Hains (2002) reported that active myofascial trigger points often refer to the shoulder. More than one-third (38.1%) of the patients diagnosed with myofasciitis had plain film radiographs which showed no abnormalities. This was followed by bicipital tendonitis of which 50% of these patients’ plain film radiographs had no abnormalities. These findings are unsurprising as soft tissue conditions are not visualised on radiographs (Yochum and Rowe, 2005). They are often diagnosed by history and examination findings (Woodward and Best, 2000).

The radiographic diagnosis was DJD in 28.6% of the myofasciitis cases and 40% in bicipital tendonitis cases. Degeneration of the shoulder joints can lead to pain and stiffness but many patients who show signs of DJD on radiographic examination are asymptomatic (Ullrich, 2000; Colledge et al., 2010). In the cases where DJD was suspected, specifically of the SC joint, there was 100% agreement between the suspected clinical and radiographic diagnoses **(Table 4.3)**.

“Suspected pathology” was the reason given for 29 (53.7%) of patients who were referred for plain film radiographs. This is a broad and vague category as no specific suspected pathology was given. There were no abnormalities detected in 13 of these cases. The vague reasons provided for ordering plain film radiographs are ethically incorrect as a specified pathology should be suspected prior to request for plain film radiographs, which will either be confirmed or ruled out (Yochum and Rowe, 2005; McKinnis, 2014). Exposing patients unnecessarily to radiation is also against good clinical practice and is unethical.

A suspected clinical diagnosis was not recorded on the SOAPE notes for two patients but the corresponding radiographic requests were “fracture” and “suspected pathology”, respectively. The plain film radiographs of both patients showed no abnormalities detected. This highlights some poor practice habits exhibited by some of the clinician who instruct the chiropractic students. Firstly, a suspected clinical diagnosis should have been recorded on the corresponding SOAPE note with the radiographic request form and, secondly, where no suspected clinical diagnosis or defined suspected pathology was noted, the patient should not have been referred for plain film radiographs.

“Suspected fracture” was the reason provided on the radiographic referral form for 14 patients **(Table 4.5)**. However, only three students had this suspected diagnosis recorded on the SOAPE notes. There were only two radiographically-confirmed cases of fracture (one traumatic and the other pathological). In the three cases of a suspected humeral fracture, only one plain film radiograph confirmed a fracture (i.e. 33.3% agreement) **(Table 4.3)**. The patients were likely referred for confirmation of a suspected fracture of the humerus due to their presenting complaint or clinical presentation as fractures are often suspected when a patient presents with a history of a fall or direct trauma and clinical signs including swelling and bruising (Vassallo, 2008). There are two implications of these findings viz. medico-legal for inadequate patient examination and clinical records, and requesting further investigations for patients whose plain film radiographs were negative for fractures. It is perplexing that the suspicion of a suspected fracture of the clavicle was missed by the student during history-taking and examination of the patient. However, it is also possible that the student did not record his or her suspect clinical diagnosis on the relevant documentation. The incomplete patients’ clinical records are also a concern. Radiographs, preferably with two views at right angles to each other, are usually the first line of investigation for suspected fracture (Yochum and Rowe, 2005; Moore and Dalley, 2006). If no fracture is found, but there is a strong suspicion of fracture, a CT or MRI scan may be used to investigate further (Colledge et al., 2010). The explanations for the lack of a visible fracture on the plain film radiographs include:

- The injury primarily involved the soft tissues (Cantanzano, 2009)
- There was bruising of the bone with no fracture
- The radiographic latent period (Yochum and Rowe, 2005)
- Microfractures from osteoporosis (in one case) were not visible radiographically (Jarraya et al., 2013)
- The fracture was not visible on the radiographic views examined (Moore and Dalley, 2006)

- Human error and failure to obtain a second opinion (Ng and Lau, 2003)

In the cases of the other 28 suspected clinical diagnoses there was no agreement between the suspected clinical and radiographic diagnoses **(Table 4.3)**. This suggests an over reliance on and overuse of plain film radiographs for shoulder complaints by chiropractic students at the CDC. Overuse of radiographs is a common trend reported by other studies viz. Fraenkel et al. (1998), Kahn and Mehta (2007), Bedson and Croft (2008), McPhail (2011) and Damon (2012) **(Table 2.9),** regardless of the setting (e.g. outpatient clinics, teaching hospitals, emergency departments and medical centres).

The general hypothesis of the study is accepted as a profile of the suspected clinical and radiographic diagnoses of shoulder conditions observed in the CDC and their management was developed. The Alternate Hypothesis (H_a) for Objective One set out the outset of the study is not accepted as an overall association between the suspected clinical and the radiographic diagnosis of the patients with shoulder pain could not be determined.

5.6 THE CONSULTATION AT WHICH THE SHOULDER PLAIN FILM RADIOGRAPH WAS REQUESTED AND THE REASON THEREOF

The majority (57.4%) of the plain film radiographs were requested at the first consultation at the CDC **(Table 4.4)** which is in keeping with previous studies conducted at this site (McPhail, 2011; Damon, 2012). The most common reason for referral for plain film radiographs at the first consultation was “suspected pathology” followed by fracture. There were four reasons marked “unknown”. “Skeletal abnormalities” was another vague reason provided by some students. “Suspected pathology”, “unknown” and “skeletal abnormalities” are vague terms and do not constitute valid reasons for a radiographic examination at the CDC (Chiropractic Clinic Manual, 2015). This trend is also reflected in the overall reason for referral regardless of consultation number **(Table 4.5)**. This may indicate a lack of confidence by the chiropractic student in arriving at a suspected diagnosis as he or she may not have been exposed to sufficient cases of shoulder complaints. The clinical instructors of the Chiropractic Programme at DUT should ensure that students are sufficiently exposed to cases of shoulder complaints. It may also indicate an over-reliance on radiographs to arrive at a diagnosis. This highlights the need for clinicians to emphasise the reasons for ordering radiographs and which lesions are apparent on radiographs and which are not. It is recommended that clinicians should carefully scrutinise the reasons for radiographic referral provided by the students and

guide them accordingly. Lecturers involved in the various radiographic courses should also emphasise these points in class. Both students and clinicians should also familiarise themselves with the valid reasons for radiographic referral outlined in the latest Clinic Manual (Chiropractic Clinic Manual, 2015). Overuse of plain film radiographs may have been facilitated by the easy access to the Radiographic Clinic (as this is located in close proximity to the CDC), and the reduced fees charged for chiropractic patients.

A high number of referrals were observed at the beginning, which tapered as the number of consultations increased. Surprisingly, some plain film radiographs were requested as late as the 18th visit. One would expect that patients would have been re-evaluated or referred sooner. Although no response to appropriate treatment is considered as an indicator for radiographic referral **(Table 2.7)**, this should have happened between treatments 6 and 8 (Wyatt, 2005). It is, however, possible that the patients developed other complaints or clinical features necessitating a radiographic examination. However, the reasons for referral at treatment numbers 10-18 in this study included “unknown”, “suspected pathology”, “calcific tendonitis”, “tumour/AVN” and “suspected pathology/fracture/ dislocation”. These are vague clinical suspicions (with the possible exception of “calcific tendonitis”) and suggest that the plain film radiographs were taken as an exploratory measure. There is also the possibility that the plain film radiographs were taken to placate the patient in order to reassure them that something “was being done” to find the cause of their pain.

In the case of a suspected clinical diagnosis of non-traumatic facet syndrome, the student requested the radiologist to investigate possible concomitant fractures in the shoulder region. This was, however, not recorded on the SOAPE note.

The findings of this study suggest overuse and over-reliance on plain film radiographs by chiropractic students at the CDC to determine the diagnosis of shoulder complaints. This is in agreement with previous studies at the CDC on low back pain (McPhail, 2011) and knee pain (Damon, 2012). Fraenkel et al. (1998) concluded that plain film radiographs are over-utilized at the initial consultation, although this was at an emergency department. In the cases regarding fractures, Kahn and Mehta (2007) and Abdulkadir et al. (2011) set at an emergency department and medical centre/hospital, respectively, it was shown that although fracture was suspected on clinical diagnosis, radiographs were important in reaching a specific diagnosis. The implications of missing a diagnosis are also important to consider especially when radiographic indicators are present (trauma and severe pain). The reasons for referral should be valid and recorded on the radiographic referral form

and on the SOAPE note. Improper or incomplete documents have the potential for medico-legal litigation and it is important that these are addressed by the clinic management.

5.7 SUSPECTED CLINICAL DIAGNOSIS AND MANAGEMENT OF PATIENTS PRESENTING WITH SHOULDER PAIN BEFORE AND AFTER PLAIN FILM RADIOGRAPHS

There was a change in the suspected clinical diagnosis in 38.8% of cases after plain film radiographs were taken **(Figure 4.3)**. In some cases it was an addition or deletion to the original suspected clinical diagnosis while in other cases the change in suspected clinical diagnosis may not have been as a direct result of the radiographic findings **(Table 4.7)**. In nine cases there was no follow-up treatment; therefore, the change in suspected clinical diagnosis and conservative management as well as the necessity for ordering plain film radiographs could not be determined. For the nine cases, no abnormalities were detected on the plain film radiographs in four cases while in the other five cases mild DJD and osteoporosis, osteophyte lipping and internal derangement, deformity of scapular, subperiosteal reaction of humerus and cortical thickening of the humerus were observed.

No specific trend in treatment could be determined for any one condition and more than one approach was utilized for most conditions. However, the most common treatment was soft tissue techniques which was utilised for the management of myofasciitis. Soft tissue therapy incorporates ischemic compression, dry needling and massage of the soft tissue surrounding the shoulder. This was followed by electrotherapy and manual therapy **(Figure 4.2).**

There was a change in treatment in 40.7% of the cases **(Figure 4.4)** but soft tissue therapy was still the most common treatment followed by electrotherapy **(Figure 4.5).** It was interesting to note that there was a decrease in manual therapy from 20% to 13.6% considering that manual therapy is an integral part of a chiropractic treatment (Bergman and Peterson, 2011). This is in contrast to the findings of Damon (2012) who reported an increase in manual therapy from 67.2% to 82.9%. The change in treatment may not have been directly related to the results of the plain film radiographs, but could have been an addition to or diversification to the management approach instead of a focused change in treatment. Follow-up treatments may have included additional modalities as less time is taken up with orthopaedic testing with more time allocated for treatment of the patient.

Many diagnoses were treated with more than one approach and similarly irrespective of the diagnosis **(Table 4.8)**. This is interesting to note as it could be questioned whether a specific diagnosis is required in the treatment of non-pathological shoulder pain due to the similarity of the treatments. The lack of a specific trend may be attributed to concomitant conditions and student preference for treatment modalities.

Shoulder pain caused by pathology can be treated conservatively, medically or surgically (Vassallo, 2008). There were six categories of treatment consisting of manual therapy, soft tissue techniques, electrotherapy, stretching and strengthening, referral and other. These are all common modalities used in conservative care and more specifically chiropractic care, to decrease pain and increase function (Burbank et al., 2008; Gonzalez, 2011). They consist of both invasive (e.g. dry needling) and non-invasive (ischemic compression, massage, stretching and strengthening and electrotheraphy etc.) methods (Kalichman and Vulfsons, 2010). While manipulation and joint mobilisation are integral aspects of chiropractic treatment (Bergman and Peterson. 2011), soft tissue treatments, electrotheraphy (TENS, IFC and US) (Wyatt, 2005) as well as lifestyle advice, patient education and ergonomic assessment (Hains, 2002) can be incorporated into an active care regime. This includes patient input and in which they have an active role to play in their recovery. Passive care methods is one where the patient is solely dependent on the practitioner (Mootz and McCarthy,1999). At the CDC the students tend to adopt the active care approach to the patient management. This is to ensure a more holistic treatment of the patient (Trivieri and Anderson, 2002) and allows the patient to play a role in their treatment and therefore a greater responsibility in their recovery. This is due to patients having an active role in the decisions made and being responsible for carrying out their home care regime. However, in the acute stages of an injury a passive care approach may be favoured (Mootz and McCarthy, 1999).

5.8 PROPOSED RECOMMENDATIONS FOR THE CDC

The following recommendations, arising from the findings of this study, are suggested for the CDC:

- Students should be given a workshop on the correct way to complete relevant paperwork (e.g. SOAPE notes, radiographic referral forms and clinic documents) required in the CDC.

- Both suspected clinical and radiographic diagnoses must be clear; vague (e.g. joint dysfunction) or unspecified diagnoses (bursitis) should be avoided. Colloquial terms or non-recognised medical terms should also be avoided.
- The reasons for radiographic referral must be clear with the intent to look for specific suspected diagnoses. Unless absolutely important, radiographs should not be utilised for exploratory purposes.
- There should be more exposure to pathologic conditions of extremities for the chiropractic students at the CDC.
- Patients should not be treated if no suspected clinical diagnosis is given. Clinicians at the CDC should take greater cognisance of this finding. A high number of treatment consultations should be avoided unless the patient has been thoroughly reassessed or a second opinion is sought from an external medical facility.
- Clinicians should be more vigilant in checking that the student has reached a reasonable clinical differential diagnosis and that the relevant paper work is complete and correct.
- Many plain film radiographs were excluded from the study as the corresponding paperwork (file and/or pages) were missing. The students and administrative staff should take greater care in filing all the necessary medical documents, including radiographs, correctly.

5.9 LIMITATIONS OF THE STUDY

This study was limited to plain film radiographs of the shoulder and the corresponding patient files within the CDC archives. The plain film radiographs of the shoulder had to be taken during the patients' management at the CDC. Since this study was designed as a retrospective one, there was no way to verify the suspected clinical findings that were recorded in the patient's files. This study may not represent all the patients with shoulder complaints that have been treated at the CDC as some plain film radiographs may have been removed to be used as teaching aids or taken home by the patient. From 2011, no new shoulder plain film radiographs were kept in the archives. This was due to a change in the CDC protocol whereby patients were required to take the plain film radiographs home. In 2011 and 2012, the CDC underwent renovations; during this time the clinical files and plain film radiographs were moved into storage and some may have been lost or discarded as they were damaged. Another limitation would be the use of plain film radiographs with only one view available as the proper approach would be to have at least two radiographic views (Yochum and Rowe, 2005).

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The most common suspected clinical diagnosis was myofasciitis (38.1 %) with the most common radiographic diagnosis being no abnormality detected. The association between the suspected clinical and radiographic diagnosis of shoulder pain could not be determined due to the many categories. There was a 100% agreement between suspected DJD of the sternoclavicular joint and the radiographic diagnosis of DJD of the sternoclavicular joint.

The majority of the plain film radiographs were taken at the initial consultation with the most common reason for referral being “suspected pathology”. There was a change in suspected clinical diagnosis in 21 cases post plain film radiographs; the most common change was the addition of DJD to the suspected clinical diagnosis. The most common treatment included soft tissue techniques both before and after plain film radiographs despite there being a change in treatment in 40.7% of the cases. A total of 10 incidental findings were found in this study with the most common being a previous fracture.

6.2 RECOMMENDATIONS

Recommendations for the future studies include the following:

- A similar study be conducted at private chiropractic practices to confirm similarities and differences in trends.

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APPENDIX A

DATA SHEET

Age		**Sex**		**Ethnicity**		**Code**	

Main complaint **Date of Initial consultation:** **____/_____/_____.**	
Clinical diagnosis/ differential diagnosis	

Treatment prior to x-rays					
Manual therapy	Soft tissue techniques	Electrotherapy	Stretching or strengthening	Referral	Other

Reason for x-ray referral (suspected diagnosis) **Treatment Number: _____.** **Date of x-ray:___/_____/___.**	
Radiological diagnosis	
Incidental findings on x-ray	

Change in clinical diagnosis after x-rays?	Yes	No
New diagnosis		
Change in treatment after x-rays?	Yes	No

Change of treatment after x-rays					
Manual therapy	Soft tissue techniques	Electrotherapy	Stretching or strengthening	Referral	Other

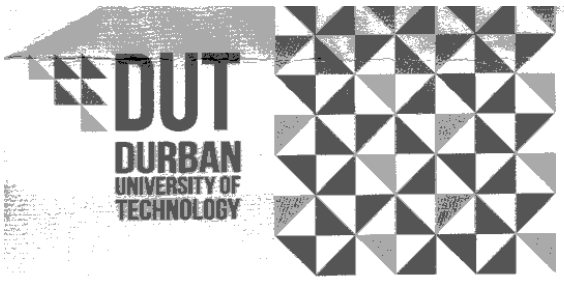
APPENDIX B

PATIENT CONFIDENTIALITY CODING SHEET

File Number	Patient Name	Date of Birth	Code

APPENDIX C

ETHICAL CLEARANCE CERTIFICATE



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

29 January 2014

IREC Reference Number: **REC 84/13**

Ms J L Redman
45B Krantzview Road
Kloof
3610

Dear Ms Redman

The role of plain film radiographs in the diagnosis and conservative management of shoulder pain

I am pleased to inform you that Full Approval has been granted to your proposal REC 84/13.

The Proposal has been allocated the following Ethical Clearance number **IREC 003/14**. 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

[redacted]

Prof J K Adam
Chairperson: IREC