THE INTER-EXAMINER RELIABILITY OF MOTION PALPATION IN CHRONIC LATERAL EPICONDYLALGIA AND ASYMPTOMATIC ELBOWS

By

Charlene Anne Manley

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Durban University of Technology

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

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Charlene Anne Manley Date

Approved for Final Submission

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Dr Heidi Kretzmann, M.Tech: Chiropractic Date

DEDICATION

This research is dedicated to my Lord and Saviour

Jesus Christ.

Your constant presence has been a joy and vital necessity in my life and throughout this course.

Thank You.

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To my family, Dad, Mom and Neill, thank you for your love, patience, support, encouragement and belief in me.

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ABSTRACT

Background

Motion palpation is an examination technique commonly used by chiropractors to identify a manipulable subluxation prior to manipulation. In order for its continued use, it must be validated. Many studies conducted on motion palpation's inter-examiner reliability in the spine have shown it to be below average, however only a few studies have addressed its use in the extremity joints. No inter-examiner reliability studies on motion palpation were found for the elbow, let alone the symptomatic elbow with regards to chronic lateral epicondylalgia, a common disorder of the elbow effectively treated by the use of manipulation.

Objectives

The objectives of this study were to determine the inter-examiner reliability of motion palpation of the elbow for the asymptomatic elbow and the symptomatic elbow with regards to chronic lateral epicondylalgia. It also aimed to compare these results to determine any difference in reliability, the number of manipulable subluxations and the presence of manipulable subluxations in particular directions, between the two groups.

Method

Twenty participants (*n*=40 elbows) between the ages of 18 to 65, with one asymptomatic and one symptomatic elbow (chronic lateral epicondylalgia) were examined by three final year masters chiropractic students for the presence of manipulable subluxations in end play, using only motion palpation. The examiners were pre-trained, randomised and blinded. Each examiner individually motion palpated both elbows on each participant, in nine directions of motion palpation, incorporating the humeroulnar and proximal radioulnar joints. They were also required to identify which elbow was symptomatic. Fleiss' kappa and percentage agreement (perfect percentage agreement and mean percentage agreement) were used to measure reliability. Paired non parametric Wilcoxon signed ranks compared the difference between both groups and McNemar's chi square tests assessed the percentage of correctly identified symptomatic elbows for each examiner. A p value <0.05 was considered statistically significant.

Results

The asymptomatic elbows showed a poor range of kappa results, from 0.0683 to -0.1321, with a mean kappa of -0.0664. Perfect percentage agreement was 50% to 85% and mean percentage agreement was 83.30% to 94.99%.

The symptomatic elbows' kappa values ranged between -0.2691 to 0.4034 with a mean kappa of -0.0028. The humeroulnar medial to lateral direction of motion palpation had a moderate kappa value of 0.4034. Perfect percentage agreement ranged from 10% to 85% and mean percentage agreement from 69.94% to 94.99%.

There was an insignificant difference in kappa values between the two groups (p=0.260), although there was a trend towards the asymptomatic kappa values being lower than the symptomatic values.

The difference between symptomatic and asymptomatic elbows was significant in proximal radioulnar posterior to anterior glide in pronation (p=0.013), as well as proximal radioulnar rotation of the radial head on the ulna (p=0.008). Overall, more manipulable subluxations were found in the symptomatic elbows than in the asymptomatic elbows.

The examiners correctly identified the symptomatic elbow in 65% to 90% of participants (p=1.000).

Conclusions and Recommendations

In conclusion, the inter-examiner reliability of motion palpation in the asymptomatic elbow was poor, and in the symptomatic elbow (chronic lateral epicondylalgia), poor to moderate. There was an insignificant difference in reliability between the two groups, although more manipulable subluxations were found in the symptomatic elbows overall. These were mainly in proximal radioulnar posterior to anterior glide in pronation, as well as proximal radioulnar rotation of the radial head on the ulna, two directions of motion that form part of Mills' manipulation. This study also found that examiners were able to identify the symptomatic elbows with the use of motion palpation. It is recommended that future research continue from this study in assessing the identification and presence of manipulable subluxations in all the extremity joints. However the methodological problems with the statistical analysis need to be addressed.

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DEFINITIONS

Manipulation

"A manual procedure that involves a directed thrust to move a joint past the physiologic range of motion without exceeding the anatomic limit."
(Gatterman, 1995:12)

Manipulable Subluxation

"A subluxation in which altered alignment, movement, or function can be improved by manual thrust procedures."
(Gatterman,1995:11)

Subluxation Complex

"A theoretical model of articular spinal lesions that incorporates the complex interaction of inflammatory, degenerative, and pathologic changes in nerve, muscle, ligaments, vascular, and connective tissues and may influence organ system function and health."
(Gatterman, 2005:10)

Motion Palpation

"Palpatory diagnosis of passive and active segmental joint range of motion."
(Bergman, Peterson and Lawrence. 1993:762)

End Play

"Discrete, short range movements of a joint independent of the action of voluntary muscles, determined by springing each vertebrae at the limit of its passive range of motion."
(Bergman, Peterson and Lawrence, 1993:757)

Inter-examiner Reliability

"The degree that results correspond between one examiner and another, using the same patient."
(Haldeman, 1992:303)

Lateral Epicondylalgia

"Lateral epicondylalgia or tennis elbow is a prevalent musculoskeletal disorder that is characterized by lateral elbow pain often associated with gripping tasks."
(Vincenzino, Cleland and Bisset, 2007)

CHAPTER ONE

1.1. Introduction

Manipulation, in order to correct a manipulable subluxation, is considered the cornerstone of chiropractic (Cooperstein and Gleberzon, 2004:10). Generally, manipulation is applied to a manipulable subluxation in order to regain mobility (Gatterman, 1990:410). This manipulable subluxation is a motion segment in which alignment, movement integrity, and/or physiologic functions are altered, and can be improved by manual thrust procedures, such as chiropractic manipulation (Gatterman, 1995:11).

Motion palpation is one of the original examination techniques used by chiropractors to detect a manipulable subluxation by palpating within a joint and is still the most recognised physical examination technique that supports the presence or absence of manipulable subluxations (Bergman, Peterson and Lawrence, 1993:81). A study conducted in Australia, chosen for its high response rate, found that chiropractors regarded motion palpation as the most reliable chiropractic test (Walker, 1998), despite research showing very little evidence of validation of motion palpation as a diagnostic tool (Cooperstein and Gleberzon, 2004:34-35). Numerous reliability studies have however been done on spinal motion palpation, in which it was shown that inter-examiner reliability was found to be poor to fair in the sacro-iliac joints, lumbar, thoracic and cervical spines (Vincent-Smith and Gibbons, 1999; French, Green and Forbes, 2000; Panzer, 1992; Potter, McCarthy and Oldham, 2006; van Trijffel, Anderegg, Bossuyt, and Lucas, 2005).

Due to the unreliability of motion palpation to detect a manipulable subluxation, the presence of the manipulable subluxation remains hypothetical (Hestbaek and Leboeuf-Yde, 2000), and the cornerstone of chiropractic is questioned. Therefore it is vital that examination techniques such as motion palpation be validated (Breen, 1992).

Lateral epicondylalgia, more frequently known as tennis elbow, is a common musculoskeletal disorder of the upper limb characterized by pain over the lateral elbow, typically aggravated by gripping activities (Haker, 1993; Waugh, 2005). A prevalence study, conducted in the United Kingdom, and chosen for its large sample size, found that 1.3% of men and 1.1% of women had lateral epicondylalgia in the general population (Walker-Bone, Palmer, Reading, Coggon and Cooper, 2004). Similarly, a prevalence study conducted in Finland showed lateral epicondylalgia to make up 1.3% of the population, and was therefore considered to be a common disorder of the elbow (Shiri, Viikari-Juntura, Varonen, and Heliövaara, 2006). Lateral epicondylalgia's pathophysiology is still uncertain, although it is generally considered microtrauma of the common wrist extensor origin due to repetitive wrist extension and rotation (Kaufman, 2000).

Research has shown that chiropractic and physiotherapy manipulation can be effective in the treatment of lateral epicondylalgia (Kaufman, 2000; Nagrale, Herd, Ganvir and Ramteke, 2009; Vicenzino, Cleland and Bisset, 2007). However, there is still a lack of well-controlled studies that focus on these manipulative therapy techniques (Vicenzino, Paungmali, Buratowski and Wright, 2001; McHardy, Hoskins, Pollard, Onley and Windsham, 2008).

Despite the use of manipulative therapy as an effective part of the treatment protocol for lateral epicondylalgia, no research has been found that assesses the inter-examiner reliability of motion palpation, to detect a manipulable subluxation, in either asymptomatic or symptomatic elbows (e.g. Chronic lateral epicondylalgia).

1.2. Aims

The aim of this research study was to assess the inter-examiner reliability of motion palpation in symptomatic elbows with regards to chronic lateral epicondylalgia and asymptomatic elbows. Chronic lateral epicondylalgic and asymptomatic elbow results were kept separate in order to compare the inter-examiner reliability between these groups.

1.3. Objectives

Objective 1: To determine the inter-examiner reliability of motion palpation of the elbow for the asymptomatic elbow.

Objective 2: To determine the inter-examiner reliability of motion palpation of the symptomatic elbow with regards to chronic lateral epicondylalgia.

Objective 3: To determine any difference in reliability between the symptomatic and asymptomatic elbows.

Objective 4: To compare the presence of manipulable subluxations found between the symptomatic and asymptomatic groups and assess if the proportion of manipulable subluxations was greater in one group compared with the other.

1.4. Rationale

- Motion palpation is a commonly used assessment tool amongst chiropractors. It is a manual technique used to determine whether there is a need for manipulation of a joint (Walker, 1998).
- Lateral epicondylalgia is a common condition of the upper limb (Walker-Bone et al., 2004), and the use of manipulation as a treatment method for lateral epicondylalgia is growing (Vicenzino, Cleland and Bisset, 2007).
- Most motion palpation studies have focussed on the spine, and there is a paucity of literature that assesses the reliability of motion palpation in the extremity joints, more specifically the inter-examiner reliability of motion palpation of the elbow. Without the confirmation of this reliability, the use of manipulation will be questioned.
- No research has been done to determine if elbows with lateral epicondylalgia exhibit more manipulable subluxations as opposed to asymptomatic elbows.

1.5. Hypotheses

Hypothesis 1: There is a difference between the inter-examiner reliability in the symptomatic elbows with chronic lateral epicondylalgia when compared to the asymptomatic elbows.

Hypothesis 2: There is a difference between the number of manipulable subluxations found in the symptomatic elbows compared to the asymptomatic elbows.

1.6. Limitations

Despite research studies which show that clinical experience does not improve the reliability of manual examinations (Stochkendahl, Christensen, Hartvigsen, Vach, Haas, Hestbaek, Adams and Bronfort, 2006; Seffinger, Najm, Mishra, Adams, Dickerson, Murphy, and Reinsch, 2004), the use of students as examiners was still considered a limitation. However, all three examiners chosen for this study were final year Master's chiropractic students with both practical and clinical experience. Seven practical training sessions were also conducted prior to seeing research participants. This was in order to standardise the motion palpation technique and ensure that each examiner was proficient in motion palpation, after which they were evaluated by a lecturer of motion palpation.

Another limitation was one that has been discussed in other research studies (van Trijffel et al., 2005; Comeaux, Eland, Chila, Pheley, Tate, 2001; French, Green and Forbes, 2000), that repetitive motion palpation will lead to a change in the biomechanical properties of a joint. This change will most likely decrease or possibly eliminate a manipulable subluxation. In this study we attempted to reduce this limitation by having only three examiners, randomising the order of examination and by limiting the number of movement repetitions in end play administered by each examiner to two, for each direction of motion in a joint. The examiners were also asked to palpate with the least amount of pressure required. However it was impossible to eliminate this drawback completely.

Pain is a protective mechanism of the body, and it is natural for a person to react in order to remove the pain when it is aggravated (Guyton and Hall, 1997:392). Motion palpation of the elbow requires the examiner to apply pressure over certain areas of the elbow. These areas are often painful in chronic lateral epicondylalgia. As a result the participant is likely to reveal their pain, thereby alerting the examiner to the symptomatic elbow. In order to reduce this limitation in this study, participants were only included if their pain levels were below 8 on a pain rating scale, in order to remove anyone with severely painful chronic lateral epicondylalgia. A screen was placed around the participant, revealing only the participants arms and eliminating any facial expressions or body language. Still it was impossible to eliminate the flexor reflex (nociceptor reflex) in this study, which may have been triggered in certain participants, causing them to withdraw their elbow from the examiner's hand that was aggravating their pain (Guyton and Hall, 1997:446).

1.7. Conclusion

In conclusion, motion palpation is a popular examination technique used by chiropractors to identify a manipulable subluxation in a joint, in order to manipulate that joint. Previous studies on the spine have shown that motion palpation is unreliable as an assessment tool, although very few studies have assessed its reliability in the extremity joints, none of which review the elbow. Therefore, this study aimed to assess the inter-examiner reliability of motion palpation of both the asymptomatic and symptomatic elbows, with regards to chronic lateral epicondylalgia, a common condition of the elbow.

This chapter gives an introduction to motion palpation and chronic lateral epicondylalgia, showing the aims, objectives, rationale, hypotheses and limitations for the study. Chapter two will elaborate on further detail with regards to past research studies on motion palpation, lateral epicondylalgia and the gap in literature that this research study aims to fill. In chapter three, the methods used and exact procedure in this study are discussed and explained. Chapter four reveals the results obtained in the study. These results are then discussed in chapter five. Finally chapter six draws up the conclusions of the study and outlines recommendations for future studies.

CHAPTER TWO

2.1. Introduction

The following chapter outlines research on the manipulable subluxation, motion palpation, and lateral epicondylalgia. It identifies the gap in literature and shows the motivation behind the aims of this study.

2.2. Manipulation and the Manipulable Subluxation

Manipulation, in order to correct a manipulable subluxation, is considered the cornerstone of chiropractic (Cooperstein and Gleberzon, 2004:10). The use of manipulation in the treatment of mechanical joint dysfunction has been researched extensively and shown to be effective in the treatment of acute and chronic cases (Bronfort, Haas, Evans and Bouter, 2004; Coulter, 1998).

The chiropractic term manipulable subluxation defines a motion segment of a joint in which alignment, movement integrity, and physiologic functions are altered, and can be improved by manual thrust procedures, such as manipulation. This manipulable subluxation must not be confused with the medical concept of a subluxation, commonly known as a partial or complete dislocation, which is visible on x-ray (Gatterman, 1995:6-11). Thus Redwood and Cleveland (2003:674) added to this definition by stating that in a manipulable subluxation the joint surfaces remain in contact. Other terms used, in place of the term manipulable subluxation, are fixation, restriction, manipulable lesion and misalignment, to name just a few (Gatterman, 1995:7-9).

A normal joint has small passive accessory movements, which allow movement of a joint into its end play zone (Dutton, 2004:174-175). The end play of these accessory movements has a certain degree of resistance. An increased resistance in end play of a particular direction forms a pathologic barrier (Redwood and Cleveland, 2003:221), and therefore a manipulable subluxation. This increase in resistance is due to a joint fixation. A joint fixation is defined by Schafer and Faye as: “any physical, functional, or psychic mechanism that produces a loss of segmental mobility within its (a joint’s) normal physiological range of motion.”

This specific direction of a manipulable subluxation determines the line of drive of a manipulative force (Haldeman, 1992:305) in order to restore normal physiological motion in that joint. Redwood and Cleveland (2003:219) discuss the importance of identifying the exact location and characteristics of a manipulable subluxation in a joint, prior to the manipulation of that joint, in order to gain the most beneficial effect. It is therefore vital that manual therapists rely on effective, reliable tests used to identify manipulable subluxations, such as motion palpation (Hestbaek and Leboeuf-Yde, 2000).

2.3. Motion Palpation

Motion palpation is defined as:
"Palpatory diagnosis of passive and active segmental joint range of motion."
(Bergman, Peterson and Lawrence. 1993:762)

It consists of the use of tactile senses of the hands to determine variations in tissue consistency of a joint in a specific direction (Haldeman, 1992:304-305). By moving the joint to its end range of motion or physiological barrier, the examiner can then spring the joint further, assessing the end play for a manipulable subluxation (Redwood and Cleveland, 2003:219).

Motion palpation is one of the original examination techniques used by chiropractors and is still the most recognized physical examination technique that supports the presence or absence of manipulable subluxations (Bergman, Peterson and Lawrence, 1993:81). A survey conducted in Australia, chosen for its high response rate of 85%, found that chiropractors regarded motion palpation as one of the most reliable chiropractic tests to indicate the use of manipulation (Walker, 1998). In spite of this popularity, there is still little evidence of the validation of motion palpation (Cooperstein and Gleberzon. 2004:34-35).

2.3.1. Previous Spinal Inter-examiner Reliability Studies

The inter-examiner reliability of motion palpation in the asymptomatic participant was assessed in the thoracic spine by Brismée, Gibson, Ivie, Lopez, Moore, Matthijs, Phelps, Sawyer and Sizer (2006). Forty-one participants were examined by three certified manual therapy instructors. They showed that the inter-examiner reliability was fair to substantial with kappa results ranging from 0.27 to 0.65 and percentage agreement from 63.4% to 82.5%. Opposite results were obtained by Vincent-Smith and Gibbons (1999), who also assessed inter-examiner reliability in asymptomatic participants, although it was done in the sacroiliac joint. Nine examiners examined the standing flexion test on nine participants. They found that the reliability was statistically insignificant with a kappa result of 0.052 and a mean percentage agreement of 42%. Smedmark, Wallin and Arvidsson (2000) demonstrated that motion palpation of the cervical spine in participants seeking treatment for cervical problems was fair to moderate. Percentage agreement was between 70% and 87% and kappa results ranged between 0.28 and 0.43. This was in spite of the therapists having equal backgrounds with regards to education and clinical experience. Another study, chosen for its good methodology utilizing blinding and same day assessment, assessed the inter-examiner reliability of motion palpation of the symptomatic lumbar spine. It also showed poor kappa results ranging from −0.20 to 0.17, with many of the results being less than chance. This examination was conducted on 39 participants by two doctors of chiropractic (Schneider, Erhard, Brach, Tellin, Imbarlina and Delitto, 2008).

As a result of the many inter-examiner reliability studies on spinal motion palpation, several authors have conducted systematic reviews. One review of literature showed that out of 39 high-quality motion palpation reliability studies, only 4 reported good reliability (Haneline, Cooperstein, Young and Birkeland, 2008). Van Trijffel et al. (2005) conducted a systematic review of studies on the inter-examiner reliability of motion palpation in the cervical and lumbar spine. They showed that the results overall were found to be poor to fair.

Motion palpation of the spine has also been assessed in combination with other examination tests in order to identify a manipulable subluxation. The reasoning behind this is such that the mechanical joint dysfunction of a manipulable subluxation does not occur in isolation in a patient, but is just one part of the subluxation complex (Redwood and Cleveland, 2003:137). The reliability of combination testing had mixed results overall. One study conducted by French, Green and Forbes (2000), evaluated commonly used chiropractic diagnostic methods in combination to detect manipulable subluxations in the lower thoracic, lumbar and sacroiliac joints of chronic mechanical low-back pain participants, these were: visual postural analysis, pain description by the participant, plain static erect x-ray film of the lumbar spine, leg length discrepancy, neurologic tests, motion palpation, static palpation, and orthopedic tests. They found that the results showed only fair reliability, and they strongly discouraged manual therapists from relying completely on the findings of any of these examination techniques when assessing patients. Still another study by Arab, Abdollahi, Joghataei, Golafshani and Kazemnejad (2009), found that the reliability of motion palpation in combination with pain provocation in the sacroiliac joint showed moderate to substantial results. They therefore concluded that this combination of motion palpation and pain provocation was reliable in the assessment of manipulable subluxations of the sacroiliac joints. However, it must be noted that there are very few studies of adequate quality on multidimensional approaches for identifying manipulable subluxations, and further research is still required in this area (Gemmell and Miller, 2005).

The reliability of motion palpation on its own has shown itself to be below average in inter-examiner studies on both asymptomatic and symptomatic participants. It has also had mixed reliability results in combination with other examination tests when identifying manipulable subluxations. However, the majority of research studies have focused on the use of motion palpation in the spine, with little attention being paid to its reliability in extremity joints. This study therefore aimed to address the inter-examiner reliability of motion palpation in an extremity joint.

2.3.2. Previous Extremity Inter-examiner Reliability Studies

A few studies have investigated the use of motion palpation in the extremity joints, although none were found on the elbow. One study was found that tested the inter-examiner reliability of motion palpation of the patella. It was found to be fair, but not reliable enough to play a significant role in the diagnosis, management and assessment of knee/patella disorders (Bezuidenhout, 2002). Another study by Brantingham, Wood, Parkin-Smith, Van der Muelen and Weston (2003) assessed the Inter-examiner reliability of the circumduction test for general foot mobility/joint dysfunction. Seventeen participants with only one symptomatic foot were examined. Both feet were examined in all participants as the non-injured foot was used as a comparison and control. Kappa results in both groups ranged from moderate agreement of 0.452 for decreased mobility in the symptomatic feet to excellent agreement of 0.85 in the asymptomatic feet. No studies have assessed the inter-examiner reliability of motion palpation of the elbow, let alone the symptomatic elbow with regards to chronic lateral epicondylalgia. Therefore this study focussed on this gap in the literature.

2.3.3. Symptomatic vs. Asymptomatic

The use of symptomatic joints in a reliability study on motion palpation has been encouraged by numerous authors (van Trijffel et al., 2005; Vaughan, 2002). Firstly as motion palpation of asymptomatic joints is not representative of clinical practice, and secondly as symptomatic joints would be expected to have more manipulable subluxations, with easier identification of these manipulable subluxations, than asymptomatic joints. This is especially true in chronic conditions where there has been a long-standing history of symptoms and functional limitations of joints (Redwood and Cleveland, 2003:219), possibly leading to more manipulable subluxations. Therefore the calculation of kappa could be more accurate in symptomatic joints, leading to higher reliability results (Hestbaek and Leboeuf-Yde, 2000).

Therefore, in this study, the inter-examiner reliability of motion palpation in both asymptomatic and symptomatic elbows was assessed. It was assumed that more manipulable subluxations would be found in the symptomatic elbows, possibly leading to a higher inter-examiner reliability in this group. The symptomatic inter-examiner reliability results could therefore be compared to the asymptomatic inter-examiner reliability results, allowing for a clear illustration of their difference, and giving a more descriptive picture of the inter-examiner reliability of motion palpation in the elbow joint complex.

2.4. The Elbow

2.4.1. Anatomy

The elbow joint complex consists of three joints as described in Schafer and Faye (1990:354); the humeroradial joint, the humeroulnar joint and the proximal radioulnar joint. The humeroulnar and humeroradial joints are hinge type of synovial joints, located 2-3 cm inferior to the epicondyles of the humerus. Their articulations are made up of the trochlea and capitulum of the humerus articulating with the trochlear notch of the ulna and the slightly concave superior aspect of the head of the radius respectively. The proximal radioulnar joint is a pivot type of synovial joint which allows movement of the head of the radius on the radial notch of the ulna. A fibrous capsule surrounds the elbow joint complex, thickened on its medial and lateral aspect to form the strong triangular collateral ligaments of the elbow.

Another ligament, called the anular ligament, encircles and stabilises the radial head in position, maintaining articulation of the proximal radioulnar joint.

Several muscles cross the elbow and extend the length on the forearm and hand allowing movement of the elbow. These are:
Chief flexors of the elbow joint: brachialis, biceps brachii, and brachioradialis, in order of decreasing strength, and assisted by pronator teres when flexion is resisted.
Chief extensors of the elbow joint: triceps brachii (especially the medial head), assisted by anconeus (Moore and Dalley, 1999:795-800).
Two more groups of muscles also cross both the elbow and wrist, although their function is to allow movement in the wrist. These groups are the flexors and extensors of the forearm, and originate on medial and lateral epicondyles of the humerus, as the common flexor and common extensor tendons respectively (Moore and Dalley, 1999:734-750).

The elbow joint complex allows for active range of motion in flexion, extension, pronation and supination (Moore and Dalley, 1999:796; 801). Along with these gross movements, it also has a number of accessory movements in each joint which are assessed by motion palpation for manipulable subluxations (Dutton, 2004:540).

2.4.2. Motion Palpation of the Elbow

Motion Palpation of the elbow incorporates the humeroulnar and proximal radioulnar joints. Four accessory movements can be examined in the humeroulnar joint, namely: long axis distraction, medial to lateral glide, lateral to medial glide and posterior to anterior glide in extension. In the proximal radioulnar joint five accessory movements can be examined, namely: anterior to posterior glide, posterior to anterior glide, posterior to anterior glide in pronation, rotation of the radial head on the ulna and inferior glide. The technique of motion palpation of the elbow in these directions has been described clearly by Bergman, Peterson and Lawrence (1993:597-608) and Schafer and Faye (1990:356), and are as follows:

2.4.2.1. Humeroulnar Joint

- Long Axis Distraction

Assess long axis distraction, primarily of the humeroulnar joint, with the patient sitting or supine with their elbow bent slightly. Stand to the side of involvement, facing the patient, and use your inside hand to stabilize the humerus while your outside hand grasps the distal forearm. Then stress the forearm along its long axis, feeling for a springing end play (Bergman, Peterson and Lawrence, 1993:597-608).

- Medial to Lateral Glide

Evaluate medial to lateral glide of the humeroradial and humeroulnar joints with the patient seated, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the medial side of the affected arm. Stabilize the patient's arm against your body by your outer arm while your inside hand takes a calcaneal contact over the medial aspect of the elbow joint. With the forearm stabilized, stress the elbow, medial to lateral, assessing for the presence of a springing end play (Bergman, Peterson and Lawrence, 1993:597-608).

- Lateral to Medial Glide

Assess lateral to medial glide of the humeroradial and humeroulnar joint with the patient in a seated position, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the lateral aspect of the affected arm. Stabilize the patient's forearm using the inside arm to hold the patient's arm against your body. Your outside arm takes a calcaneal contact over the lateral aspect of the elbow joint. With the patient's forearm stabilized against your body, stress the elbow, lateral to medial, determining the presence of a springing end play (Bergman, Peterson and Lawrence, 1993:597-608).

- Posterior to Anterior Glide in Extension

Evaluate posterior to anterior glide of the humeroulnar joint in extension with the patient sitting, with the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the lateral side of the affected arm. Form a ring with your thumb and index finger of your outside hand and place it over the posterior aspect of the olecranon process. Rest your other hand on the anterior aspect of the distal forearm. With very little downward pressure on the distal forearm, apply a gentle posterior to anterior stress to the olecranon process, looking for a springing end play (Bergman, Peterson and Lawrence, 1993:597-608).

2.4.2.2. Proximal Radioulnar Joint

- Anterior to Posterior Glide and Posterior to Anterior Glide – radioulnar joint

Assess anterior to posterior and posterior to anterior glide of the radioulnar joint with the patient in the seated position, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the lateral aspect of the affected arm. With your inside arm, stabilize the patient's forearm against your body and grasp the distal humerus and proximal ulna. With your outside hand, hold the radial head between the thumb and index finger. While stabilizing the ulna and humerus, stress the radial head, anterior to posterior and posterior to anterior, determining the presence of a springing end play (Bergman, Peterson and Lawrence, 1993:597-608).

- Posterior to Anterior Glide in Pronation – radioulnar joint

Evaluate posterior to anterior glide of the radioulnar joint in pronation with the patient in the seated position, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the lateral aspect of the affected arm. With your outside hand, grasp the distal forearm with digital contacts of the index, middle, and ring finger on the posterior aspect of the radius. With your inside hand, place a thumb contact on the posterior aspect of the radial head. Use your outside hand to pronate the forearm. At the contact over the radial head, you should first perceive a rotational movement of the radial head, and at the end point of movement, apply a posterior to anterior stress to the radial head to determine the presence of a springing end play (Bergman, Peterson and Lawrence, 1993:597-608).

- Rotation of the Radial Head on the Ulna

Pronate the standing patient's forearm. Place the thenar eminence of your medial hand over the anterior surface of the head of the radius. With your other hand, grasp the radial side of the patient's wrist. You should feel the proximal aspect of the radius against your thenar eminence. At this point, quickly rotate the patient's arm into full pronation. You should feel the head of the radius spin backward on the ulna. Assess for any manipulable subluxation in end play (Schafer and Faye, 1990:356).

- Inferior Glide of the Proximal Radioulnar Joint

  Stand perpendicular to sitting patient, flex the patient's elbow to a right angle, and supinate the forearm. Grasp the patient's forearm with your active hand just above the wrist, anchor your stabilizing hand against the patient's distal humerus, and apply longitudinal traction with your active hand. Feel the end play movement (Schafer and Faye, 1990:356).

In the normal pain-free, asymptomatic elbow, one would expect it to be absent of manipulable subluxations in these accessory movements. However, as discussed previously, a symptomatic condition, such as lateral epicondylalgia, could show more manipulable subluxations, especially in its chronic stage.

2.5. Lateral Epicondylalgia

Lateral Epicondylalgia is a condition that affects the extensor carpi radialis longus and brevis muscles and tendons near their origin (Cyriax and Cyriax, 1993:58). These muscles originate on the lateral epicondyle of the humerus, and along with their tendons, span the entire length of the forearm bridging the elbow and wrist joints (Peterson and Renstrom, 2001:163), thereby controlling wrist extension and radial deviation (Dutton, 2004:553). On contraction of these muscles it results in the characteristic lateral elbow pain (Dutton, 2004:553). It is commonly referred to as tennis elbow, or lateral epicondylitis, although these two are not true descriptions of this condition as only 5% of cases occur in tennis players (Cyriax and Cyriax, 1993:58), and its aetiology is not typically inflammatory, especially in chronic cases (Kjaer, Krogsgaard, Magnusson, Engebretsen, Roos, Takala and Woo, 2003:747; Goguin and Rush, 2003). One of the preferred names is however lateral epicondylalgia, as the term "-algia" refers to pain. Therefore this term emphasizes the concept that it is a complex condition in which many possible pathophysiological mechanisms and underlying causes of pain are at work. This encourages medical practitioners to comprehensively examine every elbow in order to find the most effective treatment for that patient (Waugh, 2005).

2.5.1. Clinical Presentation

Lateral epicondylalgia commonly affects people between the age of 45-54 years (Shiri et al., 2006). According to a study conducted in the UK by Walker-Bone et al. (2004), involving a screening questionnaire of 9696 randomly selected adults and physical examination in symptomatic participants, lateral epicondylalgia had a prevalence of 1.3% of males and 1.1% of females in the general population. Another study conducted in Finland also assessed the prevalence of lateral epicondylalgia in the general population. Of the 4783 participants who were included in the study, 1.3% were diagnosed with lateral epicondylalgia, with no difference between men and women (Shiri et al., 2006); a very similar result.

It is most commonly found with vocations and avocations such as carpentry, gardening, dentistry, sewing, tennis, squash, golf, bowling and baseball (Saidoff and McDonough, 1997:69), as lateral epicondylalgia is associated with any activity which involves repeated wrist extension against resistance (Brukner and Khan, 2007:293). More recently computer usage has been identified as the most common work-related cause, being attributed to 74% of work related lateral epicondylalgia (Waugh, Jaglal, Davis, Tomlinson and Verrier, 2004). The study by Shiri et al. (2006) gave evidence of the interaction between repetitive movements of the arms and forceful activities for the risk of lateral epicondylalgia. It showed that there was also an association of current smoking and former smoking to lateral epicondylalgia.

Lateral epicondylalgia has two distinct clinical presentations. The most common is an insidious onset, with lateral elbow pain occurring 24-72 hours after an unaccustomed activity involving repeated wrist extension. The second clinical presentation is a very sudden onset of pain. This sharp lateral elbow pain occurs with a single exertion of the wrist extensors in activities such as lifting a heavy bag (Brukner and Khan, 2007:293). Lateral epicondylalgia most commonly presents as a chronic disorder (Saidoff and McDonough, 1997:69-70). Grip strength is usually diminished with lateral epicondylalgia, as it is the wrist extensors that must contract during gripping activities in order to stabilize the wrist. This leads to the common complaint of frequently dropping objects, especially when objects are carried with the palm of the hand facing down. Diffuse achiness, morning stiffness and night pain are also common complaints (Dutton, 2004:555).

Typically the pain is reproduced and the diagnosis made with the use of resisted wrist extension and resisted extension of the middle finger (Brukner and Khan, 2007:293; Dutton, 2004:555). The chair lift test is another common and effective assessment test, used to reproduce pain form lateral epicondylalgia by utilizing wrist extension (Paoloni, Appleyard and Murrell, 2004).

2.5.2. Pathoanatomy

The exact nature of the anatomic structures involved in lateral epicondylalgia and its pathophysiology are still contentious issues, however it is generally believed that it consists of damage to the tendons that extend the wrist and attach to the lateral epicondyle (Hong, Durand and Loisel, 2004). According to Peterson and Renstrom (2001:163), lateral epicondylalgia consists of a degenerative process that is secondary to tensile overuse fatigue, weakness, and possibly avascular changes. Kjaer et al. (2003:747) discuss the histological changes, emphasizing that they are usually not typical of inflammation, but rather a repair process after microtrauma to the tissue resulting in adhesions. They begin with small ruptures of the muscle and tendon, and later become granulomatous tissue, rich in fibroblasts, vessels and nerves, and destroying the natural parallel architecture of the collagen fibrils. Cyriax and Cyriax (1993:58) described four sites of lateral epicondylalgia, namely: on the tenoperiosteal junction of the epicondyle, in the wrist extensor muscle bellies, in the body of the tendon adjacent to the head of the radius, or at the origin of the extensor carpi radialis longus at the supracondylar edge. According to Cyriax and Cyriax, 90% of cases occur on the tenoperiosteal junction of the epicondyle. Due to this close proximity to the joint capsule, and its effect on the subluxation complex (Redwood and Cleveland, 2003:137), one would expect there to be a certain degree of mechanical joint dysfunction. There is however a lack of research focussing on this joint pathophysiology in lateral epicondylalgia.

2.5.3. Treatments

The controversy over the exact pathophysiology of lateral epicondylalgia may have influenced the treatment and management protocols, as these have also been numerous yet overall inconclusive (Hong, Durand and Loisel, 2004). However, it is generally considered standard practice with medical practitioners, to send a patient with lateral epicondylalgia for conservative treatment prior to any invasive techniques (Dutton, 2004:555). For this reason, there has been a substantial amount of research on the various forms of conservative treatment. Trudel, Duley, Zastrow, Kerr, Davidson and MacDermid (2004) conducted a systematic review of previous research studies, to determine the effectiveness of the various conservative treatments for lateral epicondylalgia. Despite them not being able to identify a specific technique that was the most efficient treatment, they did find that there was a high level of evidence that acupuncture, exercise therapy, manipulations and mobilizations, ultrasound, phonophoresis, Rebox, and ionization with diclofenac, all cause a reduction of pain or improvement in function in patients with lateral epicondylalgia.

2.5.4. Manipulation in Lateral Epicondylalgia

There is a growing body of literature reporting the effects and use of joint manipulation in the treatment of lateral epicondylalgia. Many types of manipulation have been used for this condition, being directed at the elbow, wrist, cervical and thoracic spinal regions, resulting in clinical alteration of pain and the motor system (Vincenzino, Cleland and Bisset, 2007). It has been shown that when manual therapists chose to use manipulation as the treatment of choice for lateral epicondylalgia, the most commonly used manipulation was Mills' manipulation (Greenfield and Webster, 2002).

A study by Kaufman (2000) showed that Mills' manipulation is effective in treating lateral epicondylalgia as it relieved symptoms in patients when applied twice a week for four weeks. This was backed up by Nagrale et al. (2009), in which Mills' manipulation was found to be more effective than a treatment of phonophoresis and exercise in managing lateral epicondylalgia.

As explained in Cyriax and Cyriax (1993:59) and Dutton (2004:568), Mills' manipulation is generally applied after the application of transverse frictions to the tendon. The clinician stands behind the seated patient's shoulder. The patient's arm is lifted to a right angle while the clinician internally rotates their shoulder and fully pronates their forearm. The clinician then maintains full flexion of the patient's wrist whilst applying a high-velocity, low-amplitude thrust to the patient's flexed elbow. This thrust forces the elbow into full extension, and a cavitation is commonly heard. The effect of this manipulation is believed to be directly on the adhesions in the common extensor tendon (Cyriax and Cyriax, 1993:59; Dutton, 2004:568), and therefore purely a musculotendinous manipulation. This is in spite of the common belief that a manipulation affects the joint structure (Gatterman, 1995:12), yet there is a lack of research on this aspect in Mills' manipulation.

2.6. Conclusion

Motion palpation is a common examination technique used to identify manipulable subluxations prior to manipulating a joint. Still it is necessary that it be validated for its continued use in a clinical setting. There is a substantial amount of research on its inter-examiner reliability when assessing the spine, although no research studies have been found that assess the reliability of motion palpation of the elbow, in either symptomatic or asymptomatic cases. Due to the use of manipulation as a treatment for lateral epicondylalgia, and its long-standing history of symptoms in chronic conditions, it is assumed that these elbows have more manipulable subluxations present when compared to the asymptomatic elbows. Motion palpation should therefore be utilized in assessing these elbows prior to manipulation. Therefore this study aimed to assess the inter-examiner reliability of motion palpation in the asymptomatic elbow and symptomatic elbows with regards to chronic lateral epicondylalgia.

CHAPTER THREE

3.1. Introduction

This chapter explains in detail the method that was undertaken to compile this research study. It includes the objectives, the advertising and recruitment, the sampling, the exact procedure the participant underwent, the examination procedure, and the statistical methods that were used to analyse the data.

3.2. Research Methodology

This research study consisted of a quantitative non-intervention study that proposed to assess the inter-examiner reliability of motion palpation in the asymptomatic elbow, and the elbow with chronic lateral epicondylalgia.

3.2.1. Advertising and Recruitment

In order to recruit participants for this research study, advertisements (appendix 1) were placed around the Durban University of Technology campuses and in local sports clubs, gyms and public areas. Flyers were also posted in post boxes in Durban and surrounding areas. These informed people of the research, and offered one free assessment and treatment for those with tennis elbow. A telephone number was printed on the advert in order to contact the researcher. Advertising was also done via word of mouth. The researcher placed no pressure on the potential participants to enrol.

Over a four month period willing participants contacted the researcher, or the researcher contacted possible participants, telephonically. They were screened over the phone, by the researcher, according to inclusion and exclusion criteria. The following questions were asked:

“How old are you?”

“Do you have tennis elbow or pain on the outside of only one elbow, the other elbow being pain-free and fully functional?”

"Have you had tennis elbow for 3 months or longer?"

"If you had to rate your pain from zero to ten, zero meaning no pain, and ten meaning the worst pain possible, at what level would you describe your pain?"

If they were between the ages of 18 to 65, had tennis elbow in only one elbow, the other being pain-free and fully functional, had had the tennis elbow for 3 months or longer, and described their pain at a level below 8, then they were asked to schedule a once-off appointment at the clinic with the researcher for a full assessment.

3.2.2. Sampling

Sample size for the reliability objectives was not calculated according to statistical criteria, since the Fleiss' kappa is not an inferential test, thus there was no null hypothesis. However, a small sample size will tend to exaggerate discordant results. Thus a sample size of twenty, therefore forty elbows, was used since this number was deemed practical.

Participants were accepted based on the inclusion and exclusion criteria.

3.2.3. Inclusion Criteria

- Between 18 to 65 years old, as chronic lateral epicondylalgia is most prevalent in adults (Davis, Davis and Ross, 2005:313).
- Must have had symptoms for longer than 3 months, as this is defined as chronic. (Greenfield and Webster, 2002).
- One elbow had to be symptomatic, and the other pain-free and fully functional. Thus the variables were decreased and allowed to be based on the most similar comparison.
- They described their pain at a level below 8 on the numerical pain rating scale. This removed participants with severe pain (Fosnocht, Homel, Todd, Crandall, Choiniere, Ducharme and Tanabe, 2006), who were most likely to react to palpation of their symptomatic elbow.
- The diagnosis of chronic lateral epicondylalgia was as follows:

- Maximal tenderness localized to the lateral epicondyle (Martinez-Silvestrini, Newcomer, Gay, Schaefer, Kortebein and Arendt, 2005; Newcomer, Martinez-Silvestrini, Schaefer, Gay and Arendt, 2005).
- Pain with two of the following three manoeuvres: resisted wrist extension and resisted middle finger extension, both commonly used tests to reproduce pain (Dutton, 2004:555), and the chair-lift test (Martinez-Silvestrini et al., 2005; Newcomer et al., 2005). Research done on a simulated chair lift test has been shown to be reliable and reproducible as an assessment tool for lateral epicondylalgia (Paoloni, Appleyard and Murrell, 2004).

3.2.4. Exclusion Criteria

- Substantial osteoarthritis, rheumatoid arthritis, or inflammatory arthropathy affecting the elbow or wrist;
- Connective tissue disease;
- Diffuse pain syndrome (e.g., generalized tension myalgia or fibromyalgia);
- Carpal tunnel syndrome;
- Cervical radiculopathy;
- History of fracture of the radius, ulna, or humerus with resultant deformity of the affected extremity.

} (Martinez-Silvestrini et al., 2005; Newcomer et al., 2005)

3.2.5. Examiners

Three examiners in their final year of Master's chiropractic education, at the Durban University of Technology, were used in this study. They were at the same level of chiropractic education, and had been taught the same techniques. Previous studies (Currier, Froehlich, Carow, McAndrew, Cliborne, Boyles, Mansfield and Wainner, 2007; Gerwin, Shannon, Hong, Hubbard and Gevirtz, 1997; Fjellner, Bexander, Faleij and Strender, 1999), trained examiners prior to seeing participants. This helped to ensure standardisation in the examination technique and interpretation of findings, thereby increasing the reliability (Degenhardt, Snider, Snider and Johnson, 2005). As a result, the examiners in this study underwent seven training sessions, over a three week period, following which they were considered proficient in the same technique of motion palpation of the elbow. Each practical training session was overseen by the researcher and followed the motion palpation technique described in Bergman, Peterson and Lawrence (1993:597-608) and Schafer and Faye (1990:356) (appendix 2). At the end of the training a lecturer of motion palpation assessed each examiner's motion palpation technique.

The examiners were each offered remuneration for their involvement in the study, in order to cover their travelling costs, and as an incentive to be at all the training days and every participant's consultation.

3.2.6. Examination Procedure

The participant was only required to have a single consultation for the research study. Each participant was assessed on their own, within the Durban University of Technology Chiropractic Clinic. When the participant presented to the Chiropractic Day Clinic on the day of their scheduled appointment, the researcher screened the participant briefly, confirming the presence of unilateral chronic lateral epicondylalgia, and then explained the research procedure giving the participant the opportunity to ask any questions about the research. They were initially given a letter of information and consent (appendix 3) to sign. The participant then underwent a full case history (appendix 4), physical examination (appendix 5), and elbow regional examination (appendix 6), with all relevant findings being summarized on a SOAPE note (appendix 7). The three examiners then independently entered the room and motion palpated the participant's elbows, beginning with the right elbow, then the left.

3.2.6.1. Blinded

Participants were encouraged not to engage in conversation with the examiners, nor say or do anything that would alert any of the examiners to an area or direction of pain. The examiners were also told not to ask the participants any questions or engage in conversation with them, and to avoid palpating or contacting with pressure over the lateral epicondyles. In order to shield the participant's body language and facial expressions from the examiner, a screen was placed between the examiner and participant. Only the participant's arms were visible on either side of the screen. The examiners were blinded to the participant's information, including which elbow had chronic lateral epicondylalgia. Only the researcher was aware of which elbow was asymptomatic and which was symptomatic, and recorded this for each participant, on a form (appendix 8). The examiners were also blinded to each other's results, and were advised not to discuss any findings with each other.

3.2.6.2. Randomised

Prior to each participant assessment, the examiners each drew one folded piece of paper out of a box with the number 1, 2 or 3 written within it. This number depicted when each examiner would assess the participant (1^{st}, 2^{nd} or 3^{rd}). This ensured that the order of examination was randomized. Each of the examiners were also given a letter (A, B or C) for the duration of the study, in order to recognise who they were on their results form without revealing their identity.

3.2.6.3. Motion Palpation

Each examiner motion palpated each of the participant's elbows once. Examiners motion palpated each joint in the elbow in specific directions as specified by the motion palpation technique (appendix 2) and recorded the results on a results form (appendix 9). They assessed for the presence of a manipulable subluxation in end play, ensuring that they motioned each direction, in end play, no more than twice.

The following directions were motion palpated:

Accessory Movements of the Elbow Joint Complex:

Humeroulnar Joint:

- Long axis distraction
- Medial to lateral glide
- Lateral to medial glide
- Posterior to anterior glide in extension

(Bergman, Peterson and Lawrence, 1993:597-608)

Proximal Radioulnar Joint:

- Anterior to posterior glide
- Posterior to anterior glide
- Posterior to anterior glide in pronation
- Rotation of the radial head on the ulna
- Inferior glide

(Schafer and Faye, 1990:356)

Technique outlined in appendix 2.

3.2.6.4. Results Forms (Appendix 9)

Each examiner individually recorded their results on a new form for each participant, and was required to indicate with a cross, in the relevant block, when a manipulable subluxation was present. They were also required to mark, at the bottom of the form, following the motion palpation, which elbow they perceived to have chronic lateral epicondylalgia. At the top of each form examiners wrote their letter (A, B or C) followed by their order number (1, 2 or 3). Therefore each participant had three forms at the end of the study, one from each examiner. The asymptomatic or normal readings were taken from the pain free elbow, and the symptomatic readings were taken from the elbow with chronic lateral epicondylalgia.

This concluded the research component of this study. The participant was then given one free treatment for their lateral epicondylalgia, for their own benefit.

3.2.7. Flow Chart of Methodology

A brief outline of the tasks involved in the methodology and their order are illustrated in figure 1.

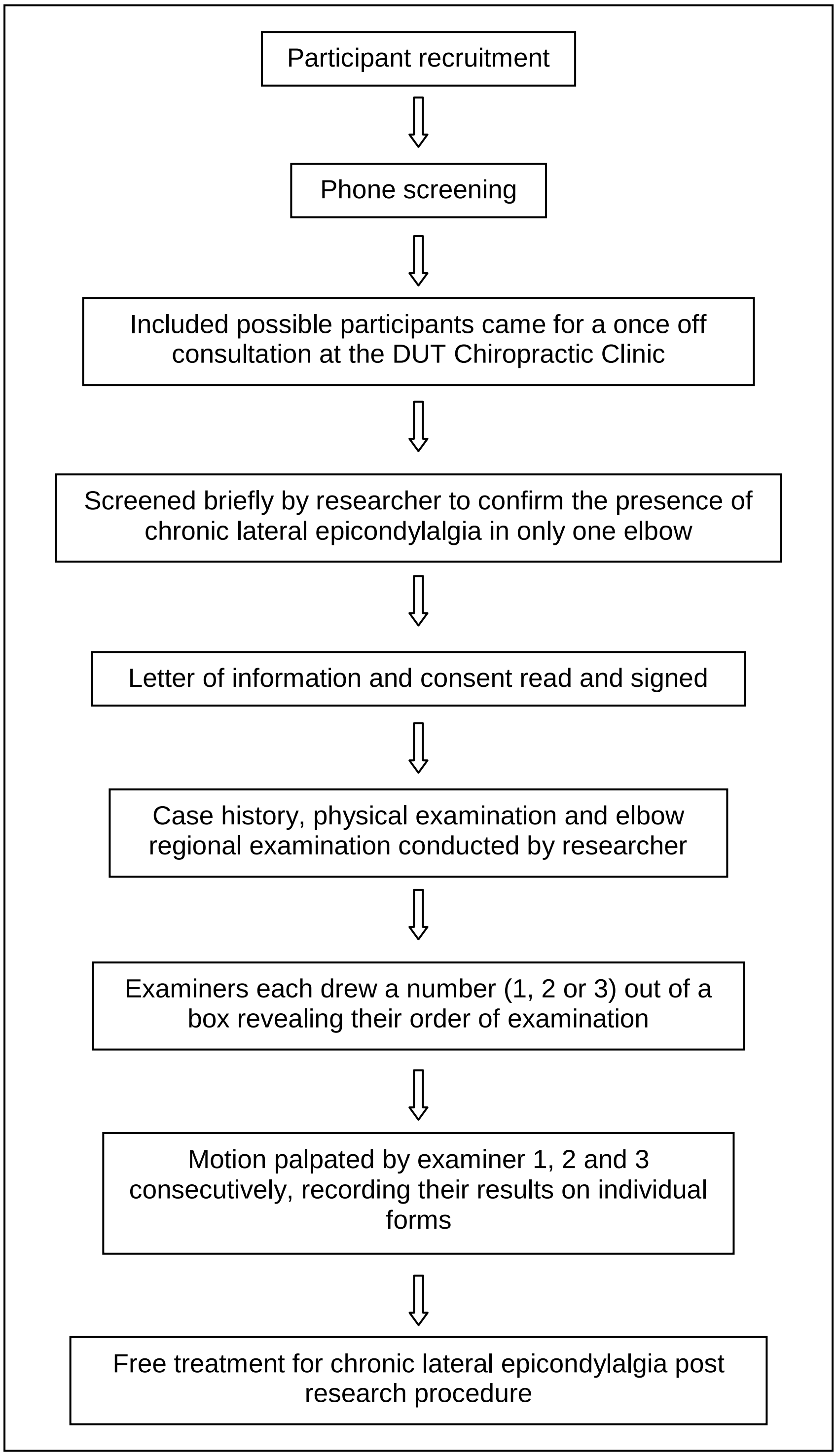

Figure 1: Methodological Flow Chart

3.3. Statistical Methodology

Data was captured from the results forms into MS Excel and imported into SPSS version 15.0 (SPSS Inc., Chicago, Illinois) for summary statistics and analysis.

Fleiss' kappa and percentage agreement (perfect percentage agreement and mean percentage agreement) were used to assess the inter-examiner reliability in symptomatic and asymptomatic elbows for each direction of motion palpation.

Fleiss' kappa statistics, standard errors of the estimates, and 95% confidence intervals were calculated in symptomatic and asymptomatic elbows separately by comparing the ratings between all 3 examiners using Stat Tools freeware (Fleiss's Kappa from rating scores, 2009).

Percentage agreement between all three examiners was calculated for each participant by assessing whether either all three examiners agreed on the absence or presence of a manipulable subluxation (in which case 100% agreement was recorded), or whether two of the three examiners agreed on either the presence or absence of a manipulable subluxation, assuming the majority rule (in which case 66.6% agreement was recorded). For example, if two examiners reported a manipulable subluxation and one reported no manipulable subluxation, then it was assumed, due to majority rule, that that participant had a manipulable subluxation (and thus 66.6% agreement was recorded), but if one examiner reported a manipulable subluxation while the other two reported no manipulable subluxation, then it was assumed, using the same logic, that that participant had no manipulable subluxation present (and similarly, 66.6% agreement was recorded). Percentage agreement consists of perfect percentage agreement and mean percentage agreement. Perfect percentage agreement was the percentage of participants in which all three examiners agreed on the presence or absence of a manipulable subluxation (100%) for each direction of motion palpation in both asymptomatic and symptomatic groups. The mean percentage agreement across all participants for each movement was calculated and reported for symptomatic and asymptomatic elbows separately. It took both 100% and 66.6% agreement into account.

The remainder of the analysis was done in SPSS. Paired non parametric Wilcoxon signed ranks test was used to compare the kappa values in the symptomatic and asymptomatic groups for the nine directions of motion palpation. The first examiner's results from each participant were used as a standard to identify whether there was or was not a manipulable subluxation, as these results were the least changed by the effect of mobilisation during motion palpation.

McNemar's chi square tests were performed to assess the significance of the percentage of correctly identified symptomatic elbows by each of the examiners. A p value <0.05 was considered as statistically significant.

CHAPTER FOUR

4.1. Introduction

This chapter includes the statistical analysis of the results of the study. They were statistically analysed using Fleiss' kappa, percentage agreement, paired Wilcoxon signed ranks test and McNemar's chi square tests, and reported in the following tables and bar charts.

<u>Fleiss' kappa</u>

The interpretation of the kappa statistic is:

"The kappa is a measurement of agreement. In Cohen's kappa, it measures agreements between two raters. In Fleiss' kappa, it measures the overall agreements between all the raters. Conventionally, a kappa of <0.2 is considered poor agreement, 0.21-0.4 fair, 0.41-0.6 moderate, 0.61-0.8 strong, and more than 0.8 near complete agreement. Given kappa is an estimate from a sample, the se=Standard Error provides an estimate of error. The 95% confidence interval is kappa +/- 1.96 se. Although concordance is usually used as a scalar measurement of agreement, a 95% confidence interval of kappa that does not cross the zero value does allow a conclusion that significant concordance exists."

(Fleiss's Kappa from rating scores, 2009)

The Standard Error used in Fleiss' Kappa formula was 0.1291.

The kappa results in this study were based on the guidelines in table 1.

Table 1: Interpretation of kappa results

Kappa value	Agreement
<0.2	Poor
0.21 – 0.4	Fair
0.41 – 0.6	Moderate
0.61 – 0.8	Good
>0.8	Near Perfect

(Landis and Koch, 1977)

Wilcoxon signed ranks test

“Wilcoxon Paired Signed Rank test is a nonparametric evaluation of paired differences. Pairs of measurements forms the raw data, and the difference between the two members of the pair is used to calculate the statistics. Wilcoxon is therefore the nonparametric equivalent of the paired t test.”

(Explanation of Wilcoxon PSRT for non parametric paired differences, 2010)

McNemar’s chi square test

“The McNemar's test evaluates changes in related or paired binomial attributes, whether changes in one direction is significantly greater than that in the opposite direction.”

(McNemar Test Explained, 2010)

Fleiss’ kappa and percentage agreement (perfect percentage agreement and mean percentage agreement) were used to assess the inter-examiner reliability in symptomatic and asymptomatic elbows for each direction of motion palpation. Paired Wilcoxon signed ranks test was used to compare the reliability between symptomatic and asymptomatic elbows, and assess for any differences, and McNemar’s chi square tests were performed to assess the percentage of correctly identified symptomatic elbows by each of the examiners.

4.2. Demographics

4.2.1. Participants

Sample size for the reliability objectives was not calculated according to statistical criteria, since Fleiss' kappa is not an inferential test, thus there was no null hypothesis. However, a small sample size will tend to exaggerate discordant results. A sample size of twenty participants, with one symptomatic and one asymptomatic elbow, were enrolled into this study since this number was deemed practical (*n*=40 elbows).

Table 2 shows that their mean age was 45.5 years (standard deviation 2.1 years) with a range from 25 to 58 years.

Table 2: Age of participants

N	Valid	20
	Missing	0
Mean		45.45
Std. Error of Mean		2.072
Minimum		25
Maximum		58

Figure 2 shows that their gender was mainly female (*n*=12, 60%).

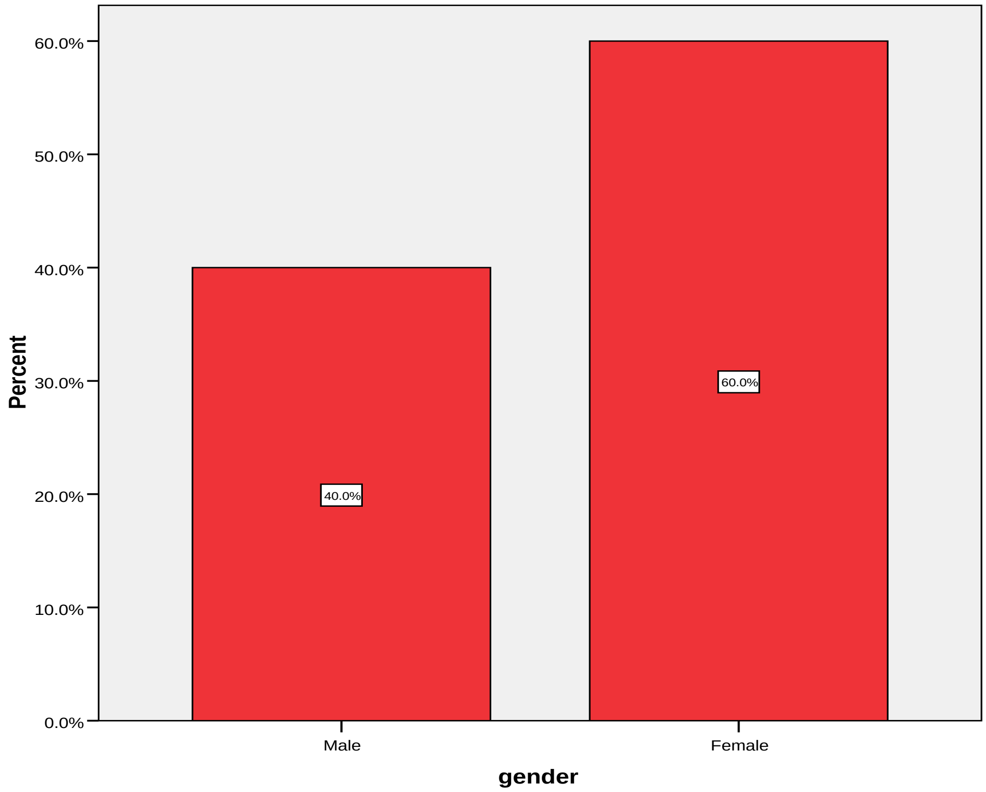

Figure 2: Gender of the sample participants (*n*=20)

Figure 3 shows that 85% of participants had symptomatic right elbows and in only 15% the left elbow was symptomatic.

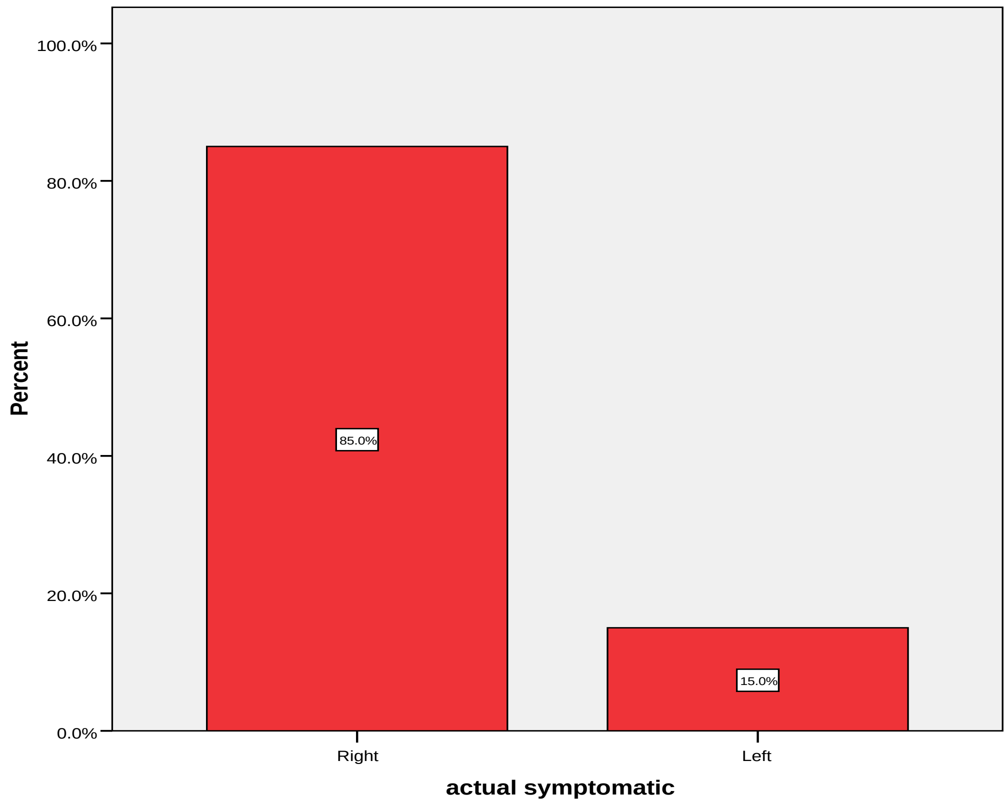

Figure 3: Percentage of symptomatic right and left elbow (*n*=20)

4.2.2. Examiners

Prior to each participant's consultation, examiners each drew one folded piece of paper out of a box, with the number 1, 2 or 3 written within it. That number depicted in which order they would examine the patient. This ensured that the order remained randomized. Table 3 shows the examiners' order for each of the participants. In order to keep examiners anonymous they were named examiner A, examiner B and examiner C respectively.

Table 3: Order of examination for participants

	Frequency	Percent
ABC	5	25.0
ACB	2	10.0
BAC	5	25.0
BCA	3	15.0
CAB	1	5.0
CBA	4	20.0
Total	20	100.0

4.3. Results

The following analysis of the inter-examiner reliability of motion palpation was represented in tables 4 to 41.

Each direction of motion palpation for both asymptomatic and symptomatic elbows has two tables. The first table depicts the number of examiners who agreed on the absence or presence of a manipulable subluxation for each participant. The participants' numbers are written in the first vertical column. The number of examiners, who agreed that there was not a manipulable subluxation found for that particular direction of motion palpation in each of the correlating participants, is shown on the second vertical column. Written in the final vertical column (or third column) is the number of examiners who agreed that there was a manipulable subluxation present for that particular direction of motion palpation in each of the correlating participants.
For example, when looking at table 4: In the first participant it was found that all three examiners agreed that there was no manipulable subluxation in humeroulnar long axis distraction. Whereas, in the second participant it was found that two of the examiners agreed that there was not a manipulable subluxation in humeroulnar long axis distraction, and only one of the examiners found a manipulable subluxation in humeroulnar long axis distraction.

In the second table for each of the directions of motion palpation, the results of the first table are divided into two sections, those participants in which all three examiners agreed (100%), and those participants in which only two of the examiners agreed and one of the examiners disagreed (66.6%).These numbers and percentages should all add up to the total number of participants on the bottom horizontal line. Therefore the perfect percentage agreement is determined from this table by calculating the percentage of participants in which all three examiners agreed on the absence or presence of a manipulable subluxation.
For example, in table 5, there was a 65% perfect percentage agreement by all three examiners because 13 of the participants had all three examiners agree on the absence or presence of a manipulable subluxation.

Tables 22 and 41 illustrate the mean percentage agreement for all directions of motion palpation in both asymptomatic and symptomatic groups respectively.

4.3.1. To determine the inter-examiner reliability of motion palpation in asymptomatic elbows

The inter-examiner comparisons between the three examiners for the 20 asymptomatic elbows, in each direction of motion palpation are shown here.

4.3.1.1. Humeroulnar long axis distraction

Table 4: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar long axis distraction for each participant

	No	Yes
1	3	0
2	2	1
3	3	0
4	3	0
5	3	0
6	3	0
7	2	1
8	3	0
9	3	0
10	3	0
11	3	0
12	3	0
13	3	0
14	2	1
15	2	1
16	3	0
17	3	0
18	2	1
19	2	1
20	2	1

Kappa: The overall kappa agreement was poor and not significantly different from 0.

Overall kappa = -0.1321   SE=0.1291
95% CI=-0.3851 to 0.1210

Percentage agreement: In table 5 it can be seen that there was 65% perfect percentage agreement amongst all 3 examiners.

Table 5: Humeroulnar long axis distraction percentage agreement

		Frequency	Percent
Valid	66.60	7	35.0
	100.00	13	65.0
	Total	20	100.0

4.3.1.2. Humeroulnar medial to lateral glide

Table 6: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar medial to lateral glide for each participant

	No	**Yes**
1	3	0
2	3	0
3	3	0
4	3	0
5	1	2
6	3	0
7	3	0
8	3	0
9	2	1
10	2	1
11	3	0
12	2	1
13	2	1
14	2	1

15	3	0
16	2	1
17	3	0
18	3	0
19	3	0
20	2	1

Kappa: The kappa agreement was poor and not significantly different from 0.

Overall kappa = -0.0458 SE=0.1291
95% CI=-0.2988 to 0.2073

Percentage agreement: In table 7 it can be seen that in 60% of the participants there was perfect percentage agreement amongst the examiners.

Table 7: Humeroulnar medial to lateral glide percentage agreement

		Frequency	Percent
Valid	66.60	8	40.0
	100.00	12	60.0
	Total	20	100.0

4.3.1.3. Humeroulnar lateral to medial glide

Table 8: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar lateral to medial glide for each participant

	No	**Yes**
1	2	1
2	3	0
3	3	0
4	2	1
5	3	0
6	3	0
7	2	1

8	3	0
9	3	0
10	3	0
11	3	0
12	3	0
13	2	1
14	2	1
15	3	0
16	3	0
17	2	1
18	3	0
19	3	0
20	2	1

Kappa: Kappa agreement was poor and not significantly different from 0.

Overall kappa = -0.1321 SE=0.1291
95% CI=-0.3851 to 0.1210

Percentage agreement: In table 9 it shows that there was perfect percentage agreement between the examiners in 65% of the asymptomatic participants.

Table 9: Humeroulnar lateral to medial glide percentage agreement

		Frequency	Percent
Valid	66.60	7	35.0
	100.00	13	65.0
	Total	20	100.0

4.3.1.4. Humeroulnar posterior to anterior glide in extension

Table 10: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar posterior to anterior glide in extension for each participant

	No	Yes
1	3	0
2	3	0
3	3	0
4	3	0
5	2	1
6	3	0
7	1	2
8	3	0
9	1	2
10	1	2
11	3	0
12	3	0
13	3	0
14	2	1
15	1	2
16	2	1
17	3	0
18	2	1
19	2	1
20	2	1

Kappa: There was overall poor kappa agreement which was not significantly different from 0.

Overall kappa = 0.0683   SE=0.1291
95% CI=-0.1847 to 0.3214

Percentage agreement: In table 11 it shows that there was perfect percentage agreement in 50% of the participants.

Table 11: Humeroulnar posterior to anterior glide in extension percentage agreement

		Frequency	Percent
Valid	66.60	10	50.0
	100.00	10	50.0
	Total	20	100.0

4.3.1.5. Proximal radioulnar anterior to posterior glide

Table 12: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar anterior to posterior glide for each participant

	No	**Yes**
1	3	0
2	3	0
3	2	1
4	3	0
5	3	0
6	3	0
7	3	0
8	3	0
9	3	0
10	3	0
11	3	0
12	3	0
13	3	0
14	2	1
15	2	1
16	3	0
17	3	0
18	3	0
19	3	0
20	2	1

Kappa: The overall kappa agreement was poor and not significantly different from 0.

Overall kappa = -0.0714   SE=0.1291
95% CI=-0.3245 to 0.1816

Percentage agreement: In table 13 it shows that there was perfect percentage agreement between all 3 examiners in 80% of asymptomatic elbows.

Table 13: Proximal radioulnar anterior to posterior glide percentage agreement

		Frequency	Percent
Valid	66.60	4	20.0
	100.00	16	80.0
	Total	20	100.0

4.3.1.6. Proximal radioulnar posterior to anterior glide

Table 14: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar posterior to anterior glide for each participant

	No	Yes
1	2	1
2	2	1
3	2	1
4	2	1
5	3	0
6	3	0
7	3	0
8	3	0
9	3	0
10	3	0
11	3	0
12	3	0
13	2	1
14	3	0

15	3	0
16	3	0
17	3	0
18	3	0
19	2	1
20	3	0

Kappa: The overall kappa agreement was poor and not significantly different from 0.

Overall kappa = -0.1111   SE=0.1291
95% CI=-0.3641 to 0.1419

Percentage agreement: In table 15 it shows that there was perfect percentage agreement in 70% of the cases.

Table 15: Proximal radioulnar posterior to anterior glide percentage agreement

		Frequency	Percent
Valid	66.60	6	30.0
	100.00	14	70.0
	Total	20	100.0

4.3.1.7. Proximal radioulnar posterior to anterior glide in pronation

Table 16: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar posterior to anterior glide in pronation for each participant

	No	**Yes**
1	3	0
2	3	0
3	3	0
4	2	1
5	2	1
6	3	0
7	3	0

8	1	2
9	3	0
10	3	0
11	3	0
12	3	0
13	3	0
14	3	0
15	3	0
16	2	1
17	3	0
18	2	1
19	2	1
20	2	1

Kappa: The overall kappa agreement was poor and not significantly different from 0.

Overall kappa = -0.0096 SE=0.1291
95% CI=-0.2627 to 0.2434

Percentage agreement: In table 17 it shows that there was perfect percentage agreement in 65% of the samples.

Table 17: Proximal radioulnar posterior to anterior glide in pronation percentage agreement

		Frequency	Percent
Valid	66.60	7	35.0
	100.00	13	65.0
	Total	20	100.0

4.3.1.8. Proximal radioulnar rotation of the radial head on the ulna

Table 18: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar rotation of the radial head on the ulna for each participant

	No	**Yes**
1	3	0

2	3	0
3	3	0
4	3	0
5	3	0
6	3	0
7	2	1
8	2	1
9	2	1
10	3	0
11	2	1
12	3	0
13	3	0
14	3	0
15	2	1
16	3	0
17	3	0
18	3	0
19	2	1
20	3	0

Kappa: There was poor kappa agreement which was not significantly different from 0.

Overall kappa = -0.1111   SE=0.1291
95% CI=-0.3641 to 0.1419

Percentage agreement: In table 19, percentage agreement shows that all three examiners agreed in 70% of the asymptomatic elbows.

Table 19: Proximal radioulnar rotation of the radial head on ulna percentage agreement

		Frequency	Percent
Valid	66.60	6	30.0
	100.00	14	70.0
	Total	20	100.0

4.3.1.9. Proximal radioulnar inferior glide

Table 20: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar inferior glide for each participant

	No	Yes
1	3	0
2	3	0
3	3	0
4	3	0
5	3	0
6	3	0
7	3	0
8	3	0
9	2	1
10	3	0
11	2	1
12	3	0
13	3	0
14	3	0
15	3	0
16	3	0
17	3	0
18	3	0
19	2	1
20	3	0

Kappa: The overall kappa agreement was poor and not significantly different from 0.

Overall kappa = -0.0526   SE=0.1291
95% CI=-0.3057 to 0.2004

Percentage agreement: In table 21 it shows that there was perfect percentage agreement in 85% of cases.

Table 21: Proximal radioulnar inferior glide percentage agreement

		Frequency	Percent
Valid	66.60	3	15.0
	100.00	17	85.0
	Total	20	100.0

4.3.1.10. To determine the inter-examiner mean percentage agreement between all three examiners in asymptomatic elbows

The mean percentage agreement between all three examiners in asymptomatic elbows was calculated for each participant by taking into account all the agreement, not only perfect percentage agreement.

The percentages are ranked from highest to lowest in the following table.

Table 22: Mean percentage agreement in asymptomatic elbows

	Mean
proximal radioulnar inferior glide agreement	94.99
proximal radioulnar anterior to posterior glide agreement	93.32
proximal radioulnar posterior to anterior glide agreement	89.98
proximal radioulnar rotation of the radial head on ulna agreement	89.98
humeroulnar long axis distraction agreement	88.31
humeroulnar lateral to medial agreement	88.31
proximal radioulnar posterior to anterior glide in pronation agreement	88.31
humeroulnar medial to lateral agreement	86.64
humeroulnar posterior to anterior glide in extension agreement	83.30

4.3.2. To determine the inter-examiner reliability of motion palpation in symptomatic elbows

The inter-examiner comparisons between the three examiners for the 20 symptomatic elbows, in each direction of motion palpation are shown here.

4.3.2.1. Humeroulnar long axis distraction

Table 23: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar long axis distraction for each participant

	No	Yes
1	2	1
2	3	0
3	2	1
4	3	0
5	3	0
6	3	0
7	3	0
8	2	1
9	1	2
10	3	0
11	2	1
12	2	1
13	3	0
14	3	0
15	1	2
16	2	1
17	2	1
18	2	1
19	2	1
20	3	0

Kappa: The overall kappa was -0.0802 meaning very poor agreement. The 95% CI crosses over 0 meaning that the kappa was not significantly different to 0.

Overall kappa = -0.0802   SE=0.1291
95% CI=-0.3332 to 0.1728

Percentage agreement: In table 24, percentage agreement shows that in 45% of the cases, there was 100% agreement between all 3 examiners, while in 55% of the cases 2 of 3 examiners agreed.

Table 24: Humeroulnar long axis distraction percentage agreement

		Frequency	Percent
Valid	66.6	11	55.0
	100.0	9	45.0
	Total	20	100.0

4.3.2.2. Humeroulnar medial to lateral glide

Table 25: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar medial to lateral glide for each participant

	No	**Yes**
1	1	2
2	3	0
3	2	1
4	3	0
5	3	0
6	2	1
7	1	2
8	2	1
9	3	0
10	0	3
11	1	2
12	3	0
13	3	0

14	3	0
15	2	1
16	3	0
17	0	3
18	3	0
19	3	0
20	3	0

Kappa: The kappa was 0.4034 meaning moderate agreement. The 95% CI did not cross over 0 so the kappa was significantly different to 0.

Overall kappa = 0.4034 SE=0.1291
95% CI=0.1504 to 0.6564

Percentage agreement: In table 26, it shows that there was 65% perfect percentage agreement between all 3 examiners in the sample.

Table 26: Humeroulnar medial to lateral glide percentage agreement

		Frequency	Percent
Valid	66.60	7	35.0
	100.00	13	65.0
	Total	20	100.0

4.3.2.3. Humeroulnar lateral to medial glide

Table 27: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar lateral to medial glide for each participant

	No	**Yes**
1	2	1
2	2	1
3	2	1
4	3	0
5	3	0

6	3	0
7	3	0
8	2	1
9	3	0
10	2	1
11	1	2
12	2	1
13	3	0
14	3	0
15	2	1
16	1	2
17	3	0
18	2	1
19	2	1
20	2	1

Kappa: There was poor kappa agreement which was not significantly different to 0.

Overall kappa = -0.1180   SE=0.1291
95% CI=-0.3710 to 0.1350

Percentage agreement: In table 28 it shows that 40% of the sample had perfect percentage agreement between the 3 examiners.

Table 28: Humeroulnar lateral to medial glide percentage agreement

		Frequency	Percent
Valid	66.60	12	60.0
	100.00	8	40.0
	Total	20	100.0

4.3.2.4. Humeroulnar posterior to anterior glide in extension

Table 29: The number of examiners agreeing on the absence or presence of a manipulable subluxation in humeroulnar posterior to anterior glide in extension for each participant

	No	Yes
1	3	0
2	2	1
3	1	2
4	0	3
5	1	2
6	3	0
7	2	1
8	2	1
9	2	1
10	2	1
11	2	1
12	1	2
13	1	2
14	3	0
15	2	1
16	1	2
17	0	3
18	2	1
19	1	2
20	3	0

Kappa: The kappa agreement was poor and not significantly different to 0.

Overall kappa = 0.0498 SE=0.1291
95% CI=-0.2033 to 0.3028

Percentage agreement: In table 30 it shows that 30% of the sample had perfect percentage agreement between all 3 examiners.

Table 30: Humeroulnar posterior to anterior glide in extension percentage agreement

		Frequency	Percent
Valid	66.60	14	70.0
	100.00	6	30.0
	Total	20	100.0

4.3.2.5. Proximal radioulnar anterior to posterior glide

Table 31: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar anterior to posterior glide for each participant

	No	**Yes**
1	2	1
2	2	1
3	2	1
4	3	0
5	3	0
6	2	1
7	3	0
8	3	0
9	3	0
10	3	0
11	2	1
12	3	0
13	3	0
14	3	0
15	3	0
16	3	0
17	3	0
18	3	0
19	3	0
20	2	1

Kappa: There was overall poor agreement with the kappa not being significantly different to 0.

Overall kappa = -0.1111   SE=0.1291
95% CI=-0.3641 to 0.1419

Percentage agreement: In table 32 it shows that 70% of the sample had perfect percentage agreement between all 3 examiners.

Table 32: Proximal radioulnar anterior to posterior glide percentage agreement

		Frequency	Percent
Valid	66.60	6	30.0
	100.00	14	70.0
	Total	20	100.0

4.3.2.6. Proximal radioulnar posterior to anterior glide

Table 33: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar posterior to anterior glide for each participant

	No	Yes
1	3	0
2	3	0
3	3	0
4	3	0
5	3	0
6	3	0
7	3	0
8	3	0
9	3	0
10	3	0
11	3	0
12	2	1
13	3	0
14	3	0
15	2	1
16	3	0
17	3	0
18	2	1

19	3	0
20	3	0

Kappa: There was poor kappa agreement which was not significantly different to 0.

Overall kappa = -0.0526 SE=0.1291
95% CI=-0.3057 to 0.2004

Percentage agreement: In table 34 it shows that 85% of the sample had perfect percentage agreement.

Table 34: Proximal radioulnar posterior to anterior glide percentage agreement

		Frequency	Percent
Valid	66.60	3	15.0
	100.00	17	85.0
	Total	20	100.0

4.3.2.7. Proximal radioulnar posterior to anterior glide in pronation

Table 35: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar posterior to anterior glide in pronation for each participant

	No	**Yes**
1	2	1
2	2	1
3	1	2
4	3	0
5	2	1
6	2	1
7	3	0
8	3	0
9	2	1
10	2	1
11	2	1

12	0	3
13	3	0
14	1	2
15	3	0
16	3	0
17	1	2
18	1	2
19	2	1
20	2	1

Kappa: There was poor kappa agreement which was not significantly different to 0.

Overall kappa = 0.0250   SE=0.1291
95% CI=-0.2280 to 0.2780

Percentage agreement: In table 36 it shows that there was 35% perfect percentage agreement in the sample.

Table 36: Proximal radioulnar posterior to anterior glide in pronation percentage agreement

		Frequency	Percent
Valid	66.60	13	65.0
	100.00	7	35.0
	Total	20	100.0

4.3.2.8. Proximal radioulnar rotation of the radial head on the ulna

Table 37: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar rotation of the radial head on the ulna for each participant

	No	Yes
1	1	2
2	1	2
3	2	1
4	2	1
5	3	0

6	2	1
7	2	1
8	2	1
9	1	2
10	1	2
11	2	1
12	2	1
13	2	1
14	2	1
15	2	1
16	3	0
17	2	1
18	2	1
19	2	1
20	1	2

Kappa: The kappa agreement was significantly worse than chance.

Overall kappa = -0.2691   SE=0.1291
95% CI=-0.5221 to -0.0161

Percentage agreement: In table 38 it shows that only 10% of the sample showed perfect percentage agreement.

Table 38: Proximal radioulnar rotation of the radial head on ulna percentage agreement

		Frequency	Percent
Valid	66.60	18	90.0
	100.00	2	10.0
	Total	20	100.0

4.3.2.9. Proximal radioulnar inferior glide

Table 39: The number of examiners agreeing on the absence or presence of a manipulable subluxation in proximal radioulnar inferior glide for each participant

	No	Yes
1	3	0
2	3	0
3	2	1
4	3	0
5	3	0
6	3	0
7	3	0
8	3	0
9	3	0
10	3	0
11	3	0
12	3	0
13	3	0
14	3	0
15	3	0
16	3	0
17	3	0
18	2	1
19	2	1
20	1	2

Kappa: The kappa agreement was poor and not significantly different to 0.

Overall kappa = 0.1273   SE=0.1291
95% CI=-0.1258 to 0.3803

Percentage agreement: In table 40 it shows that 80% of the participants had perfect percentage agreement by all 3 examiners.

Table 40: Proximal radioulnar inferior glide percentage agreement

		Frequency	Percent
Valid	66.60	4	20.0
	100.00	16	80.0
	Total	20	100.0

4.3.2.10. To determine the mean percentage agreement between all three examiners in symptomatic elbows

The mean percentage agreement between all three examiners in symptomatic elbows was calculated for each participant by taking into account all the agreement, not only perfect percentage agreement.

The percentages are ranked from highest to lowest in the following table:

Table 41: Mean percentage agreement in symptomatic elbows

	Mean
proximal radioulnar posterior to anterior glide agreement	94.99
proximal radioulnar inferior glide agreement	93.32
proximal radioulnar anterior to posterior glide agreement	89.98
humeroulnar medial to lateral agreement	88.31
humeroulnar long axis distraction agreement	81.63
humeroulnar lateral to medial agreement	79.96
proximal radioulnar posterior to anterior glide in pronation agreement	78.29
humeroulnar posterior to anterior glide in extension agreement	76.62
proximal radioulnar rotation of the radial head on ulna agreement	69.94

4.3.3. To compare the reliability between symptomatic and asymptomatic elbows

Kappa values were extracted from objectives 2 and 3, and compared between the symptomatic and asymptomatic elbows. Non parametric testing was used since the kappa values were abnormally distributed. Paired Wilcoxon signed ranks test was used since the symptomatic and asymptomatic elbows were paired.

The tables below show that there was an insignificant difference in kappa values between the two groups (*p*=0.260). There were a greater number of positive ranks than negative ranks, suggesting a trend towards the asymptomatic kappa values being lower than the symptomatic values.

Table 42: Wilcoxon signed ranks test: Ranks

		N	Mean Rank	Sum of Ranks
symptomatic - asymptomatic	Negative Ranks	3(a)	4.33	13.00
	Positive Ranks	6(b)	5.33	32.00
	Ties	0(c)		
	Total	9		

a. symptomatic < asymptomatic
b. symptomatic > asymptomatic
c. symptomatic = asymptomatic

Table 43: Wilcoxon signed ranks test: Test Statistics

	symptomatic - asymptomatic
Z	-1.125(a)
Asymp. Sig. (2-tailed)	.260

a. Based on negative ranks.

In figure 4 a box plot is used to illustrate the kappa values for the asymptomatic and symptomatic elbows. The middle 50% of kappa values make up the box, with the vertical lines showing the lowest 25% and the highest 25%. However, kappa values that extend the vertical lines to more than 1.5 times the range of the middle 50% are excluded from use in the box plot. These excluded kappa values are represented by small circles above each group in figure 4. The box plot in figure 4 shows that the general distribution of kappa values was less spread out in the asymptomatic group than in the symptomatic group. Therefore the kappa values are very similar in the asymptomatic group.

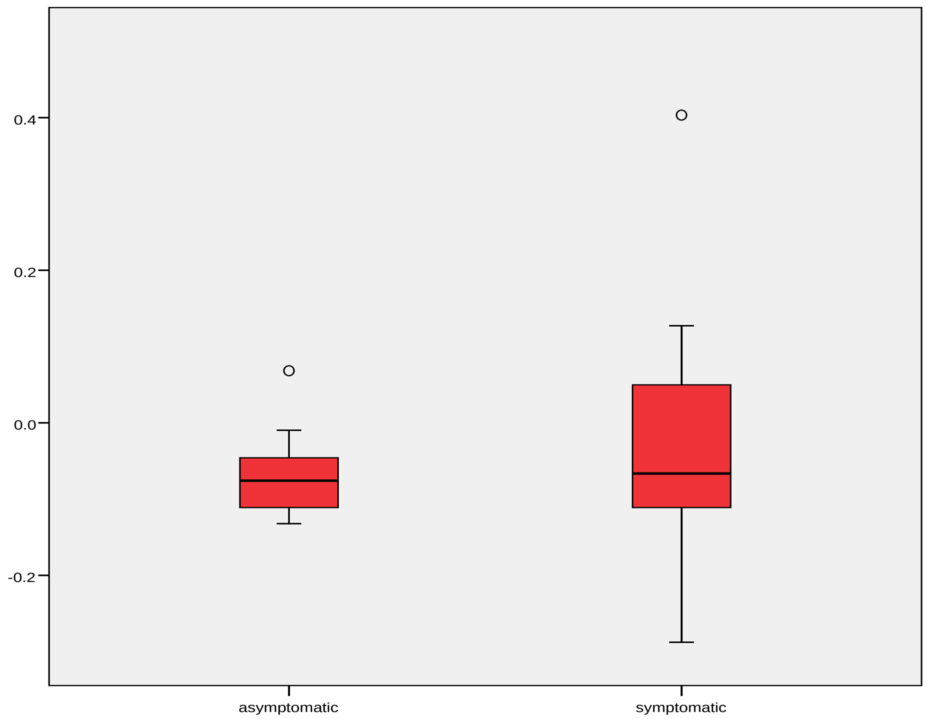

Figure 4: Box plot of the distribution of kappa values between the symptomatic and asymptomatic elbows

4.3.4. To compare the manipulable subluxations between symptomatic and asymptomatic elbows

Table 44 shows that there was a significant difference between symptomatic and asymptomatic elbows in proximal radioulnar posterior to anterior glide in pronation (*p*=0.013), as well as a significant difference between symptomatic and asymptomatic elbows in terms of proximal radioulnar rotation of the radial head on ulna (*p*=0.008). Overall, more manipulable subluxations were found in symptomatic elbows. No other difference reached statistical significance.

The first examiner's results from each participant were used to identify whether there was or was not a manipulable subluxation, with the order of examination being randomized, thereby preventing the use of only one examiner's results.

Table 44: Comparison of manipulable subluxations found in asymptomatic and symptomatic elbows

		actual symptomatic				P value
		no		yes		
		Count	Column N %	Count	Column N %	
humeroulnar long axis distraction 1	No	19	95.0%	16	80.0%	0.151
	Yes	1	5.0%	4	20.0%	
humeroulnar medial to lateral 1	No	17	85.0%	14	70.0%	0.256
	Yes	3	15.0%	6	30.0%	
humeroulnar lateral to medial 1	No	17	85.0%	17	85.0%	1.000
	Yes	3	15.0%	3	15.0%	
humeroulnar posterior to anterior glide in extension 1	No	14	70.0%	10	50.0%	0.197
	Yes	6	30.0%	10	50.0%	
proximal radioulnar anterior to posterior glide 1	No	19	95.0%	18	90.0%	0.548
	Yes	1	5.0%	2	10.0%	
proximal radioulnar posterior to anterior glide 1	No	17	85.0%	20	100.0%	0.072
	Yes	3	15.0%	0	.0%	
proximal radioulnar posterior to anterior glide	No	18	90.0%	11	55.0%	0.013

in pronation 1	Yes	2	10.0%	9	45.0%	
proximal radioulnar rotation of the radial head on ulna 1	No	19	95.0%	12	60.0%	0.008
	Yes	1	5.0%	8	40.0%	
proximal radioulnar inferior glide 1	No	19	95.0%	17	85.0%	0.292
	Yes	1	5.0%	3	15.0%	

$p<0.05$

4.3.5. To ascertain whether each examiner correctly identified the symptomatic elbows

4.3.5.1. Examiner A

There was no difference between the actual symptomatic elbows and those identified by examiner A to be symptomatic (p=1.000). Examiner A correctly identified 90% of the asymptomatic elbows and 90% of the symptomatic elbows.

Table 45: Examiner A, identification of symptomatic elbows

			Actual symptomatic		Total
			no	yes	
1	no	Count	18	2	20
		% within actual symptomatic elbow	90.0%	10.0%	50.0%
	yes	Count	2	18	20
		% within actual symptomatic elbow	10.0%	90.0%	50.0%
Total		Count	20	20	20
		% within actual symptomatic elbow	100.0%	18	2

McNemar's chi square; p =1.000

4.3.5.2. Examiner B

There was no difference between the actual symptomatic elbows and those identified by examiner B to be symptomatic (p=1.000). Examiner B correctly identified 65% of the asymptomatic elbows and 65% of the symptomatic elbows.

Table 46: Examiner B, identification of symptomatic elbows

			actual symptomatic		Total
			no	yes	no
2	No	Count	13	7	20
		% within actual symptomatic elbow	65.0%	35.0%	50.0%
	Yes	Count	7	13	20
		% within actual symptomatic elbow	35.0%	65.0%	50.0%

Total	Count	20	20	40
	% within actual symptomatic elbow	100.0%	100.0%	100.0%

McNemar's chi square; p =1.000

4.3.5.3. Examiner C

There was no difference between the actual symptomatic elbows and those identified by examiner C to be symptomatic (p=1.000). Examiner C correctly identified 80% of the asymptomatic elbows and 80% of the symptomatic elbows.

Table 47: Examiner C, identification of symptomatic elbows

			actual symptomatic		Total
			no	yes	no
3	No	Count	16	4	20
		% within actual symptomatic elbow	80.0%	20.0%	50.0%
	Yes	Count	4	16	20
		% within actual symptomatic elbow	20.0%	80.0%	50.0%
Total		Count	20	20	40
		% within actual symptomatic elbow	100.0%	100.0%	100.0%

McNemar's chi square; p =1.000

CHAPTER FIVE

5.1. Introduction

In this chapter the results of chapter four are discussed and compared to those reported in the literature. The tables and figures are worked through systematically covering each of the objectives in order. Explanations are given, and conclusions are made from the statistics.

Both Fleiss' kappa and percentage agreement were used in this study to assess reliability. Fleiss' kappa is used to assess reliability in two or more examiners. Kappa is considered the best statistical method for inter-examiner reliability studies (Sim and Wright, 2005; Tooth and Ottenbacher, 2004). Many studies have however tried to address its faults and have criticized its use (Cicchetti and Feinstein, 1990; Feinstein and Cicchetti, 1990; Byrt, Bishop and Carlin, 1993). It has been considered unreliable as many factors tend to influence its results, and the method for interpreting these results does not allow for these influences, leading to poor reflections of the agreement (Hripcsak and Heitjan, 2002). Alternatively, percentage agreement consisted of perfect percentage agreement and mean percentage agreement. Percentage agreement is simple and easy to understand, although it is considered insufficient on its own as it does not take chance agreement into consideration, and sums together the agreement of both the absence and presence of manipulable subluxations instead of separating them. Yet as an initial account of the data percentage agreement gives a good overall picture (Hripcsak and Heitjan, 2002; Ansari-Lari, 2005), and the researcher therefore included it in this study for descriptive purposes.

The results between the two methods of assessing inter-examiner reliability were generally quite opposite overall. One possible reason for this is due to there being few positive identifications of manipulable subluxations. This perhaps led the kappa results to tend towards zero and the percentage agreement to give a false reading due to the many negative agreements, thereby causing kappa results to underestimate reliability, and percentage agreement results to overestimating it (Hripcsak and Heitjan, 2002). Another reason may be that the kappa results take chance agreement into account, whereas percentage agreement does not. Therefore a large number of the negative identifications may be predicted by chance, thereby causing the kappa results to reflect a more correct reliability (French, Green and Forbes, 2000). Two motion palpation studies, Smedmark, Wallin and Arvidsson (2000) and Phillips and Tworney (1996), were found that had a high standard of quality according to Haneline et al. (2008). Both displayed a similar pattern of results as in this study, where the results between kappa and percentage agreement were conflicting, with low kappa values and high percentage agreement values.

Despite the criticism of kappa and percentage agreement, kappa is still considered the best statistical analysis for inter-examiner reliability studies, as it takes chance agreement into consideration. For this reason, kappa was chosen as the primary statistical analysis and percentage agreement as the secondary statistical analysis in this study. Therefore in the discussion of the inter-examiner reliability for both asymptomatic and symptomatic groups, kappa results were used to interpret reliability using the values set out by Landis and Koch (1977), and percentage agreement results were given to show the varying agreement without chance correction. Kappa results were further used when calculating the difference between symptomatic and asymptomatic findings.

Kappa results were calculated from the tables in chapter four for each direction of motion palpation. Mean kappa was then calculated by adding together all nine kappa values for both symptomatic and asymptomatic groups, and dividing this number by nine to give the average overall in both symptomatic and asymptomatic groups.
Perfect percentage agreement was calculated from the tables in chapter four, and consists of the number of participants in which all three examiners agreed on the presence or absence of a manipulable subluxation for each direction of motion palpation. Mean percentage agreement was then calculated by taking into account the overall agreement where all three examiners agreed, and where only two of the three examiners agreed. It was illustrated in tables 22 and 41 in chapter four.

5.2. Demographics

At the beginning of chapter four, demographics were addressed.

5.2.1. Participants

The sample group in this study consisted of twenty participants with one symptomatic and one asymptomatic elbow (*n*=40 elbows). According to Shiri et al. (2006), lateral epicondylalgia is at its highest prevalence in people between the ages of 45-54 years old. It has also been found that there is little difference in gender prevalence with chronic lateral epicondylalgia (Shiri et al., 2006), although when there was a difference it favoured the male population (Walker-Bone et al., 2004). As can be seen in table 1, the sample group in this study was a good representation of the age prevalence as their mean age was 45.5 years (standard deviation 2.1 years) with a range from 25 to 58 years, although the gender prevalence in this study was mainly female (*n*=12, 60%) (figure 2). This may have been due to the small sample size used in this study. Figure 3 shows that the majority of participants had symptomatic right elbows and in only 15% the left elbow was symptomatic.

5.2.2. Examiners

Throughout this study the randomisation of the order of examiners was maintained as described in chapter three. Table 2 illustrates this order, and clearly shows that no pattern was favoured.

5.3. Results

5.3.1. To determine the inter-examiner reliability of motion palpation of the asymptomatic elbow

The mean kappa for all nine directions of movement was below 0.2, showing that there was poor agreement in the inter-examiner reliability of asymptomatic elbows. Percentage agreement was very high for both mean percentage agreement, and perfect percentage agreement.

The tables 4; 6; 8; 10; 12; 14; 16; 18 and 20 analyse the results of the number of examiners that either identified a manipulable subluxation or did not, in the asymptomatic elbow. From these tables the kappa was calculated, which showed a narrow range of results, from 0.0683 to -0.1321. Therefore, according to these values, all directions of motion palpation had poor agreement and were not significantly different from 0 and therefore chance. The mean kappa was -0.0664, showing that the agreement overall was also no different to the agreement by chance. These poor kappa results correlate with the study done by Vincent-Smith and Gibbons (1999), which displayed similar kappa results in the asymptomatic sacroiliac joint.
Potter, McCarthy and Oldham (2006) also showed poor results in the thoracic spine in asymptomatic participants, although motion palpation's inter-examiner reliability has occasionally been shown to be fair to substantial in the asymptomatic spine (Brismée et al., 2006).

Percentage agreement was also assessed. Perfect percentage agreement results were assessed for each of the directions of motion palpation and can be seen in tables 5; 7; 9; 11; 13; 15; 17; 19 and 21, to range from 50% to 85%. This correlates with other motion palpation studies on asymptomatic participants that use percentage agreement as a statistical method, in which agreement was shown to be substantial (Brismée et al., 2006). In table 22, the mean percentage agreement between all three examiners for each of the directions of motion palpation can be seen. It ranged from 83.30% to 94.99%. These percentages are very high showing that the agreement was good without chance correction and when including agreements on the absence of a manipulable subluxation.

5.3.2. To determine the inter-examiner reliability of motion palpation of the elbow with chronic lateral epicondylalgia

The inter-examiner reliability of motion palpation in chronic lateral epicondylalgia is poor to moderate, with varying perfect percentage agreement and high mean percentage agreement.

Each of the tables, 23; 25; 27; 29; 31; 33; 35; 37 and 39, for each direction of motion palpation, show the number of examiners that agreed on the absence or presence of a manipulable subluxation for each participant.

The kappa values ranged between -0.2691 to 0.4034. According to these values, all the directions of motion palpation in the symptomatic elbow had poor agreement, except one. The humeroulnar medial to lateral direction of motion palpation had a kappa value of 0.4034 and was significantly different to 0 (table 25). It was therefore the only direction of motion palpation in the symptomatic elbow that had a moderate agreement, although the majority of agreement was based on the absence of a manipulable subluxation. The mean kappa taking into account all the kappa values was -0.0028. This shows that overall there was poor agreement. This correlates with other motion palpation studies of the spine for symptomatic participants in which the inter-examiner reliability was also poor (Schneider et al., 2008; Robinson, Brox, Robinson, Bjelland, Solem and Telje, 2007).

As with the asymptomatic elbow, percentage agreement was also assessed in the elbows with chronic lateral epicondylalgia. Perfect percentage agreements were assessed for each of the directions of motion palpation and can be seen in tables 24; 26; 28; 30; 32; 34; 36; 38 and 40, to range from 10% to 85%, showing a varying range of agreement. In table 41, the mean percentage agreement between all three examiners for each of the directions of movement was illustrated. It ranged between 69.94% and 94.99% therefore demonstrating that this agreement overall was generally very high in the symptomatic elbows.

5.3.3. To determine any difference of inter-examiner reliability between the symptomatic and asymptomatic elbows

Hypothesis 1: There is a difference between the inter-examiner reliability in the symptomatic elbows with chronic lateral epicondylalgia when compared to the asymptomatic elbows.

As discussed at the beginning of this chapter, kappa results were chosen to determine any difference in reliability between the symptomatic and asymptomatic elbows. In tables 42 and 43, non parametric testing was used since the kappa values were abnormally distributed. Paired Wilcoxon signed ranks test was used since the symptomatic and asymptomatic elbows were paired.

Results found that there was a trend towards the asymptomatic kappa values being lower than the symptomatic values with figure 4 also shows that the general distribution of kappa values was less spread out in the asymptomatic group. Therefore the symptomatic elbows had a slightly higher inter-examiner reliability than the asymptomatic elbows overall. This was due to there being a greater number of positive ranks than negative ranks. However, tables 42 and 43 clearly depict that the difference in kappa values between the symptomatic and asymptomatic groups was insignificant (p=0.260). The p value was above 0.05, and therefore the null hypothesis could not be rejected. Thus hypothesis 1 was not proven.

However, this analysis does have its flaws according to Hestbaek and Leboeuf-Yde (2000), in which a systematic critical literature review was conducted in order to see if chiropractic tests for the lumbo-pelvic spine were reliable and valid. A study attempting to detect abnormality in an asymptomatic population does not truly reflect clinical practice. The disproportionate number of normal findings could lead to problems in calculating kappa, possibly resulting in type-II errors such as incorrectly labeling a test as unreliable. This same problem has also been addressed by Hripcsak and Heitjan (2002). The asymptomatic elbows could therefore have very few manipulable subluxations, leading to incorrect kappa values and causing a problem in determining the difference of inter-examiner reliability between symptomatic and asymptomatic elbows. Nevertheless, as Brantingham et al. (2003) showed in their study on the circumduction of the foot, the comparison between the symptomatic and asymptomatic feet gave the best description of the difference between the results of the two groups.

Therefore in this study the researcher had to ignore the possibility of incorrect calculation of kappa, and decided to follow on from Brantingham et al. (2003) using both symptomatic and asymptomatic elbows and comparing their results.

5.3.4. To compare the presence of manipulable subluxations found between the symptomatic and asymptomatic groups and assess if the proportion of manipulable subluxations is greater in one group compared with the other

Hypothesis 2: There is a difference between the number of manipulable subluxations found in the symptomatic elbows compared to the asymptomatic elbows.

The above hypothesis was accepted as overall more manipulable subluxations were found in the symptomatic elbows, and these manipulable subluxations were found to be mainly present in only two directions of motion palpation.

Table 44 shows that there was a significant difference between symptomatic and asymptomatic elbows in proximal radioulnar posterior to anterior glide in pronation (p=0.013), as well as a significant difference between symptomatic and asymptomatic elbows in terms of proximal radioulnar rotation of the radial head on ulna (p=0.008). The symptomatic elbows displayed significantly more manipulable subluxations in these two directions than the asymptomatic elbows.

This is interesting as these two directions of motion palpation correlate with the common manipulation used to treat lateral epicondylalgia, Mills' manipulation (Greenfield and Webster, 2002). Mills' manipulation consists of a high-velocity, low-amplitude thrust applied to the fully pronated elbow with a fully flexed wrist, snapping it into full extension from posterior to anterior (Cyriax and Cyriax, 1993:59). The thrust would therefore force the radial head into full posterior to anterior glide on the ulna in pronation, and full rotation on the ulna, thereby possibly causing the cavitation of a manipulable subluxation, when present. This therefore suggests that Mills' manipulation is not merely stretching and breaking adhesions on the extensor tendon as commonly believed (Dutton, 2004:568; Cyriax and Cyriax, 1993:59), but also manipulating this joint in the direction of motion which this study found to be mainly restricted in symptomatic chronic lateral epicondylalgic elbows. Thus the cavitation commonly heard during Mills' manipulation can possibly be explained, and the use of Mills' manipulation as an effective treatment for chronic lateral epicondylalgia can be motivated.

When assessing all the directions of motion palpation, it was found that generally more manipulable subluxations were found in the symptomatic elbows than in the asymptomatic elbows. This therefore adds evidence to the hypothesis discussed by Vaughan (2002), that symptomatic joints will show more manipulable subluxations, although this did not increase the reliability in symptomatic elbows as he proposed.

5.3.5. To ascertain whether each examiner correctly identified the symptomatic elbows using only motion palpation as the examination technique

All three examiners showed a high percentage of identifying the symptomatic elbows, using motion palpation as the only examination technique. In table 45 it shows that Examiner A correctly identified 90% of the symptomatic elbows and 90% of the asymptomatic elbows, with 18 participants' symptomatic elbows being identified correctly. In table 46 it shows that Examiner B correctly identified 65% of the symptomatic elbows and 65% of the asymptomatic elbows, with 13 of the participants' symptomatic elbows being identified correctly. Table 47 shows that Examiner C correctly identified 80% of the symptomatic elbows and 80% of the asymptomatic elbows, with 16 of the participants' symptomatic elbows being identified correctly. Overall they correctly identified the symptomatic elbow in 65%-90% of participants (p=1.000). Therefore motion palpation is effective in identifying a symptomatic joint, without the knowledge of a patient's history or the use of pain provocation in the examination. However, this test did not take chance into account, and although precautions were made to hide the participants' reactions to any pain (a screen was placed around them), the examiners' results may have been influenced by a participant's flexor reflex (nociceptor reflex), which was impossible to eliminate in this study.

CHAPTER SIX

In this chapter the results of the aims of this study are summarized. Conclusions are made, and recommendations are given for future research studies to address.

6.1. Conclusion

In conclusion, based on Fleiss' kappa results, the mean inter-examiner reliability of motion palpation in both asymptomatic elbows and symptomatic elbows, with regards to chronic lateral epicondylalgia, was shown to be poor. The only direction of motion palpation that had a moderate reliability was in the humeroulnar joint, a glide from medial to lateral, in symptomatic elbows. Kappa results were poor in the asymptomatic elbows, ranging from 0.0683 to -0.1321, and poor to moderate in the symptomatic elbows, ranging from -0.2691 to 0.4034. The results of percentage agreement for all the directions of motion palpation in symptomatic and asymptomatic elbows were generally contradictory to the kappa results, as they were usually high. Perfect percentage agreement ranged from 50% to 85% in the asymptomatic elbows, and 10% to 85% in the symptomatic elbows. Mean percentage agreement ranged from 83.30% to 94.99% in the asymptomatic elbows, and 69.94% to 94.99% in the symptomatic elbows. Overall, statistical analysis suggested a trend toward there being a higher reliability in symptomatic elbows, although this was an insignificant statistical difference. More manipulable subluxations were found in the symptomatic elbows. The main manipulable subluxations found in the elbow in the presence of lateral epicondylalgia were in proximal radioulnar posterior to anterior glide in pronation, and in proximal radioulnar rotation of the radial head on the ulna. An investigation into the use of motion palpation in correctly identifying symptomatic elbows showed that it was found to be effective, as all examiners had high percentage results, ranging from 65% to 90%.

Regardless of the poor kappa results for the inter-examiner reliability of motion palpation of the elbow, and that many previous articles have been sceptical of the continued use of motion palpation, it was interesting to note that the two directions of motion palpation that were found to have manipulable subluxations in elbows with chronic lateral epicondylalgia, correlated with the directions of movement used in Mills' manipulation, a common and effective manipulation technique for lateral epicondylalgia.

6.2. Recommendations

The researcher has identified a lack of research that assesses the presence of manipulable subluxations and the techniques used to identify these manipulable subluxations, such as motion palpation, in extremity joints. This is in spite of the continued use of the many extremity manipulation techniques that exist. This study was the first study to assess the reliability of motion palpation of the elbow. The researcher therefore recommends that the results of this study be used as a stepping stone for further research on the reliability of motion palpation in the extremity joints.

Future research should also expand on this study's look at the inter-examiner reliability of motion palpation on the elbow. A study should be done which utilizes a sample group with a spectrum of disorders that would commonly be motion palpated in an examination. This heterogenous group may help in increasing the kappa values. The Numerical Pain Rating Scale should be included as a requirement for future research, from which an analysis can be made of the effect of pain on the reliability.

Research should also explore the relevance of the identification of a joint with a manipulable subluxation rather than a specific direction of a manipulable subluxation within a joint. A study by Clements, Gibbons and McLaughlin (2001), has shown that manipulation of a joint with a manipulable subluxation is effective regardless of the direction of thrust. This therefore contradicts authors such as Redwood and Cleveland (2003:219) who discuss the importance of identifying and treating the specific direction of a manipulable subluxation. Future inter-examiner reliability studies may need to be adjusted accordingly.

Following the studies on the reliability of motion palpation in the elbow, validity should also be addressed to confirm the continued use of this examination technique. This should include further examination of the use of motion palpation in identifying a symptomatic elbow.

With regards to methodological problems, the statistical analysis used in this study had many. It was understood that both kappa and percentage agreement had their flaws, and therefore both were commented on to give a more descriptive picture of the results, although kappa was favoured as the most dependable. Nevertheless, it is recommended that a larger sample size and possibly a larger number of examiners be used in similar future research studies, in order to potentially eliminate this problem. This will have an effect on the SE, and help in narrowing the range of confidence interval, thereby allowing less chance of results crossing over zero and leading to more significant results in kappa. However, consideration must be made when increasing the number of examiners, to the mobilization effect of motion palpation which changes the biomechanical properties of a joint, thereby possibly eliminating a manipulable subluxation. The more examiners used in a study, the more a joint is mobilized. Future research should also further assess the efficacy of using kappa as the statistical formula for agreement in motion palpation studies. A solution to the various influences on the interpretation of kappa results could be in order, thereby also allowing future motion palpation reliability studies to show more significant and accurate results.

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APPENDIX 1

Are you between the ages of

18 and 65?

Do you have a painful elbow?

Could it be

TENNIS ELBOW?

A FREE ASSESSMENT AND TREATMENT

is being offered to those who qualify

Please contact

Charlene:

031 373 2205/2512

At the Durban University of Technology Chiropractic Day Clinic

APPENDIX 2

Motion Palpation Technique of the Elbow

Taken from Bergman, Peterson and Lawrence (1993:597-608) and Schafer and Faye (1990:356).

Long Axis Distraction
Assess long axis distraction, primarily of the humeroulnar joint, with the patient sitting or supine with his elbow bent slightly. Stand to the side of involvement, facing the patient, and use your inside hand to stabilize the humerus while your outside hand grasps the distal forearm. Then stress the forearm along its long axis, feeling for a springing end feel (Bergman, Peterson and Lawrence, 1993:597-608).

Medial to Lateral Glide
Evaluate medial to lateral glide of the humeroradial and humeroulnar joints with the patient seated, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the medial side of the affected arm. Stabilize the patient's arm against your body by your outer arm while your inside hand takes a calcaneal contact over the medial aspect of the elbow joint. With the forearm stabilized, stress the elbow, medial to lateral, assessing for the presence of a springing joint play movement (Bergman, Peterson and Lawrence, 1993:597-608).

Lateral to Medial Glide
Assess lateral to medial glide of the humeroradial and humeroulnar joint with the patient in a seated position, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the lateral aspect of the affected arm. Stabilize the patient's forearm using the inside arm to hold the patient's arm against your body. Your outside arm takes a calcaneal contact over the lateral aspect of the elbow joint. With the patient's forearm stabilized against your body, stress the elbow, lateral to medial, determining the presence of a springing joint play movement (Bergman, Peterson and Lawrence, 1993:597-608).

Posterior to Anterior Glide in Extension
Evaluate posterior to anterior glide of the humeroulnar joint in extension with the patient sitting with the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the lateral side of the affected arm. Form a ring with your thumb and index finger of your outside hand and place it over the posterior aspect of the olecranon process. Rest your other hand on the anterior aspect of the distal forearm. With very little downward pressure on the distal forearm, apply a gentle posterior to anterior stress to the olecranon process, looking for a springing joint play movement (Bergman, Peterson and Lawrence, 1993:597-608).

Anterior to Posterior Glide and Posterior to Anterior Glide – radioulnar joint

Assess anterior to posterior and posterior to anterior glide of the radioulnar joint with the patient in the seated position, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the patient on the lateral aspect of the affected arm. With your inside arm, stabilize the patient's forearm against your body and grasp the distal humerus and proximal ulna. With your outside hand, hold the radial head between the thumb and index finger. While stabilizing the ulna and humerus, stress the radial head, anterior to posterior and posterior to anterior, determining the presence of a springing joint play movement (Bergman, Peterson and Lawrence, 1993:597-608).

Posterior to Anterior Glide in Pronation – radioulnar joint

Evaluate posterior to anterior glide of the radioulnar joint in pronation with the patient in the seated position, the affected arm extended at the elbow and flexed at the shoulder. Stand facing the lateral aspect of the affected arm. With your outside hand, grasp the distal forearm with digital contacts of the index, middle, and ring finger on the posterior aspect of the radius. With your inside hand, place a thumb contact on the posterior aspect of the radial head. Use your outside hand to pronate the forearm. At the contact over the radial head, you should first perceive a rotational movement of the radial head, and at the end point of movement, apply a posterior to anterior stress to the radial head to determine the presence of a springing end-feel movement (Bergman, Peterson and Lawrence, 1993:597-608).

Rotation of the Radial Head on the Ulna

Pronate the standing patien's forearm. Place the thenar eminence of your medial hand over the anterior surface of the head of the radius. With your other hand, grasp the radial side of the patient's wrist. You should feel the proximal aspect of the radius against your thenar eminence. At this point, quickly rotate the patient's arm into full pronation. You should feel the head of the radius spin backward on the ulna (Schafer and Faye, 1990:356).

Inferior Glide of the Proximal Radioulnar Joint

Stand perpendicular to sitting patient, flex the patient's elbow to a right angle, and supinate the forearm. Grasp the patient's forearm with your active hand just above the wrist, anchor your stabilizing hand against the patient's distal humerus, and apply longitudinal traction with your active hand. Feel the end play movement (Schafer and Faye, 1990:356).

APPENDIX 3

Letter of Information and Consent

Dear Participant

Thank you for your willingness to participate in my research study. This is just a brief overview of the study for your interest. If you have any further questions please feel free to ask.

Title of research study:

The inter-examiner reliability of motion palpation in chronic lateral epicondylalgia and asymptomatic elbows.

Principle investigator: Charlene Manley

Co-investigators: Dr H. Kretzmann

Introduction:

Motion Palpation is an assessment tool for a manipulable subluxation within a joint that is commonly used by chiropractors. Research studies have shown that its inter-examiner reliability of motion palpation is poor in the spine, although little research has been done on motion palpation's inter-examiner reliability in the extremity joints. No research has been done on motion palpation of the elbow. This research will study the inter-examiner reliability of motion palpation in the symptomatic and asymptomatic elbow.

Outline of procedures:

Twenty participants, aged 18-65, with unilateral lateral epicondylalgia, commonly known as tennis elbow, will be used in this study. You will only be required to have one consultation for the research study. At the consultation you will undergo a full case history, physical examination and elbow regional examination, in order to rule out any inclusion or exclusion criteria. Three examiners respectively will then motion palpate your elbows, assessing each joint in specific directions for any manipulable subluxations. Any manipulable subluxations will be recorded on standardized forms which will later be statistically analysed. This will conclude the research component of this study. You will then be given one free assessment and treatment for your tennis elbow, for your own benefit.

Risks or Discomforts to the participant:

There are no risks expected to be associated with this study.

Benefits:

If you meet the inclusion and exclusion criteria for this study, you will receive one free assessment and treatment for your tennis elbow. The results of this research will be published in a journal, and will be available at the Durban University of Technology library.

Reasons for withdrawal of participant from study:

You may withdraw from the study at any stage. However, if at any stage any exclusion criteria are revealed, or you are non-compliant to the research process or the researcher, you will be withdrawn from the study immediately and no treatment will be given. However, if you withdraw or are withdrawn from the study, there will be no adverse consequences to you following the study.

Remuneration:

You will receive no monetary or any other remuneration for being a part of this study. Your entrance into this study is completely of your own will.

Costs of the study:

The study offers you one free assessment and treatment for your tennis elbow. Any other costs, such as: transport to and from the DUT chiropractic clinic, telephone calls to the researcher, further treatment for your elbow pain etc., you will be required to pay for.

Confidentiality:

You will remain anonymous within any research data.

Research-related Injury:

In the unlikely event of any research-related injury or adverse reaction, there will be no compensation given to you, either monetary or any other type.

Persons to contact in the event of any problems or queries:

Dr H. Kretzmann: 031 2055520 (Work) 031 2053198 (Home)

Statement of Agreement to Participate in the Research Study:

I …………………………………................................... (participant's full name),
ID number ……………………………, have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by ……………………………..… to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study.

Participant's name (print)…………………....……..
Participant's signature…………..Date…..................
Researcher's name (print)………………...….........
Researcher's signature………..Date..........……..
Witness' name (print)………………..………………....
Witness' signature…………...Date…................

APPENDIX 4

DURBAN UNIVERSITY OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: ______________________________ Date: __________

File # : __________ Age: __________

Sex : __________ Occupation: ______________________________

Intern : ______________________________ Signature: ______________________________

FOR CLINICIANS USE ONLY:
Initial visit
Clinician: Signature :

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

CASE STATUS:

PTT:	Signature:	Date:

CONDITIONAL:
Reason for Conditional:

Signature: Date:

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

Case Summary signed off:	Date:

Intern's Case History:

1. **Source of History:**

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

3. **Present Illness:**

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

4. **Other Complaints:**

5. **Past Medical History:**

< General Health Status

< Childhood Illnesses

< Adult Illnesses

< Psychiatric Illnesses

< Accidents/Injuries

< Surgery

< Hospitalizations

6. Current health status and life-style:

< Allergies

< Immunizations

< Screening Tests incl. x-rays

< Environmental Hazards (Home, School, Work)

< Exercise and Leisure

< Sleep Patterns

< Diet

< Current Medication
Analgesics/week:
< Tobacco

< Alcohol

< Social Drugs

7. Immediate Family Medical History:

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

8. Psychosocial history:

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

9. Review of Systems:

< General

< Skin

< Head

< Eyes

< Ears

< Nose/Sinuses

< Mouth/Throat

< Neck

< Breasts

< Respiratory

< Cardiac

< Gastro-intestinal

< Urinary

< Genital

< Vascular

< Musculoskeletal

< Neurologic

< Haematologic

< Endocrine

< Psychiatric

APPENDIX 5

Durban University of Technology PHYSICAL EXAMINATION: SENIOR				
Patient Name : ______________		**File no :** ____		**Date :** ____
Student :		**Signature :**		

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

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

SYSTEM SPECIFIC EXAMINATION:
CARDIOVASCULAR EXAMINATION
RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION	
NEUROLOGICAL EXAMINATION	
COMMENTS	
Clinician:	**Signature :**

APPENDIX 6

ELBOW REGIONAL EXAMINATION

DURBAN UNIVERSITY of TECHNOLOGY

Patient:________________________________File no:__________Date:___________

Intern / Resident:__________________________________Sign:_______________

Clinician:____Sign:_______________

OBSERVATION

Posture and willingness to move ______________________________

Carrying angle (anatomical position) ______________________________

Swelling ______________________________

Bony and soft tissue contours ______________________________

Position of function (triangle sign) ______________________________

Colour and texture of skin ______________________________

PALPATION

Anterior aspect		***Medial aspect***	
Cubital fossa		Medial epicondyle	
Biceps tendon		Medial collateral ligament	
Bicep & brachialis muscle		Ulnar nerve	
Coronoid process & radial head			
Brachial artery			
Lateral aspect		***Posterior aspect***	
Lateral epicondyle		Olecranon process and olecranon bursa	
Lateral collateral ligament		Triceps muscle	
Radial head & Annular ligament			
Supracondylar ridge (ECRL)			

ACTIVE MOVEMENTS		**PASSIVE MOVEMENTS**	
Flexion (140-150°)		Flexion (tissue approximation)	
Extension (0-10°)		Extension (bone to bone)	
Supination (90°)		Supination (tissue stretch)	
Pronation (80-90°)		Pronation (tissue stretch)	

RESISTED ISOMETRIC MOVEMENTS (elbow at 90° flexion and supinated)	**R**	**L**
Flexion		
Extension		
Supination		
Pronation		
Wrist flexion		
Wrist extension		
Upward glide of radial head on ulna		
Downward glide of radial head on ulna		
Rotation of radial head		
Medial to lateral side tilt		
Lateral to medial side tilt		
Distraction of olecranon process on the humerus (90E) flextion		

JOINT PLAY MOVEMENTS

	R	L
Upward glide (I-S) of radial head of ulna		
Downward glide (S-I) of radial head of ulna		
Rotation of radial head of ulna		
Medial to lateral side tilt		
Lateral to medial side tilt		
Distraction of olecranon process on the humeral head (90°)		

FUNCTIONAL ASSESSMENT ____

____

SPECIAL TESTS

	R	L
Ligamentous instability test (valgus/varus)		
Cozen's test		
Mill's test		
Lateral epicondyle test		
Medial epicondyle test		
Tinel's sign		
Wartenberg's sign		
Elbow flexion test		
Pronator teres syndrome		
Pinch grip test		

NEUROLOGICAL
Reflexes and cutaneous distribution

		R	L
1. Reflexes	a. Biceps = C5-6		
	b. Triceps = C7-8		
	c. Brachioradialis = C5-6		

		R	L		R	L
2. Dermatomes	C4			C5		
	C6			C7		
	C8					
	T1			T2		

MYOFASCIAL DYSFUNCTION SYNDROMES

	Active	Latent	Not Present
Brachialis			
Brachioradialis			
Ext. Carpi rad. Brev.			
Ext. Carpi rad. Long.			
Supinator			
Ext. Carpi ulnaris			
Flex. Carpi rad.			
Flex Carpi ulnaris			
Flex Digit. Super			
Flex Digit. profund			
Coracobrachialis			
Biceps			
Triceps			

APPENDIX 7

DURBAN UNIVERSITY OF TECHNOLOGY

Patient Name: ***File #:***
Page:

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature:***

S: *Numerical Pain Rating Scale (Patient)* *Intern Rating* ***A:***
Least ***0 1 2 3 4 5 6 7 8 9 10*** *Worst*

0: ***P:***

E:

Special attention to: ***Next appointment:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature:***

S: *Numerical Pain Rating Scale (Patient)* *Intern Rating* ***A:***
Least ***0 1 2 3 4 5 6 7 8 9 10*** *Worst*

O: ***P:***

E:

Special attention to: ***Next appointment:***

Date: ***Visit:*** ***Intern:***
Attending Clinician: ***Signature***

S: *Numerical Pain Rating Scale (Patient)* *Intern Rating* ***A:***
Least ***0 1 2 3 4 5 6 7 8 9 10*** *Worst*

O: ***P:***

E:

Special attention to: ***Next appointment:***

APPENDIX 8

Symptomatic and Asymptomatic Form

Please mark symptomatic and asymptomatic blocks with left or right accordingly.

no.	Participant's name	Symptomatic	Asymptomatic
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

APPENDIX 9
Motion Palpation Results Form

Examiner:

Please mark with a cross those directions that present with a manipulable subluxation in end play.

Please follow the order from top to bottom that is stipulated, first with the right elbow, then the left elbow.

Joint	**Direction**	**Right**	**Left**
Humeroulnar	Long axis distraction		
	Medial to lateral glide		
	Lateral to medial glide		
	Posterior to anterior glide in extension		
Proximal Radioulnar	Anterior to posterior glide		
	Posterior to anterior glide		
	Posterior to anterior glide in pronation		
	Rotation of the radial head on the ulna		
	Inferior glide		
Which of the patient's elbows do you think had chronic lateral epicondylalgia?			