The intra- and interexaminer reliabilty of motion palpation of the patella.

By

BRENDON BEZUIDENHOUT

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I, Brendon Bezuidenhout do hereby declare that this dissertation represents my own work in both conception and execution.

7/11/2002

Brendon Bezuidenhout — Date

Approved for final submission

7/11/2002

Dr A.G. van der Meulen M.Tech:Chiro — Date

DEDICATION

This work is dedicated to the following people:

To my wife, Janet, for your unconditional love, support, friendship and belief in me during some frustrating times.

Andries and Cynthia, my parents, undoubtedly the strongest influences in my life, your selfless sacrifices, for always believing in me, your love and support.

Andrea, my sister, for your love, friendship and concern.

To all my friends for their support, concern and friendship.

And finally to the Lord, my saviour, for his grace and faith that have kept me on track.

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ABSTRACT

Functional and pathological joint disorders are distinguished diagnostically through orthopaedic and functional assessment tests. Motion palpation is the procedure used to assess functional status of a joint. The methods used to validate this tool are inter- and intraexaminer reliabilty studies.

The purpose of this study was to determine the intra- and interexaminer reliabilty of motion palpation of the patella.

This randomised, single-blinded, prospective clinical reliability study included 50 chiropractic students, limited to first, second and third years due to subject naivety. Motion palpation of both patellae was assessed twice, one week apart, by four different examiners. The examiners were senior interns at the Durban Institute of Technology Chiropractic Faculty. Each had an assistant that recorded their motion palpation findings.

Statistical analysis was completed under the supervision of Mr K. Thomas at Durban Institute of Technology. The results were analysed using non-parametric statistical tests such as Pearson's Chi-Square, McNemar's Test and Cohen's Kappa co-effecients.

The results showed that the association between the examiners and their motion palpation findings as demonstrated by Pearson's Chi-Square ($p<0.05$), was significant (interexaminer consistency).

The consistency of the opinion (motion palpation findings) of the examiner between their first and second examination as demonstrated by McNemar's Test ($p<0.05$), was significant (intraexaminer consistency).

Intraexaminer reliability kappa values ranged from .005 - .035, which indicates that reliability, was fair. Interexaminer reliability kappa values range from .000 - .048, which indicates that reliability, was fair.

It was concluded that intra and interexaminer reliability of motion palpation of the patella was fair, but not reliable enough for patella motion palpation to play a significant role in the diagnoses, management and assessment of progress in knee/patella disorders. Motion palpation should be used together with all our other clinical tools.

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CHAPTER ONE: INTRODUCTION

1.1 THE PROBLEM AND ITS SETTING

Functional and pathological joint disorders are distinguished diagnostically through orthopaedic and functional assessment tests. Motion palpation is the procedure used to assess functional status of a joint. The methods used to validate this tool are inter- and intraexaminer reliabilty studies. Motion palpation, a palpatory procedure used to assess the quality of movement between articular structures (Bergman et al. 1993:89), can be defined as: "that aspect of palpation which assesses the physiological range of motion possible in different axes of motion, and this evaluation determines if a joint or 'motion unit' has natural movement and if this movement is relatively increased or decreased" (Ames 1987). According to Bergman et al. (1993), loss of the normal elastic end-feel, or springiness, within the joint indicates disorders within the joint, its capsule or periarticular tissue.

According to Schafer and Faye (1989), if patella range of motion is limited in any of its axes, knee function is impaired; and it is thus important to assess patella mobility prior to any attempt to release a knee fixation[1]. Furthermore, aberrant patella motion could impair the efficient function of the quadriceps mechanism and thus result in knee disorders (Davidson 1993). Although motion palpation of the patella is a part of the functional assessment and treatment of disorders of the knee, no studies investigating the reliability of motion palpation of the patella

[1] Fixation is defined as the state whereby an articulation has become temporarily immobilised in a position that it may normally occupy during any phase of physiological movement.

have been conducted. According to Lewit and Liebenson (1993), motion palpation is one of the main assessment tools used in manipulative therapy, but they have agreed that and extrapolated from research that it is subjective and not a reliable enough assessment tool. There is thus a need for research in motion palpation, which could help provide basic scientific credibility to manipulative techniques (Lewit and Liebenson 1993).

Haas (1995) states that since 1979, there have been at least 90 papers published in the peer-reviewed chiropractic literature, which have addressed reliability. Topics have ranged from motion palpation of the spine to leg alignment inequality and from radiographic mensuration to thermography, but none of these studies involved motion palpation of the patella. The reliability of a procedure can be defined as:" the extent to which a repeated test will produce the same result when evaluating an unchanged characteristic" (Haas 1995). 'Interexaminer reliability' consists of one assessment of all subjects by each of two or more examiners, blinded to each other's observations and this is used to assess rater agreement amongst different examiners. 'Intraexaminer reliability' is computed from repeated measurements of single individuals to evaluate rater self-consistency (Haas 1995). One of the most important goals for any clinical instrument is for it to have good reliability and reproducibilty (Lewit and Liebenson 1993). Once a method of patella motion palpation is found to be statistically reliable, it may serve as a basis by which we can monitor progress of the treatment and the functionality of the joint.

1.2 AIM OF THE STUDY

The aim of this study was to evaluate the intra- and interexaminer reliabilty of motion palpation of the patella.

1.3 OBJECTIVES OF THE STUDY

1.3.1 The first objective is to investigate the intraexaminer reliabilty of motion palpation of the patella.

1.3.2 The second objective is to investigate the interexaminer reliability of motion palpation of the patella.

1.4 HYPOTHESES

1.4.1 HYPOTHESIS ONE

It was hypothesized that there would be intraexaminer reliability of motion palpation of the patella.

1.4.2 HYPOTHESIS TWO

It was hypothesized that there would be interexaminer reliability of motion palpation of the patella.

1.5 BENEFITS OF THE STUDY

Being able to identify abnormal patella motion is important, but how reliable is the method we are using? This research will hopefully give us an answer.

Once a method of identifying abnormal patella motion is found to be statistically reliable, it may serve as a basis by which we can monitor progression of the treatment.

It is hoped that this research will increase the established knowledge base on the reliabilty of motion palpation.

CHAPTER TWO – LITERATURE REVIEW

2.1 RELIABILITY

Palpation of the musculoskeletal system, be it static, active or motion palpation, is perhaps the most common tool of diagnostic assessment used by practitioners of manipulative therapy. A critical omission in the development of these diagnostic techniques, however, is the lack of proven reproducibility and repeated intra- or interexaminer agreement of findings. Only with the establishment of such statistical reliability can any diagnostic procedure be applied in a reasonable manner (Russell 1983).

The reliability of a procedure can be defined as the extent to which a repeated test will produce the same result when evaluating an unchanged characteristic. Reliabilty evaluates the ability to differentiate the target or object of interest in the presence of random measurement. In chiropractic literature, the target is a patient population (patient characteristic) and the source of error is most often limited to the examiner's performance with a diagnostic procedure (Haas 1995). Reliability is a measure of concordance, consistency or repeatability of experimental outcomes and it represents the ability of one examiner, test, or treatment to agree with or replace another (Haas 1991).

Interexaminer reliability consists of one assessment of all subjects by each of two or more examiners, blinded to each other's observations and this is used to assess rater agreement amongst different examiners (Haas 1995). Haldeman (1991:303) defines interexaminer reliability as the degree that results correspond between one examiner and another, using the same patient.

Intraexaminer reliability is computed from repeated measurements of single individuals to evaluate rater self-consistency (Haas 1995).

2.1.1 MOTION PALPATION RELIABILTY STUDIES OF EXTREMITIES

When the researcher looked for information regarding motion palpation reliabilty studies of extremities, it was found that there was one involving the shoulder and one involving the ankle.

Chesworth et al (1998) conducted a study into the end-feel reliability of lateral rotation of the shoulder in patients with shoulder pathology. Two physical therapists performed 2 assessments of passive lateral rotation of the shoulder in 34 patients. Intrarater interclass correlation coefficients (ICC) varied from 0.58 – 0.89 and interrater ICCs varied from 0.85 - 0.91. Intrarater kappa values were moderate (0.48 - 0.59) while interrater kappa values were substantial (0.62 - 0.76). End-feel therefore seems to be reliable, in terms of both inter- and intraexaminer agreement, when assessing lateral rotation of the shoulder.

In an unpublished study conducted by Brantingham et al (1997) into the possible inter-examiner agreement, using the Circumduction Test, in the detection of general foot stiffness/joint dysfunction was conducted at the Kimberley Hospital in the Northern Cape of South Africa. Totals of 17 patients, diagnosed with a moderate to severe painful lower leg, ankle or foot disorder, were included in this study. Two chiropractic practitioners independently evaluated each patient. Inter-examiner agreement was assessed using kappa coefficient and it was found that the agreement into whether there was decreased mobility in affected feet was 0.64 (substantial agreement), agreement as to whether there was decreased mobility in unaffected feet was 0.598 (moderate agreement), agreement of the exact grade of decreased movement in affected feet was 0.1785 (slight agreement) and agreement into exact grade of decreased movement in unaffected feet was 0.453 (moderate agreement). This small pilot study showed that detecting forefoot dysfunction was relatively reliable when two examiners were used (interexaminer reliability).

Only these two studies have been conducted into motion palpation reliability of extremities. The results shown are favourable. More research is needed into the inter- and intraexaminer reliability of motion palpation of extremities.

2.1.2 RELIABILITY STUDIES INVOLVING THE PATELLA

Reliability of measurements obtained with four tests for patellofemoral alignment was conducted by Fitzgerald and McClure (1995), where they had 12 physical therapists evaluate 66 patients. They tried to determine the intertester reliability of measurements obtained with four patellofemoral alignment tests: medial to lateral displacement, medial/lateral tilt, medial/lateral rotation and anterior tilt. The Kappa correlation coefficients ranged from .10-. 36, which means that the reliability ranged from poor to fair.

In a study conducted by Tomsich et al. (1996) into the reliability of patellofemoral alignment, they looked at the Q-angle, A-angle and patellar orientation (patellar tilt, glide, anteroposterior tilt and rotation). They used 27 healthy subjects and three examiners. Measurements were taken at three different times using standardized positioning and operationally defined goniometric, pluri-cal caliper and visual estimation measurement techniques. Intratester and intertester standard errors of instrumented measurements ranged from 1.6 to 3.5 degrees and 3.2 to 6.8 degrees. Intratester kappa's of visually estimating patellar orientation ranged from .4 to .57. Intertester kappa's were between .03 and 0.3. These results suggest that both clinical estimation and instrumented measurement of patellofemoral alignment may be unreliable.

The reliability of assessing the A-angle (the relationship between the patella and the tibial tuberosity) was investigated in a study conducted by Ehrat et al. (1994). There were three raters that measured the A-angles of each knee, twice, in 36 subjects. Intrarater interclass correlation coefficients (ICC) were poor (0.20-0.32) and the standard error of measurements (SEM) was 5.3-7.95 degrees. Interrater ICC were poor (-0.01) and SEM was 7.82 degrees. Results indicate that the A-angle is not reproducible and that further study is needed before the A-angle can be used as a reliable tool.

Watson et al. (2001) conducted a study into the reliabilty of the lateral pull test and tilt test to assess patella alignment in patients with symptomatic knees, using students to perform the tests. These two tests are used clinically as diagnostic tests for patellofemoral pain syndrome. Fifty-five subjects provided 99 knees and they were assessed by blinded student raters. They were retested within 3-5 days. The kappa coefficients for intrarater reliabilty varied from 0.39-0.47 (for the lateral pull test) and 0.44-0.50 (for the patella tilt test). The coefficients for interrater reliability were 0.31 (for the lateral pull test) and varied from 0.20-0.35 (for the patella tilt test). This means that these two tests had fair intrarater and poor interrater reliability. The researchers suggested that care must be taken in placing too much emphasis on these tests when making clinical decisions.

When looking at the studies conducted above it seems that when it comes to assessing the alignment of the patella, the results are not reproducible and agreement amongst different examiners is poor.

2.2 MOTION PALPATION

2.2.1 INTRODUCTION

"Palpation is the oldest examination technique used by chiropractors to detect subluxation, and is still the most emphasized physical finding supportive of subluxations" (Bergman et al.1993:81).

Palpatory procedures are divided into static and motion palpation: Static palpation involves the practitioner feeling for asymmetric tissue texture, subdermal prominences, edema and tenderness. These are evaluated with the patient in a static posture (Mootz et al. 1989). Motion palpation assesses the quality of movement between adjacent articular structures, by challenging the segment, while feeling for the absence or presence of "end-feel" at the end-points of several ranges of motion (Mootz et al. 1989).

Accessory joint movements are involuntary movements that represent the small 'give or play' within a joint that is necessary for normal function and it is the joint capsule that is responsible for the smooth give felt, as it allows for enough play and articular surface separation to avoid abnormal joint function. Motion palpation is used to assess this accessory joint movement by means of joint play and end-feel. These terms refer to the springy quality normally present in a joint taken beyond its active motion limits. End-feel is the resistance felt at the end of range of motion, whereas joint play is the resistance felt from the neutral position (Bergman et al. 1993:89-90).

Joint play should not cause pain and it should yield to pressure applied by the palpator, but slight resistance to movement is normal. If resistance is increased, articular soft tissue contracture is suspected (Bergman et al. 1993:94).

End-feel assessment is sometimes more useful than measuring the total passive range of motion, as in those cases where individual joint movement is limited. Disorders within the joint, the capsule and articular soft tissue results in a decrease in end-play elasticity or "springiness". This loss of elasticity, or increased resistance is instrumental in diagnoses of joint dysfunction, as well as determining the vector of adjustive therapy. Adjustive therapy is normally applied along the planes of encountered resistance. The presence of normal passive motion in one plane, and decreased motion in the other, is considered a dynamic indicator of a joint fixation (Bergman et al. 1993:90-92).

With all this information about joint movement available from motion palpation it is necessary to ensure that this procedure is reliable to ensure that we are getting the correct information from motion palpation.

2.2.2 MOTION PALPATION OF THE PATELLA

When it comes to literature on the procedure involved in assessing the motion of the patella, there is not a large volume of information. The method chosen for this research was Bergman's technique as this was the method that we as chiropractic students at Durban Institute of Technology Chiropractic Department were taught, and use. Bergman's technique is simple and it evaluates the patella for medial to lateral glide, lateral to medial glide, superior to inferior glide and inferior to superior glide. The patient must be lying supine and the involved leg straight in passive knee extension where the examiner contacts the borders of the patella with both thumbs and applies stress to the patella in the directions mentioned above. The examiner then feels for comparative amount of movement from side to side (Bergman et al. 1993:676).

Maitland (1991:251), writes that there are four main movements of the patella: longitudinal movement (cephalad and caudad) and transverse movement (medially and laterally).

According to Schafer and Faye (1990:396), the patella exhibits free excursion superiorly, medially, inferiorly, laterally, diagonally and in circumduction, with only superior movement under voluntary control (quadriceps contraction). If any of these movements are restricted then knee function is impaired. They go on further to say that patella mobility must be assured prior to any attempt to release a knee fixation.

Skalley et al (1993) conducted a study into quantitative measurement of normal medial and lateral patellar motion limits. They looked at 67 high school athletes randomly selected from a group of 1340 athletes undergoing preseason physical examinations. The patellar displacement was measured at knee flexion angles of 0 and 35 degrees, using a Patella Pusher (a hand held force gauge) and a manual technique, and the results were compared. With the knee at 0 degrees the patella movement was as follows: medial (average 9.6mm) and lateral (average 5.4mm). With the knee at 35 degrees the patella movement was as follows: medial (average 9.4mm) and lateral (average 10mm). The manually produced displacement was found to be more reproducible than the displacement by the Patella Pusher ($P<0.05$). From this study we can see that medial patella motion is greater than lateral patella motion when the knee is at 0 degrees. This is the position the knee is in when we as chiropractors assess the motion of the patella and therefore we must remember that there is more motion medially than laterally. The reason given for this difference in motion is because of the high lateral femoral condyle, which slightly restricts motion laterally.

2.3 BIOMECHANICS OF THE PATELLOFEMORAL JOINT

An understanding of the biomechanics of the patellofemoral joint is important and helps one choose an appropriate rehabilitation program that allows physiological loading of the joint but prevents the generation of inappropriate and sometimes damaging forces (Hungerford and Lennox 1983).

The patella has the primary function of increasing the efficacy of the quadriceps muscle by increasing its lever arm (McConnell 1986, Tria et al 1992). For this function to be efficient the patella must be aligned so it remains in the trochlear notch of the femur and any malalignment of the patella from altered mechanism will predispose an individual to patellofemoral pain and possibly articular cartilage breakdown (McConnell 1986).

There are two forces that act on the patella during knee movement. They include the patellofemoral compression force, which depends on the angle of flexion (Hungerford and Lennox 1983), as it increases in flexion and decreases in extension (Zappala et al 1992). This force also increases depending on the activity as walking and stair climbing increases the compressive force of the patellofemoral joint from 0.5-3.3 times the body weight of the individual. The other force is the quadriceps muscle tension force (Outerbridge and Dunlop 1975).

As the patellofemoral joint moves from extension through flexion, a band of contact initiated at 20 degrees moves superiorly from the inferior pole of the patella. As the angle of flexion increases, the contact area of the femur continues moving superiorly up the patella while becoming broader. At 90 degrees the femur has reached the upper pole of the patella. The "odd" medial facet of the patella does not make contact at all between 0-90 degrees of flexion.

At 135 degrees of knee flexion the contact area is divided into a medial zone and a lateral zone. The line A/B on the diagram (figure 1) coincides with a ridge separating the "odd" facet from the medial facet proper. The medial zone lies medial to this ridge (A/B) and more or less fits the "odd" facet, *Figure 1* (Goodfellow et al. 1976:288).

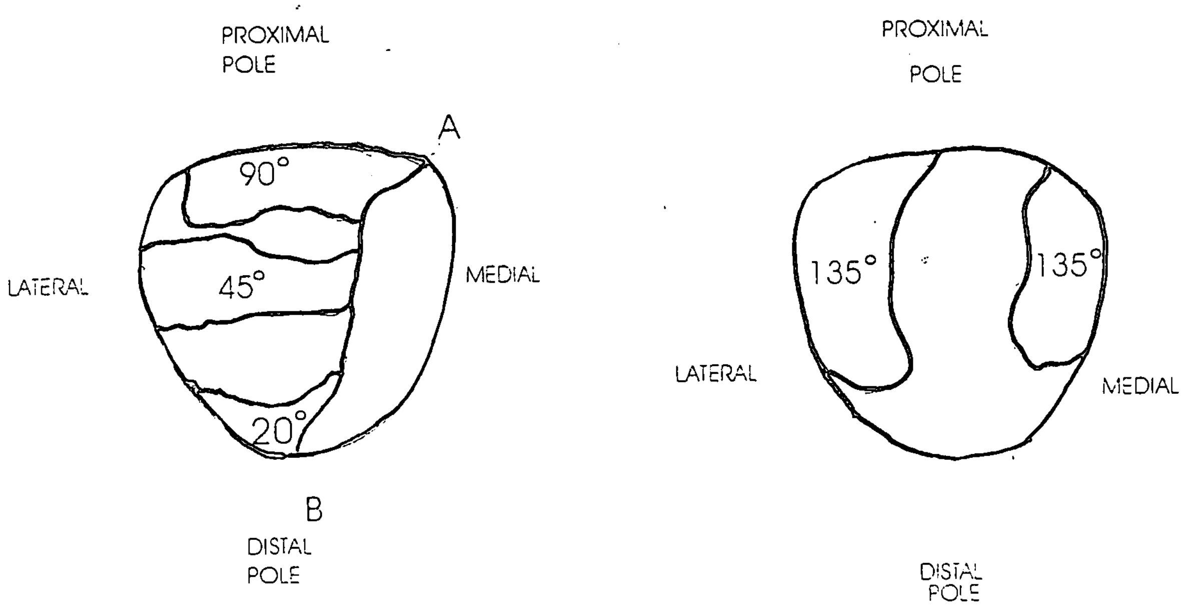

Figure 1: Contact areas of the patella during various degrees of flexion

Patellofemoral joint motion is of clinical interest, because of the large number of cases of patellofemoral disorders related to abnormal motion of the patella relative to the femur (Bull et al. 2002). In a study conducted by Bull et al. (2002) into the standardisation of the description of patellofemoral motion and the comparison between the different techniques. They found three main methods for describing patella motion: motion of the patella about the femoral body fixed axes, about patellar body fixed axes, and a combination of these. They concluded that the combination of both made most sense clinically because it uses easily found anatomical landmarks. They proposed that the description of patello-femoral motion be described in terms of shift, tilt, rotation and flexion:

- **Shift** is the medial or lateral movement of the centre of the patella along a medial-lateral axis defined as either fixed to the femur or patella.
- **Tilt** is the angular position of the patella about its own long axis, where lateral tilt follows the sense of external tibial rotation.
- **Rotation** is the angular position of the patella about an axis parallel to its own anterior-posterior axis, "tethered" to the femoral medial-lateral axis and patellar long axis as three-cylinder open-chain mechanism, where lateral rotation follows the sense of abduction in tibiofemoral motion.
- **Flexion** is the angular position of the patella about a medial-lateral axis defined as either fixed to the femur or patella.

These motions are shown in *Figure 2* (Bull et al. 2002:189)

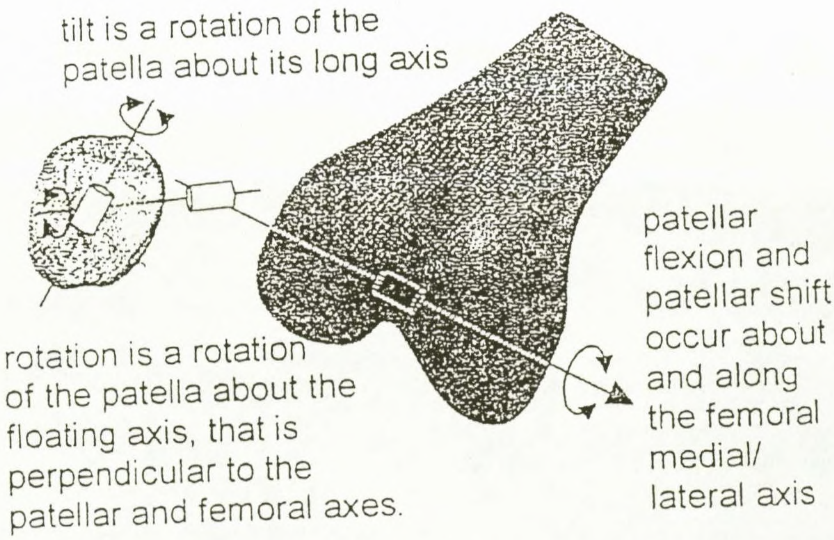

Fig. 2 Patellar motion in terms of a combination of femoral and patellar body fixed axes. This is a three-cylinder open-chain representation of the patello-femoral joint with the joint translation and rotation axes coincident

2.4 ANATOMY OF THE PATELLOFEMORAL JOINT

The patella is a sesamoid bone that exists within the quadriceps tendon proximally and within the patella tendon distally (Davidson 1993). This bone is subcutaneous and easily palpable, it lies anterior to the distal femur articulating with the condyles of the femur (Moore 1992:388). The undersurface of the patella and the patellofemoral articular surface of the femur are covered with hyaline cartilage and lubricated with synovial fluid (Kramer 1986).

Davidson (1993) states the proper tracking of the knee during flexion and extension of the knee is influenced by: height of the femoral condyles and hence depth of the femoral groove, keeping the patella "seated". The shape of the facets on the undersurface determines the "fit"; the medial and lateral retinacula which keep the patella "centered" in the femoral sulcus; the relative strength of the individual muscles composing the quadriceps group; and the Q-angle.

The patellofemoral articulation consists of the facets of the patella in contact with the sulcus of the anterior femur. The surface anatomy of each side, the overall rotational anatomy of the entire lower extremity, and the relationship of the surrounding muscles affect the contact between the two surfaces. The patella surface can include up to seven facets, with three on the medial and lateral surfaces and an extra ("odd") facet on the medial side (Tria et al. 1992).

There is naturally a lateral pull on the patella due to the physiologic valgus of the knee and the Q-angle of the quadriceps. The patella is stabilized against this lateral pull by the bony contour of the lower end of the femur and by the vastus medialis obliquus. The patella articular surface on the lateral femoral condyle is raised; this offers stability to the patella especially when the knee is flexed. However, in the last 30 degrees of knee extension, the patella sits above the patella articular surface of the femur with little stability then offered by these bony contours. The vastus medialis obliquus becomes the most important structure in providing stability for the patella in the last 30 degrees of extension (Bose et al. 1980). Most patella instability occurs in the first 30 degrees of flexion, because beyond this point, the patella has more bony support in the trochlear groove (Puniello 1993:146).

CHAPTER THREE – METHODOLOGY

3.1 OBJECTIVES OF THE STUDY

The objective of this study was to determine the intra- and interexaminer reliabilty of motion palpation of the patella.

3.1.1 The first objective was to determine the intraexaminer reliability of motion palpation of the patella.

3.1.2 The second objective was to determine the interexaminer reliability of motion palpation of the patella.

3.2 STUDY DESIGN AND PROTOCOL

The design of this study was that of a randomized, single-blinded, prospective clinical reliability study. This study incorporated fifty subjects that were accepted according to the inclusion criteria. All the subjects were students (1^{st} – 3^{rd} years) of the Durban Institute of Technology Chiropractic Department. Subjects were informed of the study via posters put up around the Durban Institute of Technology Chiropractic Day Clinic and via the researcher approaching the relevant classes and explaining the research to them. Each patient had both their patellae motion palpated by four different examiners (interexaminer reliabilty purposes) on two separate occasions, a week apart (intraexaminer reliability purposes).

3.2.1 STANDARD OF ACCEPTANCE

At the initial consultation the candidate underwent a brief Case History (Appendix A) and thorough Knee Regional Examination (Appendix B). During this process the subject was screened for any complaints that might exclude them from the study.

3.2.2 INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria

Only asymptomatic (no knee pain) students at the Durban Institute of Technology Chiropractic Department were included in this study.

Volunteers were limited to first, second and third year chiropractic students from 18-30 years of age.

Exclusion criteria

Volunteers were excluded from the study if they presented with any of the following (Powers et al.1996):

A history of traumatic patella dislocation (motion palpation might aggravate this problem)

Any knee surgery in the past two years

Patella tendonitis

3.2.3 METHODOLOGY

Subjects found suitable for the study were given a Letter of Information (Appendix C) and were asked to complete an Informed Consent Form (Appendix D).

Patients were randomly assigned a number between one and fifty.

In a review study conducted by Panzer (1992) in which he reviews reliability studies it was found that in ten reliability studies on lumbar motion palpation, 60% of the studies had examiners that were DC interns, 60% of the studies had subjects that were asymptomatic DC students and 80% of these studies had between 30 and 60 participants. This study will be based on the above findings, as there have been no studies on the reliabilty of motion palpation of the patella. The reason why qualified chiropractors were not used is that other investigators have noted reduced interexaminer reliability with increased experience, as this apparently occurs as the practitioner develops idiosyncratic standards for the palpation procedure (Panzer 1992).

Four senior students were then chosen and were informed by the researcher on the procedure the study would follow. The examiners were students who had undergone the same training in assessing motion palpation of the patella, i.e. Bergman's technique (Bergman et al. 1993:676).

On the day of the research, four blind-folded examiners (this was to enhance reliability by ensuring that examiners wouldn't be able to remember the patient and therefore the motion of their patellae), each with an assistant, were allocated to four different examination rooms. Volunteers, in a random order, then had both their patellae motion palpated. The assistant in each room then recorded the subjects number, and the examiners motion palpation findings (Appendix E)(for interexaminer reliability purposes). Subjects were then re-examined a week later in a new random order (for intraexaminer reliability purposes).

3.2.4 ETHICAL CONSIDERATIONS

The rights and welfare of the volunteers were protected:

- informed consent was gained
- the volunteers were not coerced into participating in the study
- the research involved no more than minimal risk
- confidentiality was maintained
- participation was voluntary and did not involve financial benefits
- patients were free to withdraw from the study at any stage

3.3 MEASUREMENT AND OBSERVATION

3.3.1 THE DATA

The study incorporated both primary and secondary data as mentioned below:

3.3.1.1 PRIMARY DATA

The primary data included the following:

- the brief case history (Appendix A)
- the knee regional examination (Appendix B)
- motion palpation findings (Appendix E)

The primary data was obtained from the motion palpation findings of the four examiners on the two separate occasions that they motion palpated both knees of the volunteers. All consultations took place at the Durban Institute of Technology Day Clinic.

3.3.1.2 SECONDARY DATA

Literature was obtained from journals, textbooks and the Internet.

3.4 STATISTICAL ANALYSIS

The SPSS (Version 9.0) statistical package (as supplied by SpSS Inc., Marketing Department, 444 North Michigan Avenue, Chicago, Illinois, 60611) was utilised for data analysis. The statistical evaluation was aimed at measuring

The **Pearson's Chi-Square Test** (non-parametric test) – is used to test the strength of association or interdependence between two factors. If two factors are strongly associated with each other, knowledge in one of the factors leads to knowledge in the other.

The **McNemar's Test** (non-parametric test) – was used to test the consistency of the opinion of the examiner.

The **Cohen's Kappa Test** (non-parametric test) – was used to assess inter- and intraexaminer reliability when it comes to motion palpation of the patella. Kappa is used to assess the strength of agreement between two raters.

CHAPTER FOUR – THE RESULTS

4.1 INTRODUCTION

This chapter represents the results of all data collected in the course of this research study.

4.1.1 Interexaminer consistency

The first part of the results (Table 1&2) consists of information regarding the consistency between the four examiners regarding their motion palpation findings. Pearson's Chi-Square Test was used to assess this.

4.1.2 Intraexaminer consistency

The second part of the results (Table 3-6) deals with the consistency of the motion palpation findings between examination 1 and 2 of the same examiner. McNemar Test was used to test the consistency of the opinion of the examiner.

4.1.3 Intraexaminer reliability

The third part of the results (Table 7-10) deals with intraexaminer reliability of the motion palpation findings by using Cohen's kappa co-efficients.

4.1.4 Interexaminer reliability

The fourth part of the results (Table 11-16) relates to interexaminer reliability of the motion palpation findings by using Cohen's kappa co-efficients.

4.2 INTEREXAMINER CONSISTENCY

4.2.1 Pearson's Chi-Square Test

Whenever Pearson's Chi-Square test is done to determine the strength of association between the motion palpation findings of the four examiners, the null and alternative hypothesis must be specified. The null hypothesis states that there is no association between the motion palpation findings of the examiners. The alternative hypothesis states that there is an association between the motion palpation findings of the examiners.

In this study, the level of significance, α, is fixed as 0.05. Thus, an association becomes significant if the observed significance level or P-value is smaller than 0.05. Otherwise, it is said to be insignificant at the same level.

4.2.2 Left knee

Table 1

Statistical analysis of motion palpation findings of the left knee between the four examiners using Pearson's Chi-Square method.

	Examiner				Total
	1	2	3	4	
Decreased movement	**14**	**13**	**43**	**29**	**99**
Normal movement	**344**	**361**	**344**	**353**	**1402**
Increased movement	**42**	**26**	**13**	**18**	**99**
Total	**400**	**400**	**400**	**400**	**1600**

Chi-Square Tests

	Value	df	P-value
Pearson Chi-Square	44.513[a]	6	.000 (<.001)

a. 0 cells (0%) have expected count less than 5. The minimum expected count is 24.75.

According to Pearson's Chi-Square the P-value is 0.000 (<0.001), i.e. $p<0.05$. Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that an association existed between the motion palpation findings of the left knee and examiners. This means is that there was an agreement between the different examiners in terms of their motion palpation findings.

4.2.2 Right knee

Table 2

Statistical analysis of motion palpation findings of the right knee between the four examiners using Pearson's Chi-Square method.

	Examiner				Total
	1	2	3	4	
Decreased movement	19	36	28	15	98
Normal movement	344	343	358	373	1418
Increased movement	37	21	14	12	84
Total	400	400	400	400	1600

Chi-Square Tests

	Value	df	P-value
Pearson Chi-Square	30.881[a]	6	.000 (<.001)

a. 0 cells (0%) have expected count less than 5. The minimum expected count is 21.00.

According to Pearson's Chi-Square the P-value is 0.000 (<0.001), i.e. $p<0.05$. Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that an association existed between the motion palpation findings of the right knee and examiners. This means is that there was an agreement between the different examiners in terms of their motion palpation findings.

4.3 INTRAEXAMINER CONSISTENCY

4.3.1 McNemar Test

McNemar Test was used to compare the consistency of opinion of each examiner between the first and second examination.

Due to the fact that this test can only compare two dichotomous values and there were three possibilities available to the examiner (increased, decreased and normal), it was decided to change the findings to **same** (normal movement) and **different** (includes decreased and increased movement) so as to be able to compare the proportions.

The null hypothesis states that there is no consistency of opinion between the two examinations being considered. The alternative hypothesis states that there is a consistency of opinion between the two examinations being considered.

In this study, the level of significance, α, is fixed as 0.05. Thus, consistency becomes significant if the observed significance level or P-value is smaller than 0.05. Otherwise, it is said to be insignificant at the same level.

4.3.2 Examiner 1

Table 3

Statistical analysis of motion palpation findings of examiner 1, between examination 1 and examination 2, using McNemar Test.

Examination	Motion Palpation findings	
	Different	Same
First	60	340
Second	52	348

McNemar Test

	Examination & Motion Palpation Findings
N	800
Chi-Square[a]	210.125
P-value	.000 (<.001)

a. Continuity Corrected

According to McNemar's Test the P-value is 0.000 (<0.001). Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that there was consistency in the opinions of the Examiner 1 between the first and second examinations.

4.3.2 Examiner 2

Table 4

Statistical analysis of motion palpation findings of examiner 2, between examination 1 and examination 2, using McNemar Test.

Examination	Motion Palpation findings	
	Different	Same
First	53	347
Second	43	357

McNemar Test

	Examination & Motion Palpation Findings
N	800
Chi-Square[a]	235.408
P-value	.000 (<.001)

a. Continuity Corrected

According to McNemar's Test the P-value is 0.000 (<0.001). Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that there was consistency in the opinions of the Examiner 2 between the first and second examinations.

4.3.3 Examiner 3

Table 5

Statistical analysis of motion palpation findings of examiner 3, between examination 1 and examination 2, using McNemar Test.

Examination	**Motion Palpation findings**	
	Different	**Same**
First	**41**	**359**
Second	**33**	**367**

McNemar Test

	Examination & Motion Palpation Findings
N	800
Chi-Square[a]	228.790
P-value	.000 (<.001)

a. Continuity Corrected

According to McNemar's Test the P-value is 0.000 (<0.001). Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that there was consistency in the opinions of the Examiner 3 between the first and second examinations.

4.3.5 Examiner 4

Table 6

Statistical analysis of motion palpation findings of examiner 4, between examination 1 and examination 2, using McNemar Test.

Examination	**Motion Palpation findings**	
	Different	**Same**
First	**41**	**369**
Second	**33**	**367**

McNemar Test

	Examination & Motion Palpation Findings
N	800
Chi-Square[a]	269.452
P-value	.000 (<.001)

a. Continuity Corrected

According to McNemar's Test the P-value is 0.000 (<0.001). Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that there was consistency in the opinions of the Examiner 4 between the first and second examinations.

4.4 INTRAEXAMINER RELIABILITY

4.4.1 Cohen's Kappa Test

Kappa was used to assess intraexaminer reliability when it comes to motion palpation of the patella. Kappa is used to assess the strength of agreement between two raters and between the same rater.

Kappa co-effecients range between 0 and 1. The closer it is to one the greater the reliability. The following scale was used to assess the reliability of the Kappa co-effecients:

$K > 0.75$	-	**excellent reproducibility**
$0.40 \leq K \geq 0.75$	-	**good reproducibility**
$0 < K < 0.40$	-	**fair reproducibility**

Due to the fact that this test can only compare two dichotomous values and there were three possibilities available to the examiners in terms of motion palpation findings, it was decided to change the findings to **same** (normal movement) and **different** (includes decreased and increased movement) so as to be able to assess reliability.

4.4.2 Examiner 1

Table 7

Statistical analysis of the intraexaminer reliability of motion palpation of examiner 1, using Cohen's Kappa co-effecients.

Examination	Motion Palpation findings	
	Different	**Same**
First	**60**	**340**
Second	**52**	**348**

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Measure of Agreement - Kappa	.020	0.25	.815	.415
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis.

Cohen's Kappa co-efficient is 0.020, which means there was fair intraexaminer reproducibility in terms of motion palpation findings of Examiner 1.

4.4.3 Examiner 2

Table 8

Statistical analysis of the intraexaminer reliability of motion palpation of examiner 2, using Cohen's Kappa co-effecients.

Examination	Motion Palpation findings	
	Different	**Same**
First	**53**	**347**
Second	**43**	**357**

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Measure of Agreement - Kappa	.025	.023	1.088	.277
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis.

Cohen's Kappa co-efficient is 0.025, which means there was fair intraexaminer reproducibility of motion palpation findings of Examiner 2.

4.4.4 Examiner 3

Table 9

Statistical analysis of the intraexaminer reliability of motion palpation of examiner 3, using Cohen's Kappa co-effecients.

Examination	**Motion Palpation findings**	
	Different	**Same**
First	**41**	**359**
Second	**33**	**367**

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T^2	Approx. Sig.
Measure of Agreement - Kappa	.010	0.23	.431	.666
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis.

Cohen's Kappa co-efficient is 0.010, which means there was fair intraexaminer reproducibility in terms of motion palpation findings of Examiner 3.

4.4.5 Examiner 4

Table 10

Statistical analysis of the intraexaminer reliability of motion palpation of examiner 4, using Cohen's Kappa co-effecients.

Examination	Motion Palpation findings	
	Different	Same
First	41	369
Second	33	367

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Measure of Agreement - Kappa	.020	.020	.976	.329
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis.

Cohen's Kappa co-efficient is 0.020 , which means there was fair intraexaminer reproducibility of motion palpation findings of Examiner 4

4.4.6 Summary Graph

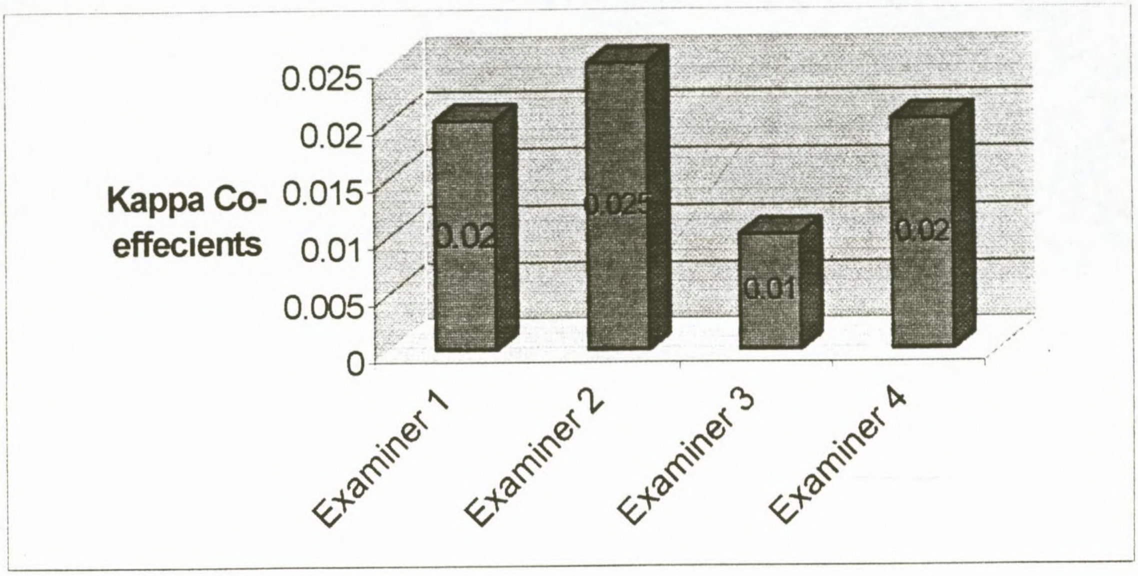

Figure 1, Statistical analysis of the intraexaminer reliability of motion palpation, using Cohen's Kappa co-effecients.

4.5 INTEREXAMINER RELIABILITY

Cohen's kappa was used to assess the interexaminer reliability.

4.5.1 Examiner 1&2

Table 11

Statistical analysis of the interexaminer reliability of motion palpation, between examiner 1 and examiner 2, using Cohen's Kappa co-effecients

	Motion Palpation findings	
First Examination	Different	Same
Examiner 1	60	340
Examiner 2	53	347
Second Examination		
Examiner 1	52	348
Examiner 2	43	357

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T^2	Approx. Sig.
Exam 1. Measure of Agreement – Kappa	.018	.025	.711	.477
N of Valid Cases	800			
Exam 2. Measure of Agreement – Kappa	.022	.023	.984	.325
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis.

Cohen's Kappa co-efficient is 0.018 for first examination and 0.022 for second examination. There was fair interexaminer reproducibility between Examiner 1&2 at the first examination and the second examination.

4.5.2 Examiner 2&3

4.5.3 Table 12

Statistical analysis of the interexaminer reliability of motion palpation, between examiner 2 and examiner 3, using Cohen's Kappa co-effecients

	Motion Palpation findings	
First Examination	Different	Same
Examiner 2	53	347
Examiner 3	51	349
Second Examination		
Examiner 2	43	357
Examiner 3	47	353

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Exam 1. Measure of Agreement – Kappa	.005	.024	.210	.833
N of Valid Cases	800			
Exam 2. Measure of Agreement – Kappa	.000	0.22	-.448	.654
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis

Cohen's Kappa co-efficient is 0.005 for first examination and 0.000 for second examination. There was fair interexaminer reproducibility between Examiner 2&3 at the first examination and the second examination.

4.5.4 Examiner 3&4

Table 13

Statistical analysis of the interexaminer reliability of motion palpation, between examiner 3 and examiner 4, using Cohen's Kappa co-effecients

	Motion Palpation findings	
First Examination	Different	Same
Examiner 3	51	349
Examiner 4	41	359
Second Examination		
Examiner 3	47	353
Examiner 4	33	367

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Exam 1. Measure of Agreement – Kappa	.025	.023	1.168	.268
N of Valid Cases	800			
Exam 2. Measure of Agreement – Kappa	.035	.021	1.650	.099
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis

Cohen's Kappa co-efficient is 0.025 for first examination and 0.035 for second examination. There was fair interexaminer reproducibility between Examiner 3&4 at both examinations.

4.5.5 Examiner 1&3

Table 14

Statistical analysis of the interexaminer reliability of motion palpation, between examiner 1 and examiner 3, using Cohen's Kappa co-effecients

	Motion Palpation findings	
First Examination	Different	Same
Examiner 1	60	340
Examiner 3	51	349
Second Examination		
Examiner 1	52	348
Examiner 3	47	353

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Exam 1. Measure of Agreement – Kappa	.022	.024	.920	.357
N of Valid Cases	800			
Exam 2. Measure of Agreement – Kappa	.012	.023	.537	.591
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis

Cohen's Kappa co-efficient is 0.022 for first examination and 0.012 for second examination. There was fair interexaminer reproducibility between Examiner 1&3 at the first examination and the second examination.

4.5.6 Examiner 1&4

Table 15

Statistical analysis of the interexaminer reliability of motion palpation, between examiner 1 and examiner 4, using Cohen's Kappa co-effecients

	Motion Palpation findings	
First Examination	Different	Same
Examiner 1	60	340
Examiner 4	41	359
Second Examination		
Examiner 1	52	348
Examiner 4	33	367

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Exam 1. Measure of Agreement – Kappa	.048	.023	2.023	.043
N of Valid Cases	800			
Exam 2. Measure of Agreement – Kappa	.048	.022	2.180	.029
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis

Cohen's Kappa co-efficient is 0.048 for first examination and 0.048 for second examination. There was fair interexaminer reproducibility between Examiner 1&4 at first and second examinations.

4.5.6 Examiner 2&4

Table 16

Statistical analysis of the interexaminer reliability of motion palpation, between examiner 2 and examiner 4, using Cohen's Kappa co-effecients

	Motion Palpation findings	
First Examination	Different	Same
Examiner 2	53	347
Examiner 4	41	359
Second Examination		
Examiner 2	43	357
Examiner 4	33	367

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[2]	Approx. Sig.
Exam 1. Measure of Agreement – Kappa	.030	.023	1.318	.188
N of Valid Cases	800			
Exam 2. Measure of Agreement – Kappa	.025	.021	1.206	.228
N of Valid Cases	800			

a. Not assuming the null hypothesis

2. Using the asymptotic standard error assuming the null hypothesis

Cohen's Kappa co-efficient is 0.030 for first examination and 0.025 for second examination. There was fair interexaminer reproducibility between Examiner 2&4 at the first and second examinations.

4.5.7 Summary Graph (First Examination)

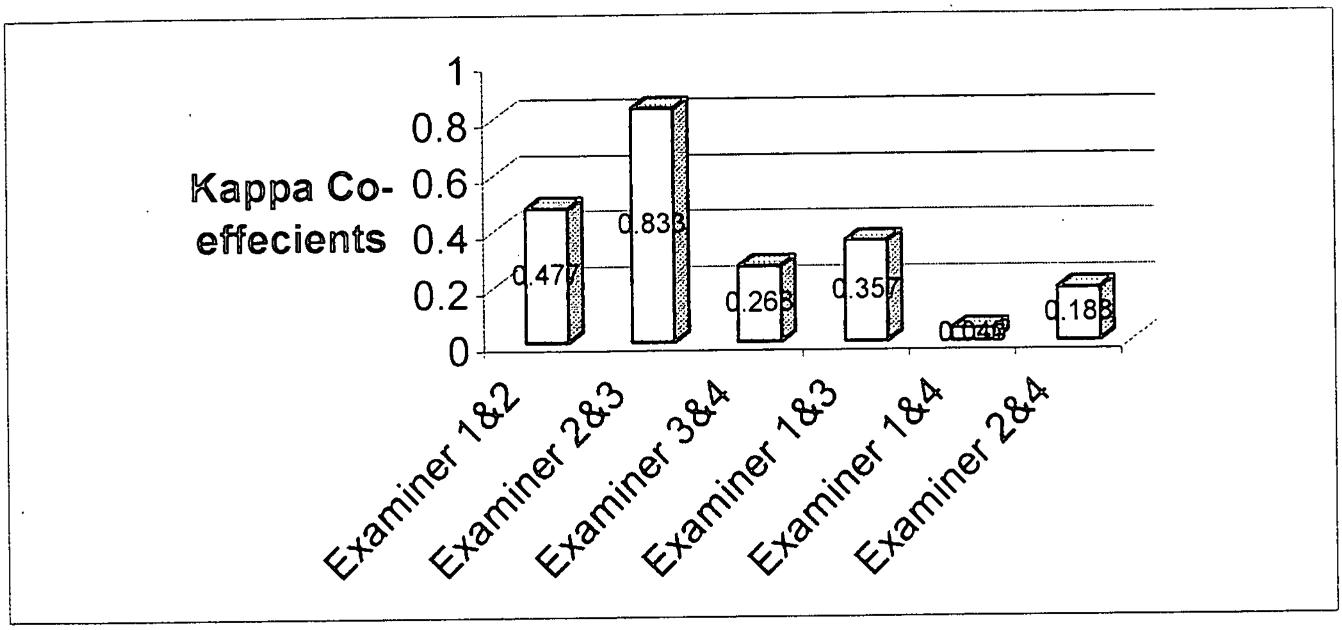

Figure 2. Statistical analysis of the interexaminer reliability of motion palpation at first examination, using Cohen's Kappa co-effecients.

4.5.8 Summary Graph (Second Examination)

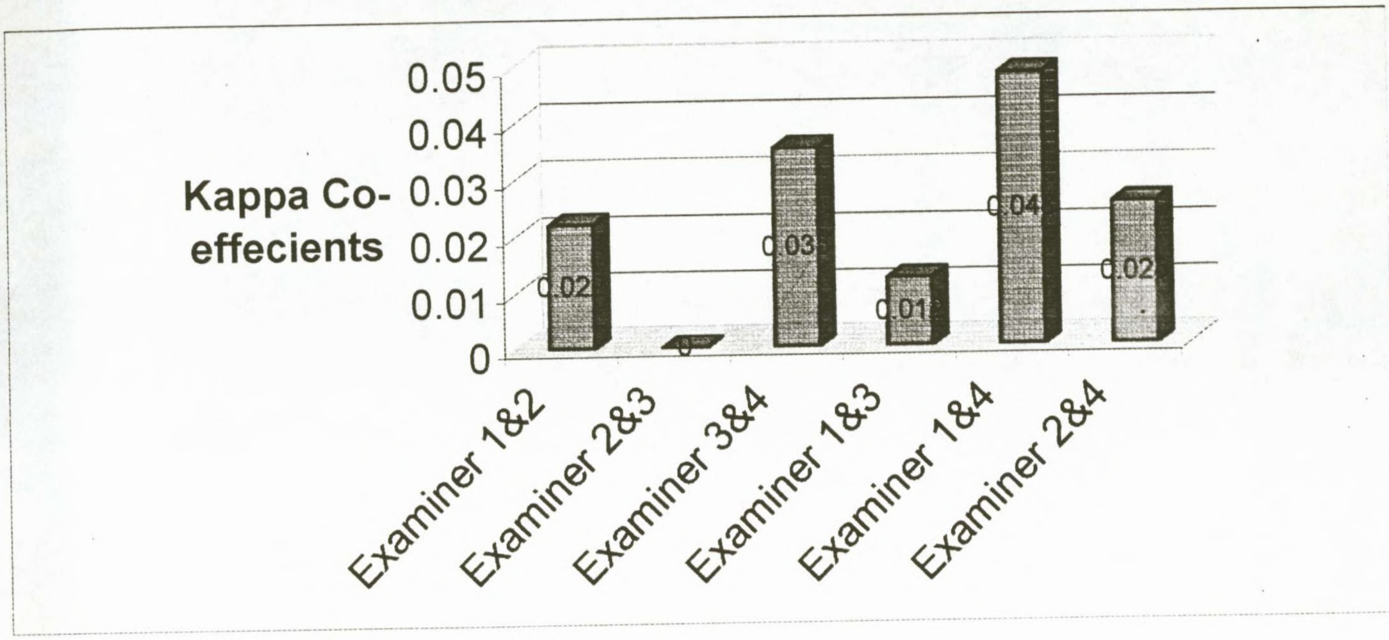

Figure 3, Statistical analysis of the interexaminer reliability of motion palpation at second examination, using Cohen's Kappa co-effecients.

4.5.9 Comparison Graph

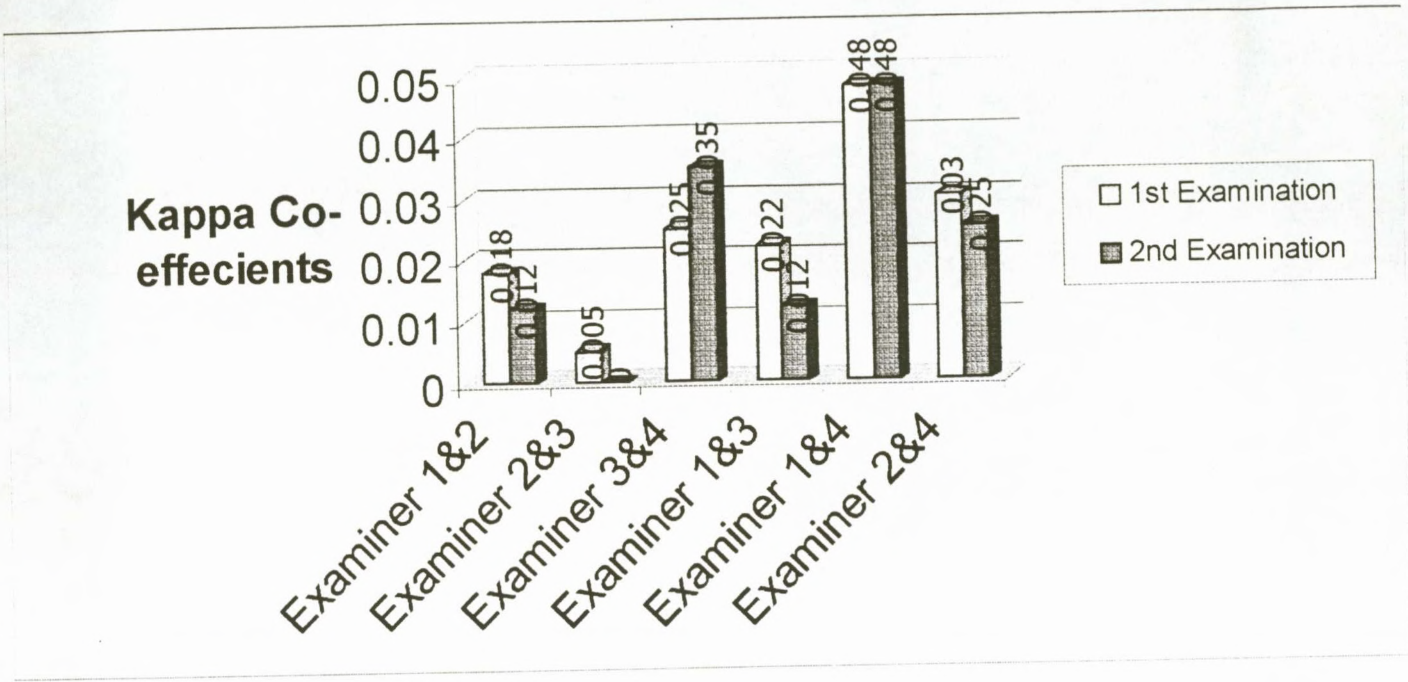

Figure 4, Comparison of the statistical analysis of the interexaminer reliability of motion palpation between the first and second examinations, using Cohen's Kappa co-effecients.

CHAPTER FIVE – DISCUSSION

5.1 Introduction

This chapter involves the discussion of the results after statistical analysis of the data obtained from the four examiners. The data collected from this study was analysed using Pearson's Chi-Square Test, which was used to assess if there was any association between the examiners and there motion palpation findings i.e. were their motion palpation findings consistent (interexaminer consistency). McNemar Test was used to test if the opinion of each examiner was consistent between examination one and two (intraexaminer consistency). Cohen's Kappa Test was used to test the reliability of the motion palpation findings, firstly intraexaminer and then interexaminer.

Interpretation of the results was necessary to ascertain whether motion palpation of the patella is reliable.

5.2 Interexaminer consistency

Chi-Square was used separately on the left knee and then the right knee. According to Pearson's Chi-Square the P-values were 0.000 (<0.001) (refer to Tables 1&2). Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that an association existed between the motion palpation findings of the right knee and the left knee of the different examiners. These results suggest that there is consistency between different examiners and their motion palpation findings. However, the results do not show us if their motion palpation findings are reliable, but at least they are consistent and significant.

5.3 Intraexaminer consistency

McNemar Test was used separately on each of the four examiners to determine the consistency of the opinion of the examiner in terms of their motion palpation findings of examination one and two.

According to McNemar's Test the P-values were 0.000 (<0.001) (refer to Tables 3-6). Thus, Ho was rejected at the 0.05 level of significance, and it was concluded that there was consistency of the opinion of the examiners between the first and second examination.

These results suggest that when it comes to motion palpation of the patella the examiner's opinion is consistent and significant.

5.4 Intraexaminer Reliability

When it came to intraexaminer reliability the results were as follows:

Examiner 1 – Kappa co-efficient was .020 (Table 7)

Examiner 2 – Kappa co-efficient was .025 (Table 8)

Examiner 3 – Kappa co-efficient was .010 (Table 9)

Examiner 4 – Kappa co-efficient was .020 (Table 10)

According to these results and the scale for assessing reliability they were below 0.40 which means that there was fair intraexaminer reliabilty when it came to comparing their first and second examinations.

These results cannot be compared to other motion palpation studies because none have been done on the patella. The kappa co-efficients are lower than the reliability study done on the "end feel" of passive lateral rotation of the shoulder by Chesworth et al. (1998) where they found the intraexaminer kappa co-effecients to be moderate (0.48 - 0.59).

5.5 Interexaminer Reliability (Tables 11-16)

When it came to the interexaminer reliability the results were as follows:

First examination

Between examiner 1&2 – the kappa co-efficient was .018 (Table 11)

Between examiner 2&3 – the kappa co-efficient was .005 (Table 12)

Between examiner 3&4 – the kappa co-efficient was .025 (Table 13)

Between examiner 1&3 – the kappa co-efficient was .022 (Table 14)

Between examiner 1&4 – the kappa co-efficient was .048 (Table 15)

Between examiner 2&4 – the kappa co-efficient was .030 (Table 16)

Second examination

Between examiner 1&2 – the kappa co-efficient was .022 (Table 11)

Between examiner 2&3 – the kappa co-efficient was .000 (Table 12)

Between examiner 3&4 – the kappa co-efficient was .035 (Table 13)

Between examiner 1&3 – the kappa co-efficient was .012 (Table 14)

Between examiner 1&4 – the kappa co-efficient was .048 (Table 15)

Between examiner 2&4 – the kappa co-efficient was .025 (Table 16)

When it came to the first examination the co-effecients ranged from .005 - .048, which is fair and the co-effecients for the second examination ranged from .000 - .048, which is fair. There was no real difference between the first and second examinations. A large *n* will cause small values of *K* to be significant while small *n* will cause large values to be insignificant. Therefore even though these kappa values are low they may not be totally insignificant as *n*=800 in this study which is above the minimum of *n*=30 suggested by Haas (1991).

These results don't compare favourably with the studies conducted by Brantingham et al. (1997) and Chesworth et al. (1998), who looked at the reliability of the Circumduction Test for foot stiffness and the "end feel" of passive lateral rotation of the shoulder respectively. Brantingham et al. (1997) found the interexaminer kappa value to be 0.64 (substantial agreement), when it came to assessing for decreased movement and Chesworth (1998) found interexaminer kappa values were substantial (0.62 - 0.76). These studies however used smaller sample sizes. Brantingham's study had n=17 and Chesworth had n=34 which is means that no meaningful comparison could be made with these studies as this research had n=800.

Haas (1991) states that meaningful comparisons between studies can only be made after giving consideration to differences in statistical analysis, experimental design and interpretation of reliability. A few of the possible differences in studies are:

- skill level of the examiners must be included in any critical discussion of reliability research, as inference can only be made when there is concordance in the examiner population e.g. student, clinician, expert. Thus, the results of this study can't be critically compared with any other motion palpation reliability studies conducted on an extremity, as other studies did not use student raters.
- the patient sample must also be considered as an extraneous variable because there may be considerable difference between asymptomatic and symptomatic patients. The other studies used symptomatic patients, whereas this study had asymptomatic patients.
- design errors such as improper blinding of subjects and patients should also be investigated before comparisons are made. The study conducted by Brantingham et al. (1997) only had partial blinding of the examiners and the study conducted by Chesworth et al. (1999) did not mention how blinding was done.

Therefore no significant comparisons can be made between this study's results and those of the other motion palpation studies conducted on extremities.

5.6 Problems with results

One of the possible reasons for these results is that the examiners weren't given enough time to practice their motion palpation skills before the research took place and to familiarize themselves with the possible motion palpation findings of the patella. Tomsich et al. (1996) also suggested this possible scenario.

Another possible reason brought to the attention of the researcher by the examiners after the research was conducted is that they battled to decide whether a certain movement was decreased on one knee or increased on the other knee. Speaking to the examiners individually afterwards it was noted that some of them chose one way and the others chose the other scenario. Foreseeing this problem and dealing with it before the study started could maybe have prevented this from happening.

Lastly, experience could have played a role in the results of this study. Although examiners had been trained in the same technique for assessing patella motion (Bergman's technique), they had limited clinical experience when it came to assessing patella disorders and they had not dealt with motion palpation of the patella on a regular basis. In a study conducted by Mior et al. (1990) into the role of experience in clinical accuracy they concluded that the level of experience of the examiners could in no way explain the difference in observer variability. They suggest that we accept that some differences will occur, even with a wide level of tolerance, due to human nature.

CHAPTER SIX – CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

When looking at the results of this study the following conclusions can be made:

a) the association between the examiners and their motion palpation findings as demonstrated by Pearson's Chi-Square ($p<0.05$), is significant. This means that the motion palpation findings were consistent between the examiners (interexaminer consistency).

b) the consistency of the opinion (motion palpation findings) of the examiner between their first and second examination as demonstrated by McNemar's Test ($p<0.05$), is significant (intraexaminer consistency).

c) Intraexaminer reliability was fair, even though the kappa values were relatively low (*K* ranged from .005 - .035)

d) Interexaminer reliability was fair, even though the kappa values were relatively low (*K*- ranged from .000 - .048)

These results suggest that the opinion of the different examiners was consistent but that the reliability of their motion palpation findings was fair (values were low, but could be significant as n=800). With the kappa values relatively low, one has to question if decisions such as diagnosis, management and assessment of progress of patella disorders should be made on motion palpation findings alone. This idea is supported by Watson et al. (2001) who states that clinicians should be cautious when making treatment decisions based on clinical measures of patella mobility until better reliability is established. Russell (1983) suggests motion palpation is an indirect analysis because it is done through the patient's skin and as with many other diagnostic procedures, motion palpation must be combined with other methods of investigation. He goes on to state that motion palpation lacks proven reproducibility and repeated intra-interexaminer agreement of findings and only when the establishment of such statistical reliability is made can a practitioner apply a procedure with confidence.

According to Lewit and Liebenson (1993) with the soaring health care costs, the need to objectively quantify a patient's progress has become important. The historic as well as rational importance of palpation in manipulative therapy is not sufficient to uphold its credibility in the care of patients, which means that more research is needed to legitimize this crucial part of the chiropractic profession.

Although this study suggests that motion palpation of the patella is not reliable, does this also mean that it is not useful? Motion palpation of the patella should be used in conjunction with other clinical tools to diagnose, manage and assess progress in-patients with knee/patella disorders. For motion palpation to play a significant role in the future, more research is needed into establishing its reliability.

6.2 Recommendations

1) Use examiners with more experience as even though the students were taught the same technique, their experience was limited because of the very few patients they have treated in the clinic environment.

2) Use symptomatic (e.g. patellofemoral pain syndrome, patella tracking problems) patients. This is because in essence motion palpation is a diagnostic procedure that looks for pathomechanics of a joint.

3) Only use two raters as using four made the statistical procedure difficult and only two examiners are needed to compute interexaminer reliability.

4) More research needs to be conducted to quantify the findings of this study. Haas et al. (1995) suggested that when further research is conducted, it needs to be conducted in other patient populations, in other regions of the body (e.g. hip, wrist, elbow etc.) and with different examiners to determine to generalizability of research findings.

5) If further studies find that motion palpation of the patella reliable, then validity studies need to be performed.

6) More time needs to be taken to ensure that the examiners are well informed on the research procedure.

7) The examiners need to have time to practice their motion palpation skills, as the examiners in this research weren't given any time to practice.

8) Exclusion criteria should incorperate any patients with pain of the patellofemoral joint.

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APPENDIX A

BRIEF CASE HISTORY FOR PURPOSES OF RELIABILTY STUDY

Name:________________________________

Date:__________________

File No:______________

Sex:____

Age:_____

Year of Study:_________

CASE HISTORY:

Are you suffering from any knee pain at present?	YES/NO
Had any knee surgery in the last 2 years?	YES/NO
Do you suffer from dislocating patella?	YES/NO
Are you suffering from patella tendonitis at present?	YES/NO

Researcher: Brendon Bezuidenhout Signed:____________________

Clinician: ________________________ Signed:____________________

APPENDIX B

KNEE REGIONAL EXAMINATION

Patient: ______________________ File No.: __________ Date: __________
Intern / Resident: ______________________ Signature: ______________________
Clinician: ______________________ Signature: ______________________

OBSERVATION:

- General:
  - posture and gait ______________________
  - skin (scars, bruises) ______________________
  - swelling / bony enlargements ______________________
- Anterior:
  - genu varum / valgum ______________________
  - patella position ______________________
  - tibial torsion ______________________
  - symmetrical extension ______________________
- Lateral
  - genu recurvatum ______________________
  - patella alta / baja ______________________
  - symmetrical extension ______________________
- Posterior:
  - swelling ______________________
- Seated:
  - patella position ______________________
  - tibial tubercle ______________________
  - tibial torsion (toe-in / toe-out) ______________________

PALPATION:

Anterior :
- patella - base, apex, pre-patella bursa ______________________
- retinaculum, cartilagenous surface ______________________
- patella tendon, infrapatella bursa, fat pad, tibial tuberosity ______________________
- quadriceps tendon, suprapatella pouch ______________________
- quadriceps and sartorious ______________________

Medial:
- MCL, medial joint line, pes anserinus ______________________

Lateral:
- LCL, lateral joint line, TFL, ITB, head of fibula ______________________

Knee flexed 45° + 90°:
- joint line, tibial plateaux, menisci, femoral condyles ______________________
- adductor tubercle and adductor muscles ______________________

Posterior:
- Popliteal artery ______________________
- Lateral
  - lateral meniscus, arcuate popliteus complex ______________________
  - lateral head gastrocnemius, biceps femoris ______________________
- Medial
  - medial meniscus, posterior oblique ligament ______________________
  - medial head gastroc, semimembranosis, semitendonosis ______________________

ACTIVE MOVEMENTS:

- Flexion (0-35°) ____________________
- Extension (0-15°) ____________________
- Medial rotation (20-30°) ____________
- Lateral rotation (30-40°) ___________

PASSIVE MOVEMENTS:

- Flexion (tissue approximation) __________
- Extension (bone to bone) ______________
- Medial rotation (tissue stretch) _________
- Lateral rotation (tissue stretch) _________

RESISTED ISOMETRIC MOVEMENTS:

- Flexion (neutral, int rot, ext rotation) ____________________________
- Extension (0°, 30°, 60°, 90°) ____________________________
- Medial rotation ____________________________
- Lateral rotation ____________________________
- Ankle plantarflexion ____________________________
- Ankle dorsiflexion ____________________________

FUNCTIONAL TESTS: ____________________________

JOINT PLAY MOVEMENTS

- P-A / A-P movement of tibia on femur ____________________________
- Medial / lateral translation of tibia on femur ____________________________
- Long-axis distraction of tibio-femoral joint ____________________________
- Patella movement (sup-inf, med-lat) ____________________________
- P-A / A-P movement of superior tib-fib joint ____________________________

LIGAMENTOUS ASSESSMENT:

- <u>One-plane medial instability</u> (valgus stress)
  - extended ____________________ - resting position ______________
- <u>One-plane lateral instability</u> (varus stress)
  - extended ____________________ - resting position ______________
- <u>One-plane anterior instability</u>
  - Lachman (0-30°) ______________ - anterior draw (90°) ____________
- <u>One-plane posterior instability</u>
  - posterior sag sign (90°) __________ - posterior draw (90°) ____________
- <u>Antero-lateral rotary instability</u>
  - Slocum ____________________ - Macintosh (lat. pivot shift) __________
- <u>Antero-medial rotary instability</u>
  - Slocum ____________________
- <u>Postero-lateral rotary instability</u>
  - Houghston's drawer ______________
- <u>Postero-medial rotary instability</u>
  - Houghston's Drawer ______________

TESTS FOR MENISCAL PATHOLOGY:

- McMurray ____________
- Anderson's Grind ____________
- Bounce-Home ____________
- Apley's ____________

PLICA TESTS

- Mediopatellar plica ____________
- Houghston's Plica ____________
- Plica stutter ____________

SWELLING

- Brush / stroke test ____________
- Patella tap test ____________

TESTS FOR PATELLO-FEMORAL PAIN SYNDROME

- Clarke's sign ____________
- Passive patella tilt ____________
- Waldron test ____________

OTHER TESTS:

- Wilson's test (osteochondritis dessicans) ____________
- Fairbank's test (dislocated patella) ____________
- Noble compression test (ITB friction) ____________
- Quadriceps contusion test ____________
- Leg length ____________

NEUROLOGICAL:

- Reflexes - Patella (L3/4) R ________ L ________
  - Medial hamstring (L5/S1) R ________ L ________

- Dermatomes L1 ______ L2 ______ L3 ______ L4 ______ L5 ______
  S1 ______ S2 ______

RADIOLOGICAL EXAMINATION:

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DIAGNOSIS:

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MANAGEMENT PLAN:

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APPENDIX C

LETTER OF INFORMATION

Dear Participant

TITLE: Intra- and interexaminer reliabilty of motion palpation of the patella.

Welcome to this research study on the reliabilty of motion palpation of patella. Firstly you must not be suffering form any knee pain at the present moment, please inform me if you are. I am investigating the reliabilty of different examiners being able to find the same characteristic when they check out the movement of your patella (knee cap) and if the same examiner will be able to find the same characteristic on the same person when examining their patella on two separate occasions.

There will be fifty volunteers and you will be required to undergo a brief medical history and thorough knee regional and if there are no problems you will be included into the study. You will then be required to have both your patella examined by four different examiners, and this process will be repeated a week apart.

The only risk involved in this study is that you might feel a slight discomfort around your knee cap due to the motion palpation but you will benefit by being exposed to the procedures used by chiropractors to assess the motion of a knee cap.

Your full co-operation in this study will enable the chiropractic profession to get a better understanding about the procedures we use to assess if there are any problems with the movement of joints.

You are assured that your confidentiality will be maintained and the results will be used for research purposes only. The clinician, research supervisor and/or research ethics representative may inspect the records.

Participation in this study is free and will be performed under the supervision of a qualified chiropractor and you are free to leave the research at any time with no consequences.

If you need to discuss any further matters feel free to contact my supervisor and if you have any complaints you may contact the Technikon Faculty of Health Research Ethics Committee.

Thank you

Sincerely yours,
Brendon Bezuidenhout
Senior Chiropractic Intern.

APPENDIX D

INFORMED CONSENT FORM

(to be completed by patient/subject)

Date :

Title of research project : Intra- and interexaminer reliabilty of motion palpation of the patella.

Name of Supervisor : Dr A. van der Meulen (262 6695 or 083 233 2924)

Name of Research Student: Brendon Bezuidenhout (303 3996 or 082 812 6808)

Please circle the appropriate answer

1. **Have you read the research information sheet?** **Yes / No**
2. Have you had an opportunity to ask questions regarding this study? Yes / No
3. Have you received satisfactory answers to your questions? Yes / No
4. Have you had an opportunity to discuss this study? Yes / No
5. Have you received enough information about this study? Yes / No
6. Who have you spoken to? ____________________
7. Do you understand the implications of your involvement in this study? Yes / No
8. Do you understand that you are free to withdraw from this study? Yes / No
   1) at any time
   2) without having to give any reason for withdrawing, and
   3) without affecting your health care.
9. Do you agree to voluntarily participate in this study Yes / No

If you have answered no to any of the above, please obtain the necessary information before signing

<u>Please print in block letters:</u>

Patient/Subject Name:____________________ Signature:____________________

Parent/Guardian:____________________ Signature:____________________

Witness Name:____________________ Signature:____________________

Research Student Name:____________________ Signature:____________________

APPENDIX E
Motion palpation findings (page 1)

1st /2nd Examination

Examiners Name:_______________________________

Possible findings: n - normal
↑ - increased
↓ - decreased

Assistants Name:_______________________________

	Left Knee				Right Knee			
No	S-I	I-S	M-L	L-M	S-I	I-S	M-L	L-M
1								
2								
3								
4								
5								
6								
7								
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14								
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20								
21								
22								
23								
24								

Motion palpation findings (page 2)

1^st^/2^nd^ Examination

Examiners Name:______________________

Assistants Name:______________________

	Left Knee				Right Knee			
No	S-I	I-S	M-L	L-M	S-I	I-S	M-L	L-M
26								
27								
28								
29								
30								
31								
32								
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