THE EFFICACY OF MOTION PALPATION USED AS A POST-ADJUSTIVE ASSESSMENT TOOL IN THE CERVICAL SPINE TO MONITOR PATIENT PROGRESS

by

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I, Ekta Lakhani, do hereby declare that this dissertation is representative of my own work.

Ekta Lakhani ______________ 3/12/1999 Date

Approved for final submission

Dr. B. Nook. DC. DACBSP. FICC ______________ 7/12/99 Date

To my parents and fiancè, thank you.

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ABSTRACT

The purpose of this study was to evaluate the efficacy and reliability of motion palpation as a post-adjustive diagnostic tool in the evaluation of the cervical spine. This study attempts to assess motion palpation's ability to determine change in a motion segment fixation following manipulation.

It was hypothesized that the inter-examiner reliability of motion palpation would be statistically significant. It was also hypothesized that upon motion palpation after treatment, a significant improvement in end-feel of the motion segment fixation will be noted in the group receiving spinal manipulative therapy; and that this change or improvement would not be noted in the motion segment fixation of the group receiving placebo ultrasound.

This study consisted of a single blind placebo controlled trial. A sample population of thirty patients was used, twenty of whom were symptomatic patients, and the other ten were asymptomatic patients. The subjects were randomly divided into two groups: the control group and the experimental group. The control group received placebo treatment of de-tuned ultrasound, whereas the experimental group received spinal manipulative therapy. Each subject was treated twice a week for three weeks totalling six treatments per patient.

At each visit, both examiners recorded what they perceived to be the most fixated joint– 'the adjustable lesion', using motion palpation. This data was transferred to tables and

underwent statistical analysis. Analysis of inter-examiner reliability was measured using Cohen's Kappa co-efficient to check for correlation beyond chance.

A statistically significant correlation ($Z>1.96$) with regard to levels (C0-C7) of the cervical segments chosen was seen between the two examiners, when assessing the total population, and when assessing the symptomatic population separately. However, this was not demonstrated when the asymptomatic population was assessed separately.

A statistically significant correlation ($Z> 1.96$) with regards to the side the fixation was located (whether on the right or left) was noted between the two examiners, when assessing the total population and the symptomatic population, but not the asymptomatic population.

No statistically significant correlation ($Z< 1.96$) was noted with regard to direction (flexion, extension, lateral flexion, anterior to posterior rotation or posterior to anterior rotation) when assessing either the total population, or the symptomatic and asymptomatic populations separately.

The efficacy of motion palpation as a post-adjustive tool was assessed using Pearson's chi-square method to assess it's sensitivity to change in a motion segment following manipulation. When assessing the total population, the null hypothesis was rejected at a 0.05 level of significance, and it was concluded that there was a strong association between receiving spinal manipulative therapy, and end-play improvement.

When assessing the symptomatic population separately, the null hypothesis was again rejected at a 0.05 level of significance, and it was concluded that there was a strong association between receiving spinal manipulative therapy, and end-play improvement.

When assessing the asymptomatic population separately however, the null hypothesis was accepted at a 0.05 level of significance, and it was concluded that a strong association failed to exist between receiving spinal manipulative therapy, and end-play improvement.

The patient's responsiveness to the treatment (whether placebo or manipulation) was assessed by calculating the RRAM (relative response attributable to the manoeuvre). The results for the RRAM were as follows:

a) For the total population: %(Rm – Rn)/Rm = (74 –32)/74 = 56.76 %.
   This implies that more than half of the response (56.76% of the response) in the total population was attributable to spinal manipulation.

b) For the symptomatic population: %(Rm-Rn) / Rm = (70-16)/70 = 77.14 %.
   This implies that more than three quarters of the response (77.14% of the esponse) in the symptomatic population, was attributable to spinal manipulation.

c) For the asymptomatic population: %(Rm-Rn) / Rm = (83-63)/83 = 24.09 %.
   This implies that less than one quarter of the response (24.09% of the response) in the asymptomatic population, was attributable to spinal manipulation.

From this data it was evident that the RRAM was far greater in the symptomatic population than the asymptomatic population. This is very important as it reveals that in a clinical situation where a symptomatic patient comes to the clinic in need of treatment, the response after manipulation is excellent.

These results indicate that motion palpation is not only a reliable diagnostic tool that can be used prior to treatment to determine where to adjust, but also, that it can be used as a post-adjustive diagnostic tool, to assess and confirm that 'the job has been done' and that the fixation has either been cleared or has improved by the manipulation performed.

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THE DEFINITIONS OF TERMS

Palpation

The use of the tactile senses to determine variations in tissue consistency to recognize whether these variations are normal or abnormal (Haldeman 1992:304).

Motion Palpation

That aspect of palpation, which assesses the physiological range of motion possible in the different axes of motion, both generally and specifically for the joints of the spine, (that is, a dynamic evaluation of the spine). This evaluation determines if a joint or motion unit has natural movement and if it is relatively increased or decreased (Ames 1987 :14).

Static Palpation

Palpatory diagnosis of somatic structures in a neutral static position (Bergmann 1993:762).

End-Feel

The consistency which describes the resistance to further stretch, which is encountered at the end of the joint's passive range of motion (Bryner 1987:18).

Joint Play

Spinal joint play is discrete, short range movements of a joint independent of the action of voluntary muscles, determined by springing, in different directions, each vertebrae, or joint surface in a neutral position (Bryner 1987:23).

Fixation

Fixation is that essential characteristic of the spinal subluxation, which indicates its lack of normal mobility. It is due to an abnormality in spinal soft tissues which holds the vertebrae in its position and limits its movement, either partially or totally. A fixation is the component of the subluxation which is corrected by the adjustment (Gillet 1996.)

Vertebral Motion Segment

The consideration of the anatomical and functional relationship of two vertebrae, the mechanical integration of their articular processes and the related musculature, ligaments and synovial membranes (Bergmann 1993:766).

Interexaminer Reliability

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

Responsiveness

Sensitivity to change in clinical outcomes or the ability to detect clinically important change. It is a property of evaluative procedures only (Haas 1998).

CHAPTER 1

1.1. INTRODUCTION

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

Motion palpation is a palpatory procedure used to assess the quality of movement between articular structures, by means of joint play and end-feel. End-feel is assessed at the end of passive range of motion, whereas, joint play is assessed from a neutral/ loose packed position (Bergmann et al.1993: 89). Upon motion palpation, one should feel a springiness in the joint. The absence of this springiness, or, as reported by Bergmann et al. (1993: 91), the loss of anticipated end-feel elasticity indicates disorders within the joint, its capsule, or periarticular tissue. Magee (1997: 21) refers to this abnormal end-feel as an increase in hard / blocked capsular end-feel. Bergmann et al. (1993: 91) stated that end-play resistance is a significant finding in the determination of joint dysfunction and adjustive vector orientation.

Lewit and Liebenson (1993) state that there is an urgent need for research in palpation, which could provide basic scientific credibility to manipulative techniques, and legitimise this crucial part of the chiropractic art. To date, most of the research done on motion palpation is to assess the intra-examiner and / or inter-examiner reliability. As reported by Haas et al. (1995), sixteen data studies have been published previously in the chiropractic literature, and seven review articles. The current consensus is that the inter-examiner reliability of active and passive motion palpation procedures is poor, whereas intra-examiner reliability is moderate (Haas et al. 1995).

Panzer (1992) criticised the fact that clinical trials did not use palpatory findings to monitor spinal changes, and suggested that motion palpation should be applied, not only to clinical decision-making, but to patient monitoring as well. Lewit and Liebenson (1993) stated that there is an acute need to objectively quantify a patient's progress, due to soaring health costs. According to Ames (1987), one of the many observations obtained from motion palpation is the confirmation of effect after an adjustment.

As reported by Haas et al. (1995), the motion palpation theory, assumes that end-play restriction is an indication for manipulation, that restriction is palpable, that immediate post-manipulative restoration of motion occurs in some cases, and that restorative changes are palpable. This presents the need to establish that motion palpation is effective as a post-adjustive assessment tool. This study will allow chiropractors world wide to utilise motion palpation, along with the assessment of pain, and range of motion changes in the protocol used to monitor patient progress.

Haas et al. (1995) assessed the short-term response of manual thoracic end-play to spinal manipulation. This was the first study conducted using human subjects to evaluate the validity of motion palpation. This study was performed by two examiners, on sixty subjects, sixty percent of whom were symptomatic and forty percent were asymptomatic. The overall improvement upon post-treatment motion palpation was noted in the group that was adjusted, as compared to those that were not adjusted. Thus, the sensitivity of manual palpation to clinical change in terms of end-play was investigated. Segmental end-play palpation was found to have moderate utility as an immediate post-treatment evaluation procedure for end-play restoration. The response of motion restriction to spinal manipulation (Rm = response to manoeuvre) was sixty percent, in contrast with the thirty seven percent response (Rn = response to noise) in the control group. The difference was statistically significant ($z = 1.86$, $p = 0.04$). This study was performed only on the thoracic spine.

Haas et al. (1995) questioned the generalizability of the study findings as the sample used in this study consisted solely of students, and therefore questioned the response rate in different patient populations. It was suggested that further research be done on other patient populations, in other regions of the spine, and with different examiners, so that the generalizability of the study findings could be determined.

Further research into the assessment and biomechanical changes in the cervical spine will lead to a greater appreciation and understanding of cervical clinical syndromes, their diagnosis and post-treatment evaluation. This will ultimately improve the quality of treatment that the patient receives.

The present study attempts to answer the question of generalizibility as queried by Haas et al. (1995). This study utilises a different patient population (some students will be included, but the majority of the patients will be walk-in patients at the Technikon Natal Chiropractic Clinic), different examiners, and will be testing motion palpation as a post-treatment evaluative tool in a different region of the spine, namely the cervical spine.

1.2. THE STATEMENT OF THE PROBLEM

The purpose of this prospective, blinded, randomized placebo-controlled study is to evaluate the efficacy and reliability of motion palpation as a post-adjustive diagnostic tool in the cervical spine, by assessing it's sensitivity to change in a motion segment fixation following manipulation.

CHAPTER TWO

2. THE REVIEW OF THE RELATED LITERATURE

2.1 MOTION PALPATION

2.1.1 Introduction

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, as previously mentioned, 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).

Motion palpation is performed during active and passive joint movement (Bergmann 1993:81). During passive movement the patient relaxes while the palpator stabilizes and carries out specific movements on the patient. During active movement however, the patient moves without the help of the palpator, while the palpator feels for gapping or approximation between adjacent spinous processes (Mootz et al. 1989).

2.1.2 Accessory Joint Movement

These are involuntary movements and represent the small 'give'-or-'play' within a joint that is necessary for normal function. The joint capsule is responsible for the smooth give felt, as it allows for enough play and articular surface separation to avoid abnormal joint function. (Bergmann 1993:89.)

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 (Bergmann 1993:89-90).

2.1.3 Joint Play

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

2.1.4 End-Feel

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 result in a decrease in end-play elasticity or 'springiness'. This loss of elasticity, or increased resistance is instrumental in the diagnosis 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. (Bergmann 1993: 90-92.)

End-feel has been classified by Magee (1992) in the following manner:

(a) There are three 'normal' end-feels:

1. ***Bone to bone*** - a hard unyielding, painless sensation.

2. ***Soft tissue approximation*** - a yielding compression that stops further movement.

3. ***Tissue stretch*** - a hard and firm (springy) movement with a slight give. A springy or elastic resistance occurs at the end of range of motion, along with a feeling of rising tension. This is the most common type of normal end-feel.

(b) There are five 'abnormal' end-feels:

1. *Muscle spasm* - the end-feel is sudden and hard, with a sudden cessation in movement, often accompanied by pain. This type of end-feel is demonstrated during the apprehension test for anterior dislocation of the shoulder. The muscle spasm occurs as a result of the subconscious efforts of the body to protect the injured joint or structure.

2. *Capsular* - this feels similar to tissue stretch, except that range of motion is reduced.

   It is further divided into:

   ⇒ **hard :** the end-feel has a thick quality and is associated with chronic conditions. The limitation comes on rather abruptly, after a smooth friction-free movement.

   ⇒ **soft :** the end-feel is similar to normal end-feels, but range of motion is greatly reduced, and is associated with acute conditions with stiffness occurring early in the range, and progressively increasing stiffness until the end of range of motion is reached.

3. ***Bone to bone*** - the difference between this and normal bone to bone end-feel, is that in the abnormal type, range of motion is reduced. This end-feel is evident in the cervical spine with osteophyte formation.

4. *Empty* - the end-feel is termed empty when movement cannot be continued due to pain. The patient has difficulty describing the empty end-feel. There is no associated muscle spasm. Examples include acute subacromial bursitis or a tumor.

5. *Springy block* - occurs in unexpected areas, but is similar to normal tissue stretch. A rebound effect exists, indicative of internal derangement within the joint. This end-feel may be found with a torn meniscus of the knee when it is locked or unable to extend fully.

2.1.5 Observations From Motion Palpation, as reported by Ames (1987:24).

These are observations that may be used in the diagnosis, treatment and possible prevention of the subluxation complex :

2.1.5.1. Range of motion of each level of the spine and pelvis.

2.1.5.2. Range of motion of the individual motor units of the spine and pelvis in all six degrees of freedom.

2.1.5.3. Normal and abnormal joint play of individual motor units of the spine and pelvis in six degrees of freedom.

2.1.5.4. Elastic limit (end-feel) of the individual motor units of the spine and pelvis in six degrees of freedom.

2.1.5.5. Pain findings within these ranges of motion.

2.1.5.6. Muscle length.

2.1.5.7. Determination of direction of applied force for correction of the aberrant motion.

2.1.5.8. ***Confirmation of effect after an adjustment on manipulation.***

2.1.6 Principles of Motion Palpation

Ames (1987:40-41) provides a comprehensive summary of the principles of motion palpation:

2.1.6.1. Use both biomechanics and kinesiology in a practical clinical application, that is, be aware of normal mechanics of each motion unit with reference to mobility and orientation of the facets.

2.1.6.2. The palpator and patient must be relaxed, and the palpator should provide support to the patient.

2.1.6.3. Concentrate on the area that is being palpated, and involve motion in a specific motion unit and in the specific direction you want to feel.

2.1.6.4. When assessing end-feel, the patient must be at the end of range of motion.

2.1.6.5. Restriction without end-feel implies that the joint has compensatory abnormal fixation of the adjacent soft tissue structures due to the other motion unit fixations.

2.1.6.6. Manipulate to find the primary fixation as compared to secondary fixation. The primary fixation has the least motion in all degrees of freedom.

2.1.7 <u>History of Motion Palpation</u>

A concise summary into the history of motion palpation is provided by Gillet (1996):

"Words such as motion, flexion, extension, rotation of a vertebra sound very familiar to us now" (Gillet 1995).

It may be surprising to note that the seeds of these concepts were only planted in 1906 when modernized chiropractic was published where O.G. Smith introduced the beginning of this concept in his chapter called "Vertebral field of Motion-Subluxation".

Henri Gillet acknowledged this idea and he is credited with introducing Motion Palpation to the world. He, his brother Marcel, and Maurice Liekens attempted to define a subluxation. Henri Gillet is also accredited along with Jerome McAndrews and John L. Faye for emphasizing the role of 'total and partial' fixations of spinal segments. (Wardwell 1992: 192).

As reported by Henri Gillet (1969), the fixation is that essential characteristic of the spinal subluxation, which indicates its lack of normal mobility. Articular fixations are total fixations, which in turn produce secondary fixations of muscular or ligamentous nature. It is imperative to correct the total fixation first, then the ligamentous component and last the muscular ones, should any of them remain since they are secondary or partial to the previous two types.

Henri Gillet believed that the symptoms of stiffness, inco-ordination and abnormal motion is more important than the symptoms of misalignment and tenderness, because the former is a general cause present in acute as well as chronic conditions.

Research continued during World War II, by Gillet and Marcel, Maurice Liekens, Fernande De May, Henri Poeck, and Paul de Borchgrave, all Belgian chiropractors who found that 'although adjusted, rarely did the vertebrae seem to be "replaced" in their so-called normal alignment', which was the common belief in that period. They realized that the profession has missed important characteristics of the spinal column by examining it in a static position and not as a living, moving organ.

After Marcel Gillet's death, Henri Gillet and Maurice Liekens entered into the theory of fixations. The researchers developed methods to measure the degree and type of abnormal motion of each segment, and how to "demonstrate evident changes of mobility in the articular fixations before and after adjustments". The first lecture on motion palpation was by Henri Gillet in New York in 1951, after which the cascade of seminars and courses trailed throughout the world. A film demonstrating motion palpation techniques, lasting 75 minutes was first realised in Belgium in 1963, and was then reviewed and completed in 1973.

It took fifty years for this essential form of patient examination to infiltrate to the chiropractic profession, and for an understanding on one of the most important aspects of the chiropractic subluxation to grow. Henri Gillet began lecturing on motion palpation at the Anglo-European College of Chiropractic in Great Britain in 1968.

There, he met John L. Faye, DC, who understood the importance of motion palpation and began teaching as well. In 1989, he created the Motion Palpation Institute in California (Schafer and Faye 1989) and motion palpation became part of the syllabus in most colleges as a required topic in chiropractic analysis.

Motion palpation has now developed into one of the essential pillars in the practice of the art of chiropractic. Motion palpation is an undeniable diagnostic part of the science of chiropractic.

2.1.8 Summary of Motion Palpation Reliability Research

Mior et al. (1985) used two examiners to test motion palpation reliability in the cervical spine, in sixty two subjects. It was found that the inter-examiner agreement beyond chance was variable with a kappa value between 0.15 and 0.52.

In a study done by Carmichael (1987) on fifty three volunteers, inter- and intra-examiner reliability was tested by ten examiners. It was found that sacro-iliac motion palpation was "specific" (able to detect the presence of normality), but not "sensitive" (unable to detect the presence of abnormality). On analysis of intra-examiner reliability, it was found that the Gillet test is fairly reliable, and inter-examiner reliability was only mildly supported. Cohen's unweighted Kappa statistic for concordance yielded 'fair' concordance (0.21 – 0.4) for aggregate intra-examiner reliability, and 'slight'concordance (0.00 – 0.20) for aggregate inter-examiner reliability. However, the mean percentage agreement for intra-examiner reliability was 89.2 percent, and for inter-examiner reliability was 85.3 percent. The results of this study supported the usefulness of this test when applied by one examiner repeatedly on the same patient, providing encouraging evidence for the conscientious use of this test in the modern chiropractic clinic. Based on this research, the author concluded that in a clinic situation where the manipulative practitioner palpates the patient before and after a sacro-iliac manipulation, a meaningful post-adjustment assessment of the sacro-iliac mobility can be made.

A study by Bergstrom and Courtis (1986), assessed the lumbar spine in 100 students by two blindfolded examiners, but the article is unclear as to the experience of these examiners. The results were based on two criteria. The first criterion involved positive findings that were based on both the level and direction of the fixation of the vertebral segments. The total number of possible positive findings were 1000 (10 per subject comprising of right and left lateral flexion at each of the five lumbar vertebrae). The total number of positive findings found in this study were 818 of the possible 1000. The mean percentage examiner agreement was found to be 81.8 percent. The second criterion involved positive findings that were based on only the level of the vertebral segment. Thus, the total number of possible positive findings were 500 (100 subjects x five lumbar vertebrae), out of which 372 were found. The mean percentage agreement was found to be 74.8 percent. The results of the intra-reliability study were based on level and direction, and the results were 95.4 percent for both examiners. Haas (1991a) criticised this research based on the fact that a kappa co-efficient was not used to statistically analyse the data. Haas (1991a) also found that the authors only evaluated the two criteria on separate occasions, and did not build their data in a serial examination. Thus, it is important for the study design proposed in the next chapter to evaluate the patients for the level and direction of the fixation at one moment.

A study by Leboeuf et al. (1989) analysed inter- and intra-examiner reliability using motion palpation, spinous percussion, pain on palpation and other factors in 39 chronic low back pain patients. Motion palpation had a significantly higher intra-examiner reliability than inter-examiner reliability ($z = 3.79$, $p<0.002$). There was also a high rate of agreement per segment, with the majority of consensus being on negative findings.

In a study done by Love and Brodeur (1987), eight examiners assessed thirty two students using motion palpation, in the thoracolumbar spine. Analysis of the data revealed statistically significant agreement for intra-examiner reliability (for $p<0.005$, the correlation co-efficient was $r = 0.3$). Inter-examiner reliability was not statistically significant. R was calculated by averaging the r values for each trial. In trial one, $R = 0.023$, and in trial two, $R = 0.0852$. Neither index of association was large enough to be considered different from chance ($R = 0.3$ for $p<0.05$).

Boline et al. (1988) studied inter- and intra-examiner reliability on fifty volunteers for pain, paraspinal tonicity, and motion palpation, using two examiners. Their research revealed weak to no reliability depending on the evaluative procedure and articulation tested. The total lumbar abnormality scores, derived by summing across all dimensions at all segmental levels, yielded a weak ($r = 0.26$) albeit significant ($p<0.05$) linear correlation. None of the dimensions nor the combined scores were segmental levels.

In a study done by Mootz et al. (1989), two examiners assessed for fixations in the lumbar spine using a passive motion palpation protocol. Sixty students were assessed. Agreement between examiners at each palpatory trial approximated the concordance expected by chance: none of the concordance co-efficients were significant ($p>0.05$ in all cases).

Haas et al. (1995) assessed the short-term response of manual thoracic end-play to spinal manipulation. This was the first study conducted using human subjects to evaluate the validity of motion palpation. This study was performed by two examiners, on sixty subjects, sixty percent of whom were symptomatic and forty percent were asymptomatic. The overall improvement upon post-treatment motion palpation was noted in the group that was adjusted, as compared to those that were not adjusted. Thus, the sensitivity of manual palpation to clinical change in terms of end-play was investigated. Segmental end-play palpation was found to have moderate utility as an immediate post-treatment evaluation procedure for end-play restoration. The response of motion restriction to spinal manipulation (Rm = response to manoeuvre) was sixty percent, in contrast with the thirty seven percent response (Rn = response to noise) in the control group. The difference was statistically significant ($z = 1.86$, $p = 0.04$). This study was done only on the thoracic spine.

2.1.9 SPINAL FIXATIONS

A subluxation is an aberrant relationship between two adjacent articular structures, which may have functional or pathological sequelae, causing an alteration in the biomechanical and/or neurophysiological reflexes of these structures, and/or body systems that may be directly or indirectly affected by them (Gatterman 1990: 415).

Ames (1987) describes the subluxation complex as a complex entity comprising one or more of the following :

- Kinesiopathology,
- Neuropathophysiology,
- Myopathology,
- Histopathology, and
- Biochemical effects.

Concepts such as joint fixations, hypermobility, loss of joint play and end-feel, compensation, and change in axis of movement are included under kinesiopathology, which is one aspect of the subluxation complex (Gattermen 1990:40).

The prognosis for the patient depends upon the reversibility of the pathophysiological elements of the subluxation complex. Manipulation and other forms of manual therapy are used to reverse kinesiopathology. Adjunctive procedures are used to reduce inflammation and reverse the histopathology, and life-style changes are recommended to prevent the recurrence of the subluxation complex (Gattermen 1990:40).

No matter what position a vertebra takes, that position is it's normal position as long as it is movable in all six degrees of freedom. A vertebra is not displaced, or 'out of it's normal place', if nothing is holding it in that abnormal position. The structure that pulls and keeps the vertebra 'subluxated' is considered the real abnormality, which is called the spinal fixation (Gillet 1960).

The fixation itself is not synonymous with 'subluxation', but is only one of the characteristics of a spinal subluxation. Those who analyse the spine by motion palpation, refer to the spinal abnormality, or lack of normal movement as the spinal fixation. Upon finding the fixation, it is corrected by the use of the chiropractic thrust (Gillet 1969). The chiropractic thrust does not 'replace' a vertebra, or 'realign' a bone, but eliminates the reason for it's 'abnormal position' (Gillet 1985: 2).

Gillet (1985: 23- 36) described three types of joint fixations, and this was later adapted and improved by Schafer and Faye (1990: 12-18) :

1. Muscular fixations.

Muscular restrictions are the most numerous type of fixations. They are, however, usually minor or secondary. These fixations exhibit restricted mobility from the start when challenged. End-feel exhibits a definite restriction with a little 'give' and a rubbery end block. The chiropractic thrust is very effective in setting the articulations in movement with this type of fixation. This is because the more acute the fixation, the less degeneration is to be found in the responsible muscle, and the greatest change can be observed after adjustment. In the presence of articular and ligamentous fixations (primary fixations) however, they are likely to recur if the primary fixation or some other focus of irritation is not corrected.

*2. **Ligamentous retractions or shortening.***

An early physiological change seen in chronically fixated vertebral articulations is the shortening of ligaments. This occurs due to the fact that ligaments always tend to adapt themselves to the range of motion used. These are motion palpated as an abrupt, hard block within the normal range of motion that exhibits no end-play. The chiropractic thrust is effective in correcting this type of fixation as well, but they improve only slightly, immediately after each corrective treatment.

*3. **Articular fixations.***

Articular fixations are 'total' fixations, and are less irritative than those caused by muscular spasm. These fixations are motion palpated as being completely immobile in all directions and are asymptomatic, except when challenged by the palpator. The fixative element is a degeneration of the interarticular and peri-articular soft tissues, with the probable production of adhesions. The corrective effect of the chiropractic adjustment is due to a forcing open of the apposed facet joints. Overt pathology does not appear to be related as the fixation is eventually made mobile by repeated chiropractic adjustments.

In all types of fixations, reciprocity of immobility and hypermobility is found. In total fixations found between vertebrae, the adaptive hyperkinesis takes place above and below, or in the opposite articulation exceptionally. In partial fixations, it takes place on the still mobile side of segments that are unilaterally fixated. Thus, the articulation that is not restricted in movement adapts by becoming overstressed in a prolonged attempt to serve the role of both joints (Schafer and Faye 1990: 17-18).

According to Gillet (1960), correction of any one fixation will not only have a local effect, but will also change to a variable degree, all other fixations in that spine. One should never try to adjust a subluxation that has corrected itself as the result of a correction in another part of the spine, as this often causes a new fixation in this area. Thus, one should learn to map out the areas that need correction, choose the one which seems most important, correct it, and re-examine the other spots. If they have changed, one should leave them alone.

Gillet (1960) states that it was found through all their work, that abnormal physiology was far more pathogenic than abnormal anatomy, and therefore warns the profession against depending principally, or solely on roentgenograms for their analysis.

2.2 NECK PAIN

2.2.1 Introduction to Neck Pain

In the past, low back disorders have been the focus of intense research, due to the fact that they had the greatest economic impact on society. Neck pain, and neck pain with upper-extremity problems represent a growing and significant number of cases of spinal disorders (Porterfield and DeRosa 1995: 2-3.)

2.2.2 Prevalence

At any specific time, neck pain exists in 12% of females and 9% of males and 35% of people generally can recall an episode of neck pain (Bland 1994:3). According to Hult (1954) in a study performed on industrial and forest workers of 15 to 49 years of age, a prevalence of between 35 - 71% was found. Even though the percentage of neck pain and stiffness sufferers are lower than that of low back pain sufferers, it is safe to say that everyone suffers from mild to moderate neck pain at some point in their lives. This constitutes a significant percentage of people who seek medical attention because the pain impairs their work capability (Bland 1994:3-4).

2.2.3 Treatment

The immediate effect of a single spinal manipulation on range of motion and pain was assessed in a controlled study by Cassidy et al. (1992), using a sample of fifty patients suffering from mechanical neck pain. Range of motion and pain were assessed before and after treatment. It was concluded that there was a significant increase in range of motion, and decrease in pain after the manipulation. Overall, the NRS-101 pain rating scores decreased from a pre-treatment mean(SD) of 43.7 (25.8) to a post-treatment value of 31.1 (24.1). All planes of range of motion increased after treatment, the greatest increase being present in ipsilateral rotation (with a mean gain of 5.2), and the least increase being in flexion (with a mean gain of 3.0).

Yeomans (1992) reported in a prospective study on cervical inter-segmental mobility before and after spinal manipulative therapy, that the post-manipulative therapy mobility was significantly greater than the pre-manipulative therapy mobility. This was assessed by utilising cervical stress radiography in the saggittal plane, to assess cervical spine mobility on a total of 58 subjects. Koes et al. (1992) performed a prospective, blinded, randomised clinical trial comparing spinal mobilisation and adjustment to the treatment given by a general medical practitioner, a physiotherapist and to placebo therapy. It was found that spinal mobilisation and adjustment were more effective in improving physical functioning in patients with chronic non-specific back and neck complaints, compared to the other treatments.

2.3 SUMMARY

"As a result of soaring health care costs, the need to objectively quantify a patients progress has become acute" (Lewit et al. 1993).

As suggested by Panzer (1992), motion palpation should be applied, not only to clinical decision making in the future, but to patient monitoring as well. Gillet estimated that of the thousands of manipulators in the world whom employ some form of motion palpation, only a small fraction, employed it completely, due to a lack of proper training (Russell 1983).

According to Ames (1987), one of the observations obtained from motion palpation is the confirmation of effect after an adjustment. As reported by Haas et al. (1995), the motion restoration that occurs after spinal manipulative therapy is palpable through motion palpation.

This presents the need to prove, through research, that motion palpation is efficient as a post-adjustive assessment tool. This, in effect will allow chiropractors worldwide to utilize motion palpation, along which the assessment of pain, and range of motion changes in the protocol used to monitor patient progress.

CHAPTER 3

3. MATERIALS AND METHODS

3.1. INTRODUCTION

This chapter comprises of the details of the research study undertaken. This includes the objective, the study design, the subjects partaking in the research programme, as well as the intervention used. It also explains the statistical methods used to analyse the data.

3.2. THE OBJECTIVE

This prospective, blinded, randomized placebo-controlled study proposed to evaluate the efficacy and reliability of motion palpation as a post-adjustive tool in the cervical spine, by assessing it's sensitivity to change in a motion segment fixation following manipulation on symptomatic and asymptomatic patients.

3.3.THE DATA

This study will involve the use of primary and secondary data.

3.3.1 The Primary Data

A complete medical case history, physical and regional examination will be required to ensure that the patient is suffering from mechanical neck pain and; to exclude any patients with contra-indications to spinal manipulation.

Radiographic confirmation of contraindications, will result in that patient being excluded from the research programme.

Motion palpation findings will be recorded by both Examiner A and Examiner B at each of the six visits for all thirty patients. The data from these forms will be used to assess the inter-examiner reliability, as well as the sensitivity of motion palpation.

Only those patients with at least one fixation in the cervical spine, as determined by motion palpation findings shall be admitted in the study, as the presence of a fixation is an indicator for spinal manipulation therapy. This is provided that they are not excluded based on the delimitations, and provided there are no contra-indications to spinal manipulative therapy.

3.3.2 The Secondary Data

Secondary data will be obtained from journal articles, books and any related literature, to obtain information on the procedure, reliability and signs to look for on motion palpation to diagnosis the most fixated segment that requires spinal manipulation.

3.3.3 Location of the data

The data was collected at the Technikon Natal Chiropractic Day Clinic. Data was collected at each of the six visits. The data collected, in the form of motion palpation findings, were recorded by both Examiner A, and B, at each visit onto appendix D. Appendix D included both pre- and post-treatment results.

3.3.4 The treatment of the data.

- The Pearson's Chisquare test, as explained by Agresti (1996), 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 factor. In this research, the Pearson

Chisquare test is used three times to measure the strength of association between the following two dichotomous factors:

Factor 1: End-feel improvement

1. Yes
2. No

Factor 2: The use of Spinal Manipulative Therapy

1. Yes
2. No

Firstly, the test was used on a sample size of 180 observations to examine the association between these factors in the total population.

Secondly, the test was used on a sample size of 120 observations to examine the association between these factors in the symptomatic population.

Thirdly, the test was used on a sample size of 60 observations to examine the association between these factors in the asymptomatic population.

Whenever Pearson's Chisquare test is done to determine the strength of association between two factors, the null and alternative hypothesis must be specified. The null hypothesis states that there is no significant association between the two factors being considered. The alternative hypothesis states that there is a significant association between the two factors being considered.

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 turns out to be smaller than 0.05. Otherwise, it is said to be significant at the same level. Calculations for Pearson's Chi-square tests were performed using the statistical package SPSS. Pearson's Chi-square test was used in this study as recommended by Haas (1998).

Decision rule:

This is a guideline on the basis of which a null hypothesis is either rejected or accepted.

1) At the α level of significance, the null hypothesis is rejected if the P-value is greater than α. If the null hypothesis is rejected, then the alternative hypothesis will be accepted automatically.
2) At the α level of significance, the null hypothesis is accepted if the P-value is less than or equal to α. If the null hypothesis is accepted, then the alternative hypothesis will be rejected automatically

- Cohen's Kappa co-efficient was used to assess inter-examiner reliability, to compare the findings made by two examiners on the same group of patients, as recommended in Haas (1991b). Cohen's kappa co-efficient was computed at the website: http://www.kokemus.kokugo.juen.ac.jp/service-e.html

Based on the statistical analysis in Fisher and Van Belle (1993), Cohen's Kappa co-efficient is defined as follows:

$$K = \frac{P_A - P_C}{1 - P_C} \quad \text{where}$$

$\mathbf{P_A}$ is "agreement actually observed", and

$\mathbf{P_C}$ is " agreement expected by chance".

$$P_A = \frac{n_{11} + n_{22} + \ldots + n_{66}}{n}$$

$$P_C = \frac{n_{1.}n_{.1} + n_{2.}n_{.2} + \ldots + n_{6.}n_{.6}}{n^2}$$

Always,

$$\frac{-P_C}{1-P_C} \leq K \leq 1$$

In extreme cases, $\mathbf{K} = 0$ if the agreement is totally by chance

K = 1 if there is complete agreement

The null hypothesis (Ho) states that **the true K = 0,** whereas the alternative hypothesis (H_1) states that **the true K ≠0.**

Decision rule:

At the 0.05 level of significance,

1) Reject Ho if $|Z| > Z_{1-\frac{\alpha}{2}} = 1.96$

2) Accept Ho if $|Z| \leq Z_{1-\frac{\alpha}{2}} = 1.96$

When calculating the Standard error, a correction factor was used to compensate for the fact that the 180 observations were obtained from only 30 patients, who were seen 6 times each, and not 180 patients seen once each (Haas 1998). Once the computed calculation of the standard error was made by the internet package, this figure was multiplied by (the square root of the total number of observations, divided by the square root of the total number of people used to get that amount of observations). Therefore, during analysis of the total population, the standard error (Se in appendix G) was multiplied by (square root of 180 / square root of 30). During analysis of the symptomatic population however, the standard error (Se in appendix G) was multiplied by (square root of 120 / square root of 20). Likewise, during analysis of the asymptomatic population, the standard error (Se in appendix G) was multiplied by (square root of 60 / square root of 10).

A 95% confidence interval for the **true value of K** is given by:

The true value of K $\in$ (K-L, K+L) where

L = The Margin of Error

K = The Estimated Kappa Co-efficient

L is calculated in the following manner:

$L = Z_{1-\frac{\alpha}{2}} \quad \times \quad$ Std (The estimated Kappa Co-efficient)

= 1.96 x (The estimated Kappa Co-efficient).

- Responsiveness has been defined as the percentage response to a maneuver itself. The index used to calculate this is the etiologic fraction / the relative response attributable to the maneuver. Based on the statistical analysis in Haas et al. (1995), Rm = percent response observed for the manoeuvre(manipulation). Rn = percent response for placebo treatment ('ultrasound'). RRAM (relative response attributable to the manoeuvre = 100% (Rm –Rn)/Rm = percentage of the response found in adjusted subjects attributable to manipulation itself. Responsiveness will be used in this study, as was demonstrated in Haas et al. (1995). The findings of both examiners will be recorded, but statistical analysis for responsiveness will only be evaluated for Examiner A.

3.4. OBSERVATIONS

Examiner A as well as Examiner B used the motion palpation form (appendix D) to record their motion palpation findings before treatment, without discussing or observing each other's findings. After treatment, each examiner recorded whether an improvement in the fixation was noticed, or had not changed compared to the pre-treatment findings. This was randomly recorded at each of the six visits made by all thirty patients, whether they received spinal manipulative therapy, or placebo ultrasound.

These records were then used to analyse the inter-examiner reliability of motion palpation by comparing the findings of examiner A, with that of examiner B. The records were also analysed to determine the responsiveness of motion palpation, or it's sensitivity to change after treatment.

Statistical analysis for responsiveness will only be evaluated for Examiner A, since some of the findings of Examiner B would have been to begin with(in those cases where inter-examiner reliability were poor). These results will be used to determine whether a close correlation exists between the group that received spinal manipulative therapy and an improvement in end-feel of the motion restriction upon re-assessment, and between the group that received placebo ultrasound and no change in end-feel of the motion restriction.

3.5 THE RESEARCH METHODOLOGY

3.5.1 The Sample

A sample size of thirty was used. A high percentage of symptomatic patients were included, as suggested by Carmichael (1987), Mootz et al. (1989), and Tuchin et al. (1996) in order to improve reliability of motion palpation. A smaller percentage of asymptomatic patients (ten out of the thirty) were included (McGregor 1998).

Patients who arrived at Technikon Natal clinic with neck pain were first scanned for fixations using motion palpation, by a blinded clinician who was on duty at the time, at the outset of the initial consultation. An initial consultation was required, during which a case history was taken, a full physical examination was carried out, as well as a regional examination for the cervical spine. This aided in the exclusion of those patients with contraindications to spinal manipulative therapy, as referenced in Haldeman (1992: 557-572). Contraindications include carcinomas, blood dyscrasias, severe osteopenia, significant recent trauma, infections, instability or disc infections. Patient's in whom a condition was suspected that contraindicated spinal manipulative therapy, were sent for radiographs. Upon radiographic confirmation of such a condition, the patient would have been excluded from the study. Fortunately, in this study, no patients were excluded after radiographic evaluation of the cervical spine. Patients included in the study then signed an informed consent form. Only two patients dropped out of the study. Both were unable to remain in the study due to unavailability of transport to and from the clinic.

3.5.2 Allocation of Subjects

The patients were then randomly divided into treatment or placebo groups. Each patient was required to draw a piece of paper from a box provided. Each piece of paper was marked with either an 'x' or a 'y'. There were fifteen pieces of paper marked 'x' , and fifteen marked 'y'. The patients who chose the 'x' marked paper received spinal manipulation; and the patients who chose the 'y' marked paper received placebo treatment, that is, detuned ultrasound.

The control group received treatment with a detuned ultrasound to exclude the factor of placebo effects on the patient. Placebo ultrasound was administered for five minutes with the patient in seated or prone position. Bearing in mind the fact that the remnants of the ultrasound gel might give Examiner A a clue that this particular patient belonged to the placebo group, ultrasound gel was applied onto the patients receiving adjustments as well, after the manipulation had been completed.

3.5.3. Study Design

Mootz et al. (1989) recommend rehearsals prior to data collection. Therefore, the present study included a two month period of rehearsals, two afternoons per week in an attempt to standardise the motion palpation procedure. Aspects such as the amount of pressure applied, the position of the examiner and patient, and which fingers are used, were rehearsed.

Advertising was carried out at the clinic, the rest of Technikon Natal, other universities, shopping malls, beauty salons and community centres.

The spinous processes, and articular pillars in the cervical spine were marked prior to every assessment, to prevent incorrect recording of the level of fixation found (Johnston et al. 1983). Arrangements were made for a fifth year student at the Technikon that was not involved in the motion palpation of the patients to mark the segments.

Motion palpation technique was carried out as is referenced in Haldeman (1992: 305-318) and in Bergmann (1993: 241-253), in order to determine the level (C0-C7), the side (right or left), and the direction of restricted motion (flexion, extension, right or left rotation, or, right or left lateral flexion) in the fixated joint.

Boline et al. (1988) suggested limiting positive findings to the detection of 'adjustable lesions'. They criticised their own research on the grounds that the procedure of examining every segment for pain, fixations, and tissue changes may have forced 'oversensitization' of palpators to clinically trivial cues by requiring judgements which would not normally be made in actual clinical practice. Therefore, in the present study, one examiner motion palpated the patient, in order to find the most fixated joint - "the adjustable lesion" within the cervical spine. The examiner then recorded the level (C0-C7), the side, as well as the direction in the which it felt most restricted namely right or left flexion, right or left extension, right or left anterior to posterior rotation, right or left posterior to anterior rotation, or, right or left lateral flexion). At this time the second examiner was not in the room. It is important to note that the order of examination was randomised, that is, for half the patients, examiner A assessed first, and for the other half, examiner B assessed first. This was required because if it is randomised, then any systematic differences between examiners can be attributed to examiner performance itself, and not to any change in the subjects following the first examination.

The second examiner then came in and motion palpated the same patient, in the first examiner's absence, and repeated the above procedure. These assessments were eventually evaluated to assess inter-examiner reliability. Inter-examiner reliability was assessed taking into account the level of fixation, and the correct side, and direction of loss of motion.

It is important to note that throughout the study, Examiner A, being a blinded objective observer, was unaware as to which patient belonged to the treatment group, and which patient belonged to the control group. It is also important to note that Examiner A was blindfolded throughout the assessment (pre-treatment and post-treatment) and this helped to alleviate the possibility of receiving visual clues from the patient. Both examiners then compared their findings. If there was a discrepancy between the two, the fixation found by Examiner A was treated as the adjustable lesion. The reason for this, is that the difference in experience was a key factor that needed to be given careful consideration. Examiner A has had sixteen years of practice experience, as well as having lectured and trained students with regard to the motion palpation technique for the same amount of time. Examiner B on the other hand has had two years of motion palpation training under Examiner A, and had only six months of practice experience as an intern at the Technikon Natal Clinic before the research study began.

De Boer et al. (1985) suggest that stress put on subjects by consecutive examination, might cause subluxations to occur, or remove subluxations that are already present. Carmichael (1987) suggested this as well, stating that "the testing procedure when performed repeatedly may alter sacro-iliac mobility". In view of this information, it was decided that only two examiners be used in the study, to minimise the stress on each segment of the cervical spine, thus limiting the chance of fixations forming, or changing due to excessive palpation.

The adjustment to be used was determined by the direction of loss of motion, as chosen by examiner A, using motion palpation at the outset of each of the six treatments received by the thirty patients. That is, the joint was adjusted with the force directed into the restriction, and in line with the articular plane (Schafer and Faye 1989: 37). The adjustments used included, but were not limited to the following, which were done in the supine or seated position (Bergmann et al. 1993):

1) for an occipital-axis fixation – Occipital lift on page 263 (supine), or page 267-9 (seated);
2) for an atlas-axis fixation – Index atlas for loss of rotation, lateral flexion and extension on page 267-8 (supine); and
3) for a fixation at segments between C2 and C7 – index pillar for loss of rotation, lateral flexion, extension or flexion on page 274 (supine), or page 283-5 (seated).

At the end of the treatment, randomly, the examiners motion palpated the target segment again, and once more, recorded whether the end-feel in the target segment remained the same, or had changed. A form was provided for each examiner at the post-treatment evaluation with the above two options printed on it, allowing the examiner to tick off the correct block and record whether the end-feel had remained the same, or changed. This re-motioning was done on all patients, whether adjusted or not. The patient was then re-motioned by the next examiner, and the above procedure was repeated. This procedure was carried out at every treatment session. Thus, the sensitivity of motion palpation to clinical change within the joint was assessed.

Treatment protocol: Twice a week for three weeks, which results in a total of six treatments per patient.

CHAPTER 4

THE RESULTS

4.1. INTRODUCTION

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

The first section consists of demographic data collected from the sample of 30 patients. This includes data regarding the age and gender distribution of the sample population.

The second section includes 15 tables revealing the correlation of motion palpation over the entire 180 visits, as well as of the symptomatic and asymptomatic populations separately.

Motion palpation reliability was assessed using Cohen's kappa co-efficient (Tables 23-28), which is the method of choice to determine agreement between two examiners beyond chance.

The third section consists of information regarding sensitivity of the motion palpators to change following the treatment (Tables 18-21). Pearson's chi-square method was used to determine this in the total population, as well as in the symptomatic and asymptomatic populations separately.

The fourth section includes data wherein the RRAM (relative response attributable to the manoeuvre) is calculated (Table 22). This, once again is calculated for the total population, as well as in the symptomatic and asymptomatic populations separately.

4.2. DEMOGRAPHICAL DATA

Table 1

Gender distribution within the 2 sample groups.

Gender distribution		Adjustment group	Placebo group	Subtotal	Total
Females	Symptomatic	7	9	16	
	Asymptomatic	3	3	6	**22**
Males	Symptomatic	3	1	4	
	Asymptomatic	2	2	4	**8**
					30

This study sample consisted of twenty two females, and only eight males. Ten females were treated with spinal manipulative therapy and twelve were treated with placebo, whereas five males were treated with spinal manipulative therapy and three were treated with placebo.

Table 2

Age distribution with the two sample groups.

AGE DISTRIBUTION	ADJUSTMENTS	PLACEBO ULTRASOUND	TOTAL
AGE RANGE(YEARS)	20-64	21-67	20-67
MEAN(YEARS)	32.1333	35.6	33.86
20-29 YEARS	11	7	18
30-39 YEARS	0	3	3
40-49 YEARS	2	2	4
50-59 YEARS	1	2	3
60-69 YEARS	1	1	2

This table shows that the majority of patients (18) in this study belonged to the 20-29 year age bracket, leaving a minority of 12 patients from the remaining four age groups.

4.3. MOTION PALPATION FINDINGS

❖ **In tables 3 to 17, the horizontal axis represents the findings of examiner A, and the vertical axis represent the findings of examiner B.**

Table 3

Motion palpation correlation of the total population with regard to the level perceived by the examiners as being the most fixated.

	C0-C1	**C1-C2**	**C2-C3**	**C5-C6**	**C6-C7**	**C7-T1**	**SUM**
C0-C1	9	4	0	0	0	0	13
C1-C2	7	88	3	2	9	0	109
C2-C3	0	3	0	0	0	2	5
C5-C6	0	0	0	0	0	0	0
C6-C7	1	18	1	0	7	4	31
C7-T1	1	4	0	0	12	3	20
SUM	18	117	4	2	28	9	180

The above table reveals that when assessing each of the 30 patients at each of the 6 visits using motion palpation, agreement as to which level was the most fixated occurred the following number of times:

- ✓ Level C0-C1 was chosen by both examiners 9 times, out of the total 180
- ✓ Level C1-C2 was chosen by both examiners 88 times out of the total 180
- ✓ Level C2-C3 was never chosen by both examiners at the same visit

- ✓ Levels C3-C4 and C4-C5 were never chosen by examiner A, nor examiner B (therefore excluded from the table above)
- ✓ Level C5-C6 was never chosen by both examiners at the same visit
- ✓ Level C6-C7 was chosen by both examiners 7 times, out of the total 180
- ✓ Level C7-T1 was chosen by both examiners 3 times, out of the total 180
- ✓ Thus, it can be seen that agreement was reached 107 out of the total 180 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different levels to be the most fixated.

<u>**Table 4**</u>

Motion palpation correlation of the total population with regard to the side perceived by the examiners as being the most fixated.

	LEFT	RIGHT	SUM
LEFT	39	12	51
RIGHT	32	97	129
SUM	71	109	180

The above table reveals that when assessing each of the 30 patients at each of the 6 visits using motion palpation, agreement as to which side was the most fixated occurred the following number of times:

- ✓ The left side was chosen by both examiners 39 times out of the total 180
- ✓ The right side was chosen by both examiners 97 times, out of the total 180
- ✓ Thus, it can be seen that agreement was reached 136 out of the total 180 observations. These are indicated in red ink. The rest of the cells in the table

account for the times when examiners A, and B found different levels to be the most fixated.

Table 5

Motion palpation correlation of the total population with regard to the direction perceived by the examiners as being the most fixated.

	Lateral flexion	**Extension**	**A-P Rotation**	**P-A Rotation**	**General**	**SUM**
Lateral flexion	82	32	4	1	7	125
Extension	15	10	0	0	1	26
A-P Rotation	6	2	0	0	0	8
P-A Rotation	7	0	0	0	0	7
General	3	1	0	0	9	13
SUM	112	45	4	1	17	180

The above table reveals that when assessing each of the 30 patients at each of the 6 visits using motion palpation, agreement as to which direction the motion segment was most fixated in, occurred the following number of times:

- ✓ Lateral flexion was chosen by both examiners 82 times, out of the total 180.
- ✓ Extension was chosen by both examiners 10 times out of the total 180
- ✓ A-P Rotation was never chosen by both examiners at the same visit
- ✓ P-A Rotation was never chosen by both examiners at the same visit
- ✓ Flexion fixations were never found by examiner A, nor examiner B (therefore excluded from the table above)

- ✓ At any point that C0-C1 was chosen by any examiner, the direction noted was 'general' due to the fact that the adjustment used for a C0-C1 fixation in this study was always the seated occipital lift, which is the adjustment aimed to clear the C0-C1 fixation whatever direction it is fixated. This was chosen by both examiners 9 times out of the total 180
- ✓ Thus, it can be seen that agreement was reached 101 out of the total 180 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B did not agree as to the direction of loss of motion.

Table 6

Motion palpation correlation of the total population showing correlation of sides of those visits in which the same levels were chosen.

	LEFT	RIGHT	SUM
LEFT	25	4	29
RIGHT	17	61	78
SUM	42	65	107

The above table reveals the correlation with regard to side chosen, for only those visits wherein perfect correlation existed with regard to levels chosen. Correlation for level occurred 107 out of the total 180. Agreement as to which side was the most fixated occurred the following number of times:

✓ The left side was chosen by both examiners 25 times out of the total 107

✓ The right side was chosen by both examiners 61 times, out of the total 107

✓ Thus, it can be seen that agreement was reached 86 out of these 107 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different sides to be the most fixated.

Table 7

Motion palpation correlation of the total population showing correlation of direction of restricted motion for those visits in which the same levels as well as sides were chosen.

	Lateral flexion	Extension	A-P Rotation	P-A Rotation	General	SUM
Lateral flexion	37	19	3	0	0	59
Extension	11	6	0	0	0	17
A-P Rotation	0	0	0	0	0	0
P-A Rotation	1	0	0	0	0	1
General	0	0	0	0	9	9
SUM	48	25	3	0	9	86

The above table reveals the correlation with regard to direction of restricted motion chosen, for only those visits wherein perfect correlation existed with regard to levels as well as side chosen. Correlation for side occurred 86 out of the total 107. Agreement as to direction of loss of motion, occurred the following number of times:

- ✓ Lateral flexion was chosen by both examiners 37 times, out of the total 86.
- ✓ Extension was chosen by both examiners 6 times out of the total 86
- ✓ A-P Rotation was never chosen by both examiners at the same visit
- ✓ P-A Rotation was never chosen by both examiners at the same visit
- ✓ General fixation at C0-C1 was chosen 9 times out of the total 86
- ✓ Flexion fixations were never found by examiner A, nor examiner B (therefore excluded from the table above)

✓ Thus, it can be seen that agreement was reached 52 out of these 86 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B did not agree as to the direction of loss of motion.

Table 8

Motion palpation correlation of the symptomatic population with regard to the level perceived by the examiners as being the most fixated.

	C0-C1	C1-C2	C2-C3	C5-C6	C6-C7	C7-T1	SUM
C0-C1	6	3	0	0	0	0	9
C1-C2	3	56	3	1	6	0	69
C2-C3	0	2	0	0	0	1	3
C5-C6	0	0	0	0	0	0	0
C6-C7	0	13	1	0	7	3	24
C7-T1	0	3	0	0	9	2	14
SUM	9	77	4	1	22	6	120

The above table reveals that when assessing each of the 20 symptomatic patients at each of the 6 visits using motion palpation, agreement as to which level was the most fixated, occurred the following number of times:

✓ Level C0-C1 was chosen by both examiners 6 times, out of the total 120

✓ Level C1-C2 was chosen by both examiners 56 times out of the total 120

✓ Level C2-C3 was never chosen by both examiners at the same visit

✓ Levels C3-C4 and C4-C5 were never chosen by examiner A, nor examiner B (therefore excluded from the table above)

✓ Level C5-C6 was never chosen by both examiners at the same visit

✓ Level C6-C7 was chosen by both examiners 7 times, out of the total 120

✓ Level C7-T1 was chosen by both examiners 2 times, out of the total 120

✓ Thus, it can be seen that agreement was reached 71 out of these 120 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different levels to be the most fixated.

Table 9

Motion palpation correlation of the symptomatic population with regard to the level perceived by the examiners as being the most fixated.

	LEFT	**RIGHT**	**SUM**
LEFT	24	7	31
RIGHT	18	71	89
SUM	42	78	120

The above table reveals that when assessing each of the 20 symptomatic patients at each of the 6 visits using motion palpation, agreement as to which side was the most fixated, occurred the following number of times:

✓ The left side was chosen by both examiners 24 times out of the total 120

✓ The right side was chosen by both examiners 71 times, out of the total 120

✓ Thus, it can be seen that agreement was reached 95 out of these 120 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different side to be the most fixated.

Table 10

Motion palpation correlation of the symptomatic population with regard to the direction perceived by the examiners as being the most restricted.

	Lateral flexion	**Extension**	**A-P Rotation**	**P-A Rotation**	**General**	**SUM**
Lateral flexion	60	16	4	1	1	82
Extension	10	6	0	0	1	17
A-P Rotation	5	2	0	0	0	7
P-A Rotation	5	0	0	0	0	5
General	2	1	0	0	6	9
SUM	82	25	4	1	8	120

The above table reveals that when assessing each of the 20 symptomatic patients at each of the 6 visits using motion palpation, agreement as to which direction the motion segment was most fixated in, occurred the following number of times:

✓ Lateral flexion was chosen by both examiners 60 times, out of the total 120.

✓ Extension was chosen by both examiners 6 times out of the total 120

✓ A-P Rotation was never chosen by both examiners at the same visit

✓ P-A Rotation was never chosen by both examiners at the same visit

✓ General fixation at C0-C1 was chosen 6 times out of the total 120

- ✓ Flexion fixations were never found by examiner A, nor examiner B (therefore excluded from the table above)
- ✓ Thus, it can be seen that agreement was reached 72 out of these 120 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B did not agree as to the direction of loss of motion.

<u>**Table 11**</u>

Motion palpation correlation of the symptomatic population showing correlation of sides of those visits in which the same levels were chosen.

	LEFT	RIGHT	SUM
LEFT	14	2	16
RIGHT	12	43	55
SUM	26	45	71

The above table reveals the correlation with regard to side chosen, for only those visits wherein perfect correlation existed with regard to levels chosen in the symptomatic population. Correlation for level occurred 71 out of the total 120. Agreement as to which side was the most fixated, occurred the following number of times:

- ✓ The right side was chosen by both examiners 43 times, out of the total 71
- ✓ The left side was chosen by both examiners 14 times out of the total 71
- ✓ Thus, it can be seen that agreement was reached 57 out of these 71 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different sides to be the most fixated.

Table 12

Motion palpation correlation of the symptomatic population showing correlation of direction of restricted motion for those visits in which the same levels as well as sides were chosen.

	Lateral flexion	Extension	A-P Rotation	P-A Rotation	General	SUM
Lateral flexion	27	8	3	0	0	38
Extension	8	4	0	0	0	12
A-P Rotation	0	0	0	0	0	0
P-A Rotation	1	0	0	0	6	7
General	0	0	0	0	0	0
SUM	36	12	3	0	6	57

The above table reveals the correlation with regard to direction of restricted motion chosen, for only those visits wherein perfect correlation existed with regard to levels as well as side chosen in the symptomatic population. Correlation for side occurred 57 out of the total 71. Agreement as to direction of loss of motion, occurred the following number of times:

- ✓ Lateral flexion was chosen by both examiners 27 times, out of the total 57.
- ✓ Extension was chosen by both examiners 4 times out of the total 57
- ✓ A-P Rotation was never chosen by both examiners at the same visit
- ✓ P-A Rotation was never chosen by both examiners at the same visit
- ✓ General fixation at C0-C1 was not chosen out of the total 57
- ✓ Flexion fixations were never found by examiner A, nor examiner B (therefore excluded from the table above)

✓ Thus, it can be seen that agreement was reached 31 out of these 57 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B did not agree as to the direction of loss of motion.

Table 13

Motion palpation correlation of the asymptomatic population with regard to the level perceived by the examiners as being the most fixated.

	C0-C1	**C1-C2**	**C2-C3**	**C5-C6**	**C6-C7**	**C7-T1**	**SUM**
C0-C1	3	1	0	0	0	0	4
C1-C2	4	32	0	1	3	0	40
C2-C3	0	1	0	0	0	1	2
C5-C6	0	0	0	0	0	0	0
C6-C7	1	5	1	0	0	1	8
C7-T1	1	1	0	0	3	1	6
SUM	9	40	1	1	6	3	60

The above table reveals that when assessing each of the 10 asymptomatic patients at each of the 6 visits using motion palpation, agreement as to which level was the most fixated, occurred the following number of times:

✓ Level C0-C1 was chosen by both examiners 3 times, out of the total 60

✓ Level C1-C2 was chosen by both examiners 32 times out of the total 60

✓ Level C2-C3 was never chosen by both examiners at the same visit

- ✓ Levels C3-C4 and C4-C5 were never chosen by examiner A, nor examiner B (therefore excluded from the table above)
- ✓ Level C5-C6 was never chosen by both examiners at the same visit
- ✓ Level C6-C7 was not chosen by both examiners out of the total 60
- ✓ Level C7-T1 was chosen by both examiners 1 time, out of the total 60
- ✓ Thus, it can be seen that agreement was reached 36 out of these 60 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different levels to be the most fixated.

<u>**Table 14**</u>

Motion palpation correlation of the asymptomatic population with regard to the side perceived by the examiners as being the most fixated.

	LEFT	RIGHT	SUM
LEFT	15	5	20
RIGHT	14	26	40
SUM	29	31	60

The above table reveals that when assessing each of the 10 asymptomatic patients at each of the 6 visits using motion palpation, agreement as to which side was the most fixated, occurred the following number of times:

- ✓ The left side was chosen by both examiners 15 times out of the total 60
- ✓ The right side was chosen by both examiners 26 times, out of the total 60

✓ Thus, it can be seen that agreement was reached 41 out of these 60 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different side to be the most fixated.

Table 15

Motion palpation correlation of the asymptomatic population with regard to the direction perceived by the examiners as being the most restricted.

	Lateral flexion	**Extension**	**A-P Rotation**	**P-A Rotation**	**General**	**SUM**
Lateral flexion	22	16	0	0	6	44
Extension	5	4	0	0	0	9
A-P Rotation	1	0	0	0	0	1
P-A Rotation	2	0	0	0	0	2
General	1	0	0	0	3	4
SUM	31	20	0	0	9	60

The above table reveals that when assessing each of the 10 asymptomatic patients at each of the 6 visits using motion palpation, agreement as to which direction the motion segment was most fixated in, occurred the following number of times:

✓ Lateral flexion was chosen by both examiners 22 times, out of the total 60.

✓ Extension was chosen by both examiners 4 times out of the total 60

✓ A-P Rotation was never chosen by both examiners at the same visit

✓ P-A Rotation was never chosen by both examiners at the same visit

✓ General fixation at C0-C1 was chosen 3 times out of the total 60

- ✓ Flexion fixations were never found by examiner A, nor examiner B (therefore excluded from the table above)
- ✓ Thus, it can be seen that agreement was reached 29 out of these 60 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B did not agree as to the direction of loss of motion.

<u>**Table 16**</u>

Motion palpation correlation of the symptomatic population showing correlation of sides of those visits in which the same levels were chosen.

	LEFT	RIGHT	SUM
LEFT	11	2	13
RIGHT	5	18	23
SUM	16	20	36

The above table reveals the correlation with regard to side chosen, for only those visits wherein perfect correlation existed with regard to levels chosen in the symptomatic population. Correlation for level occurred 36 out of the total 60. Agreement as to which side was the most fixated, occurred the following number of times:

- ✓ The left side was chosen by both examiners 11 times out of the total 36
- ✓ The right side was chosen by both examiners 18 times, out of the total 36
- ✓ Thus, it can be seen that agreement was reached 29 out of these 36 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B found different sides to be the most fixated.

Table 17

Motion palpation correlation of the symptomatic population showing correlation of direction of restricted motion for those visits in which the same levels as well as sides were chosen.

	Lateral flexion	Extension	A-P Rotat0ion	P-A Rotation	General	SUM
Lateral flexion	10	11	0	0	0	21
Extension	3	2	0	0	0	5
A-P Rotation	0	0	0	0	0	0
P-A Rotation	0	0	0	0	3	3
General	0	0	0	0	0	0
SUM	13	13	0	0	3	29

The above table reveals the correlation with regard to direction of restricted motion chosen, for only those visits wherein perfect correlation existed with regard to levels as well as side chosen in the symptomatic population. Correlation for side occurred 29 out of the total 36. Agreement as to direction of loss of motion, occurred the following number of times:

- ✓ Lateral flexion was chosen by both examiners 10 times, out of the total 29
- ✓ Extension was chosen by both examiners 2 times out of the total 29
- ✓ A-P Rotation was never chosen by both examiners at the same visit
- ✓ P-A Rotation was never chosen by both examiners at the same visit
- ✓ General fixation at C0-C1 was not chosen out of the total 29

✓ Flexion fixations were never found by examiner A, nor examiner B (therefore excluded from the table above)

✓ Thus, it can be seen that agreement was reached 12 out of these 29 observations. These are indicated in red ink. The rest of the cells in the table account for the times when examiners A, and B did not agree as to the direction of loss of motion

4.4. THE STATISTICAL ANALYSIS OF THE DATA.

4.4.1. Abbreviations

K = Kappa co-efficient

Po = Proportion of observed agreement

Pc = Proportion of chance agreement

S.E.= Standard Error

Z = The associated score (kappa divided by the standard error)

L = The margin of error

Ho = Null Hypothesis

H1 = Alternative Hypothesis

RRAM = Relative Responsiveness Attributable to the Manoeuvre

Rm = Fraction of the treatment group with end-feel response subsequent to manipulation

Rn = Fraction of the treatment group with end-feel response despite absence of manipulation

4.4.2 Pearson's Chi-square

Pearson's Chi-square method was used to assess the sensitivity of motion palpation to change following manipulation. The strength of association between 2 factors was tested:

Ho: A strong association between receiving spinal manipulative therapy and end-feel improvement fails to exist.

H1: A strong association between receiving spinal manipulative therapy and end-feel improvement does exist

Table 18

Analysis of the end-feel response of the patient following manipulation in the total population.

		Spinal manipulative therapy received		**Total**
		YES	**NO**	
End-feel improved	**YES**	67	29	**96**
	NO	23	61	**84**
Total		**90**	**90**	**180**

- ✓ End-feel improvement was noted in 67/90 patients receiving SMT, and 29/90 patients receiving Placebo.
- ✓ No end-feel improvement was noted in 23/90 patients receiving SMT, and 61/90 patients receiving Placebo.

Table 19

Analysis of the end-feel response of the patient following manipulation in the symptomatic population.

		Spinal manipulative therapy received		Total
		YES	NO	
End-feel improved	YES	42	10	52
	NO	18	50	68
Total		60	60	120

- ✓ End-feel improvement was noted in 42/60 patients receiving SMT, and 10/60 patients receiving Placebo.
- ✓ No end-feel improvement was noted in 18/90 patients receiving SMT, and 50/90 patients receiving Placebo.

Table 20

Analysis of the end-feel response of the patient following manipulation in the asymptomatic population.

		Spinal manipulative therapy received		Total
		YES	NO	
End-feel improved	YES	25	19	44
	NO	5	11	16
Total		30	30	60

✓ End-feel improvement was noted in 25/30 patients receiving SMT, and 19/30 patients receiving Placebo.

✓ No end-feel improvement was noted in 5/30 patients receiving SMT, and 11/30 patients receiving Placebo.

Table 21

Statistical analysis of the end-feel response of the patient following manipulation using Pearson's Chi-square method for the total population, as well as the symptomatic and asymptomatic populations separately.

	γ^2 cal	γ^2 tab	Ho rejected: $\alpha = 0.05$
Total population	32.231	3.841	YES
Symptomatic population	34.75	3.841	YES
Asymptomatic population	3.068	3.841	NO

According to the Pearson's Chi-square method, if γ^2 cal is greater than γ^2 tab, then the null hypothesis is rejected. Thus, the results are as follows:

1) **For the total population**

   The P- value is 0.00000, and we see that $P < 0.05$. Thus, the Ho was rejected at a 0.05 level of significance, and it was concluded that a strong association does exist between receiving spinal manipulative therapy, and end-feel improvement. In fact, the association is significant even at the 0.01 level.

2) **For the symptomatic population**

   The P- value is 0.00000, and we see that $P < 0.05$. Thus, the Ho was rejected at a 0.05 level of significance, and it was concluded that a strong association does exist between receiving spinal manipulative therapy, and end-feel improvement. In fact, the association is significant even at the 0.01 level.

3) **For the asymptomatic population**

The P- value is 0.07984, and we see that P > 0.05. Thus, the Ho was accepted at a 0.05 level of significance, and it was concluded that a strong association failed to exist between receiving spinal manipulative therapy, and end-feel improvement. However, there is a significant association at the 0.10 level.

In all 3 cases above, the Pearson Chi-square test was used accurately as there were no cell frequencies less than 5. As reported by Agresti (1996), if there were cell frequencies less than 5, the Pearson Chi-square test would have been inappropriate.

4.4.3 Results of responsiveness in Percentages

As was reported in the article by Haas et al. (1995), response has been defined as an improvement in end-feel quality after the treatment. Responsiveness refers to the percentage response to the manoeuvre that can be attributed to the manoeuvre itself.

- As can be extrapolated from the blue print in Table 19 above, responsiveness, or an improvement in end-feel was noted in **70%** (42/60) of the *symptomatic* population being *adjusted*, leaving a remainder of 30% (18/60) in whom improvement was not noted (refer to figure 1).

- As can be extrapolated from the red print in Table 19 above, responsiveness, or an improvement in end-feel was noted in **16%** (10/60) of the *symptomatic* population receiving *placebo,* leaving a remainder of 84% (50/60) in whom improvement was not noted (refer to figure 2).

- As can be extrapolated from the blue print in Table 20 above, responsiveness, or an improvement in end-feel was noted in **83%** (25/30) of the *asymptomatic* population being *adjusted,* leaving a remainder of 17% (5/30) in whom improvement was not noted (refer to figure 3).

- As can be extrapolated from the red print in Table 20 above, responsiveness, or an improvement in end-feel was noted in **63%** (19/30) of the *asymptomatic* population receiving *placebo,* leaving a remainder of 37% (11/30) in whom improvement was not noted (refer to figure 4).

- A summary of the above showing patient numbers rather than percentages can be seen in figure 5.

Figure 1. Pie graph showing percentage responsiveness of symptomatic patients receiving Spinal Manipulative Therapy.

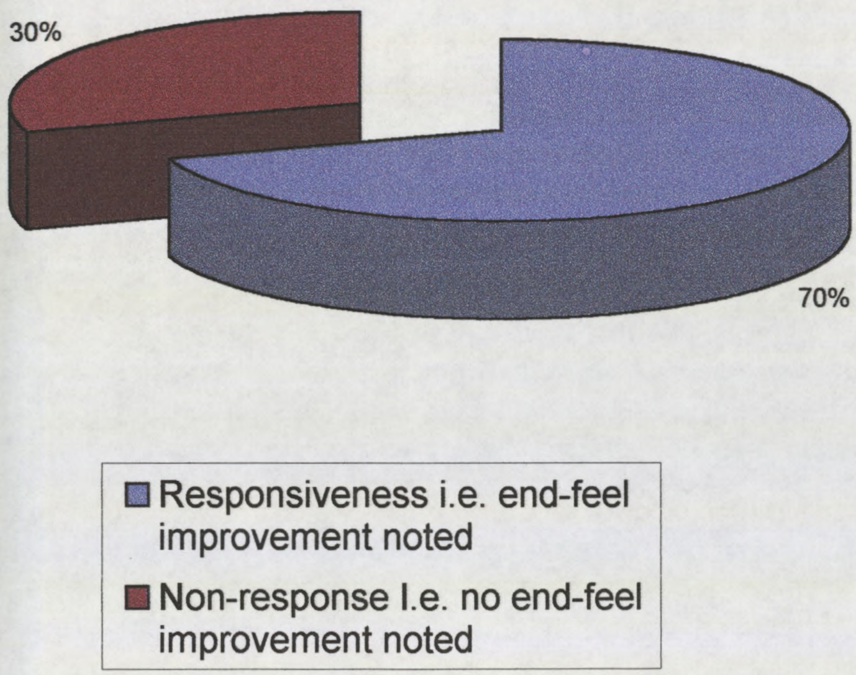


Figure 2. Pie graph showing percentage responsiveness of symptomatic patients receiving placebo treatment in the form of de-tuned ultrasound.

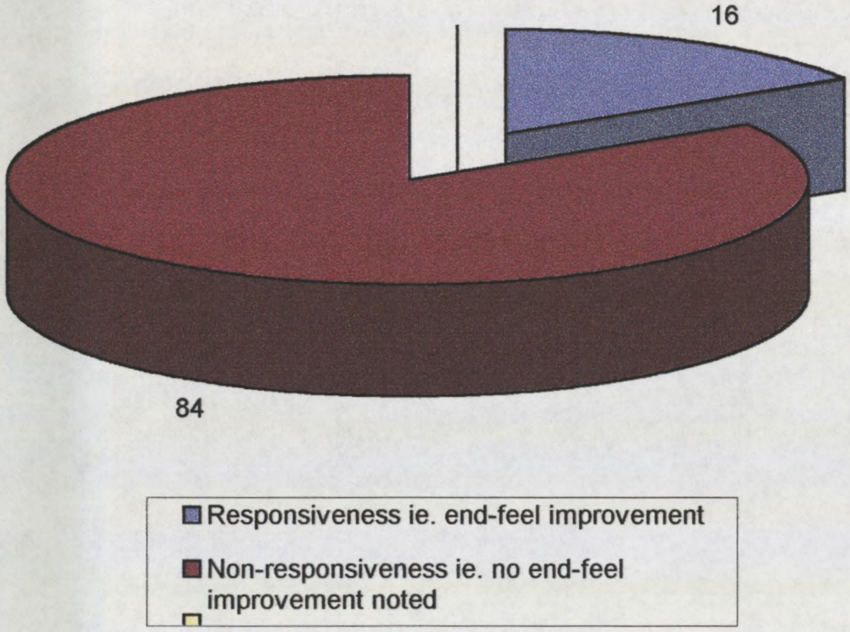


Figure 3. Pie graph showing percentage responsiveness of asymptomatic patients receiving Spinal Manipulative Therapy.

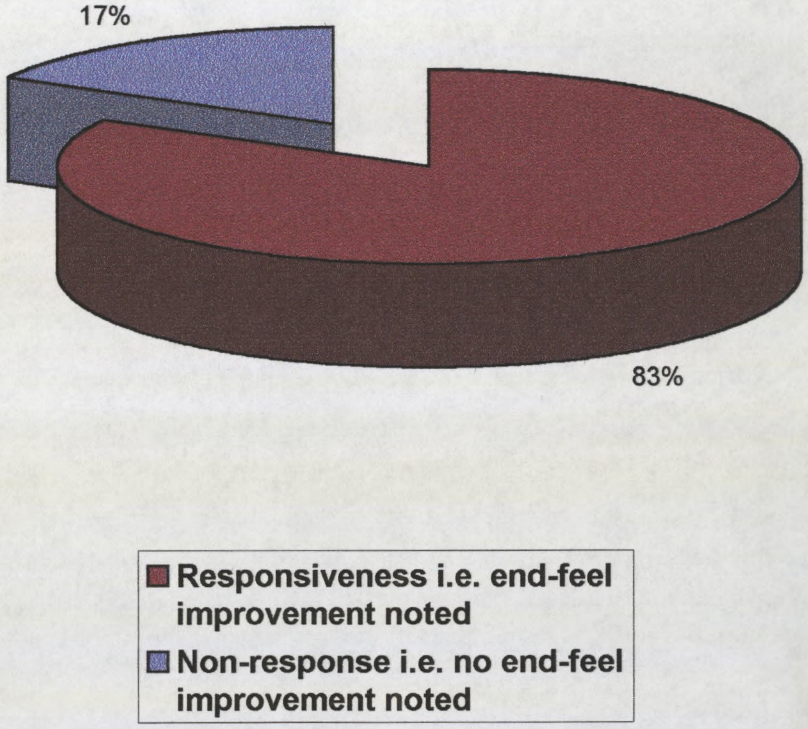


Figure 4. Pie graph showing percentage responsiveness of asymptomatic patients receiving placebo treatment in the form of de-tuned ltrasound.

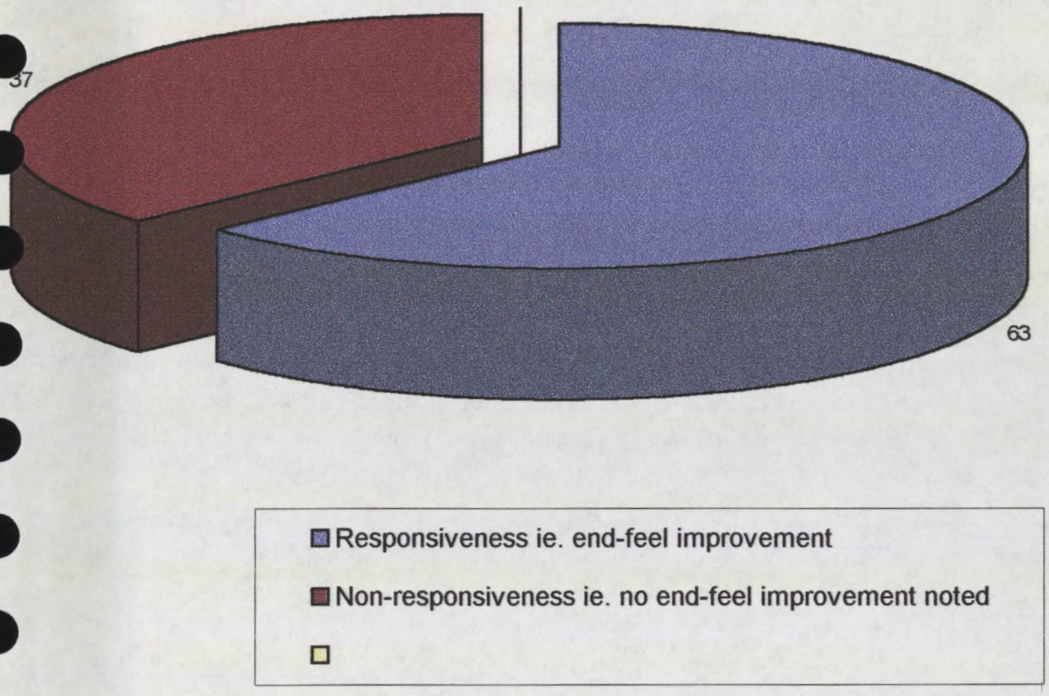
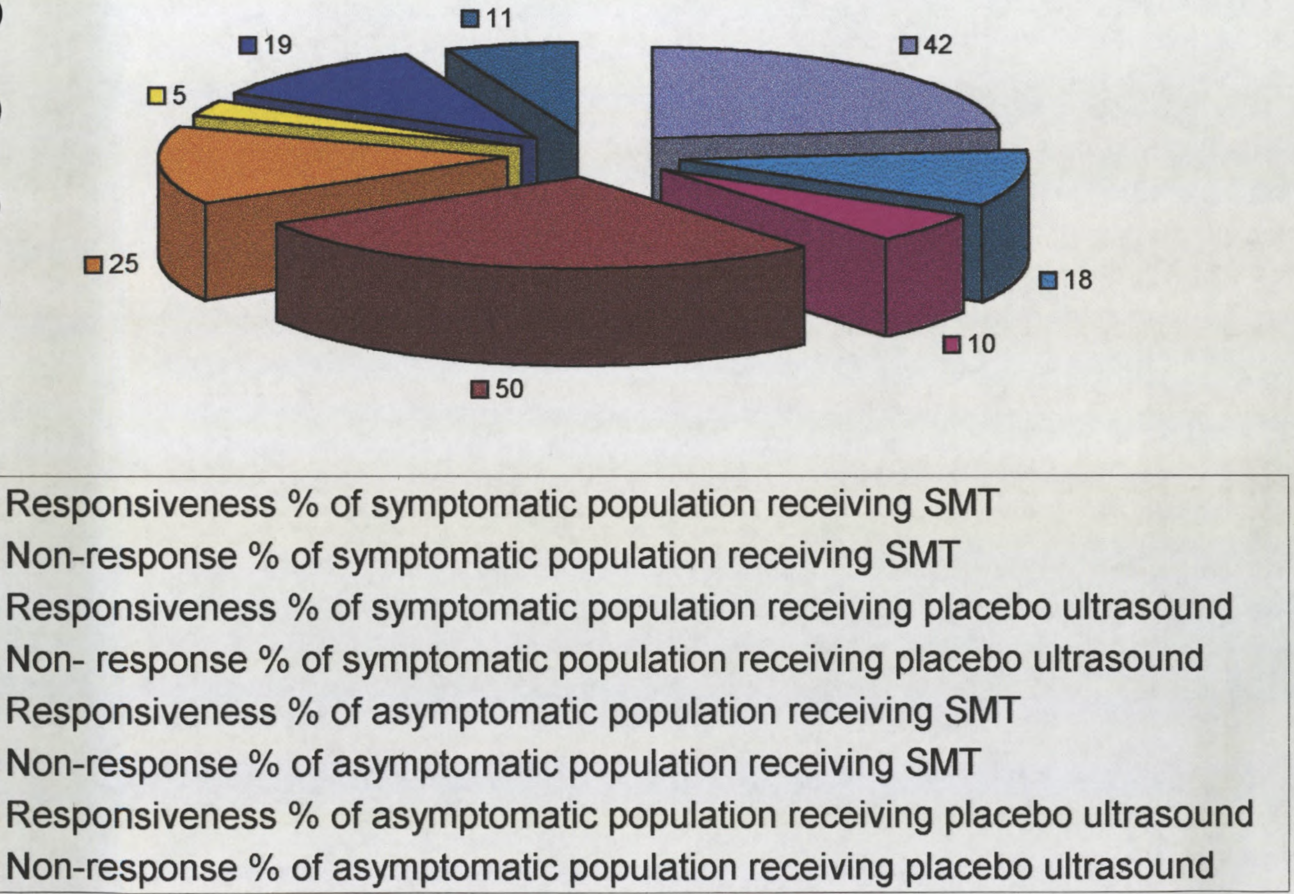


Figure 5. Pie graph showing percentage responsiveness of the Total Population receiving both Spinal Manipulative Therapy and Placebo treatment in the form of de-tuned ultrasound.



4.4.4 Calculating RRAM:

RRAM refers to the relative response attributable to the manoeuvre, and is calculated using the equation seen below in the table.

Table 22

Calculation of the Rm, the Rn, and the RRAM for the total population, as well as the symptomatic and asymptomatic populations separately.

	Rm (%)	Rn (%)	RRAM = %(Rm-Rn)/Rm
Total population	74	32	56.76%
Symptomatic population	70	16	77.14%
Asymptomatic population	83	63	24.09%

From the above table, the following information can be retrieved:

1) More than half of the response in the total population was attributable to spinal manipulation (RRAM = 56.76%).
2) More than three quarters of the response in the symptomatic population, was attributable to spinal manipulation (RRAM = 77.14%).
3) Less than one quarter of the response in the asymptomatic population, was attributable to spinal manipulation (RRAM = 24.09%).

4.4.5 Statistical Analysis of Motion Palpation Correlation Using Cohen's Kappa Co-efficient

Table 23

Statistical analysis of the motion palpation correlation between the two examiners with regard to level, side and direction of loss of motion chosen in the total population (refer to figure 6).

	K	Po	Pc	Se	Z	L	Confidence Interval K∈(K-L,K+L)
Level	0.2719	0.5944	0.4429	0.1132	2.4006	0.222	(0.0499, 0.494)
Side	0.4618	0.7555	0.5457	0.1770	2.6090	0.3469	(0.1149, 0.8088)
Direction	0.1501	0.5611	0.4835	0.1216	1.2336	0.2385	(-0.0882, 0.3886)

Statistically significant correlation was found with regard to levels and side of the cervical segments chosen ($Z>1.96$), but not with regard to the direction of loss of motion chosen ($Z<1.96$).

Figure 6. Statistical analysis of the motion palpation correlation between the two examiners with regard to level, side and direction of loss of motion chosen in the total population.

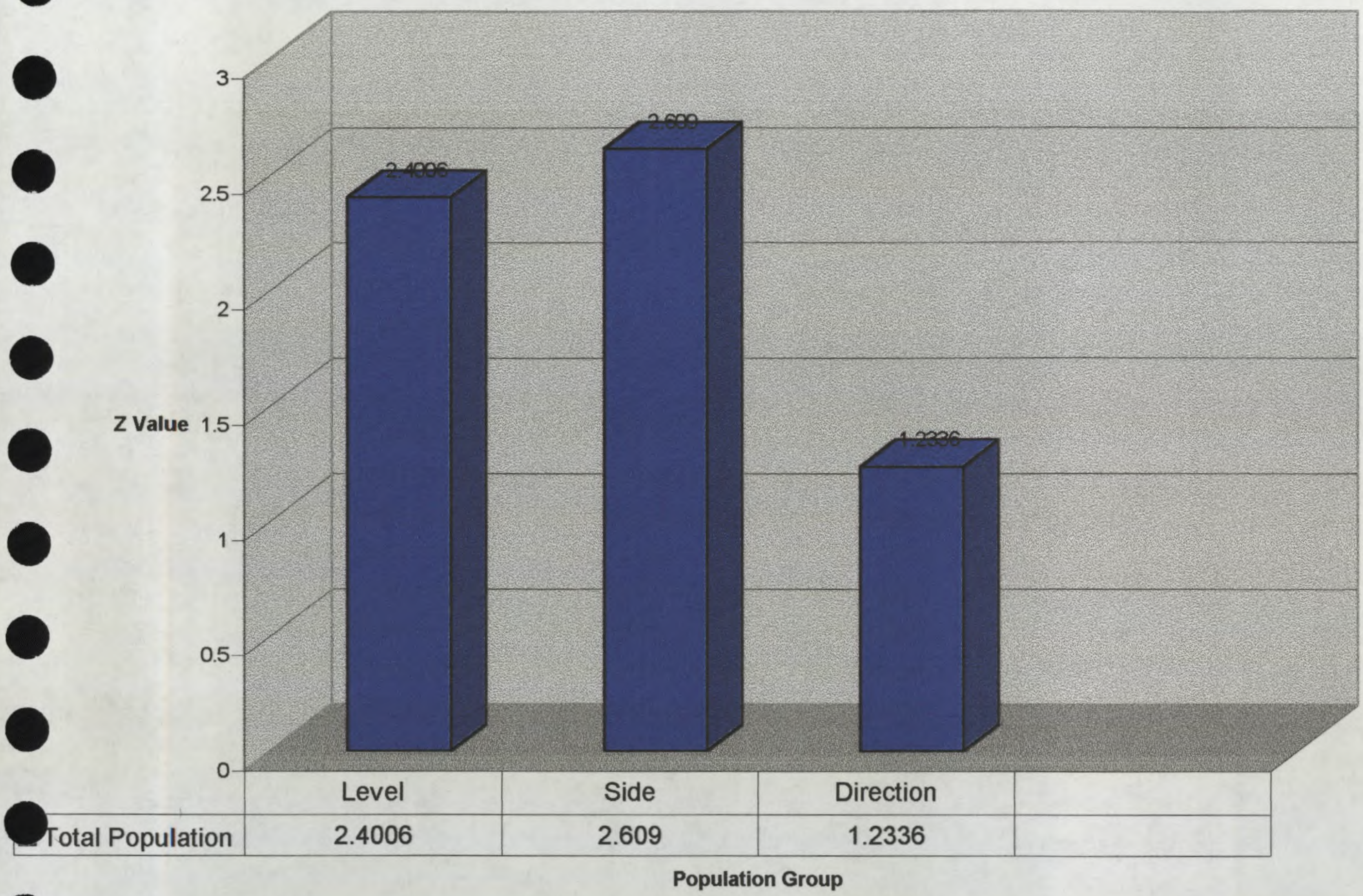


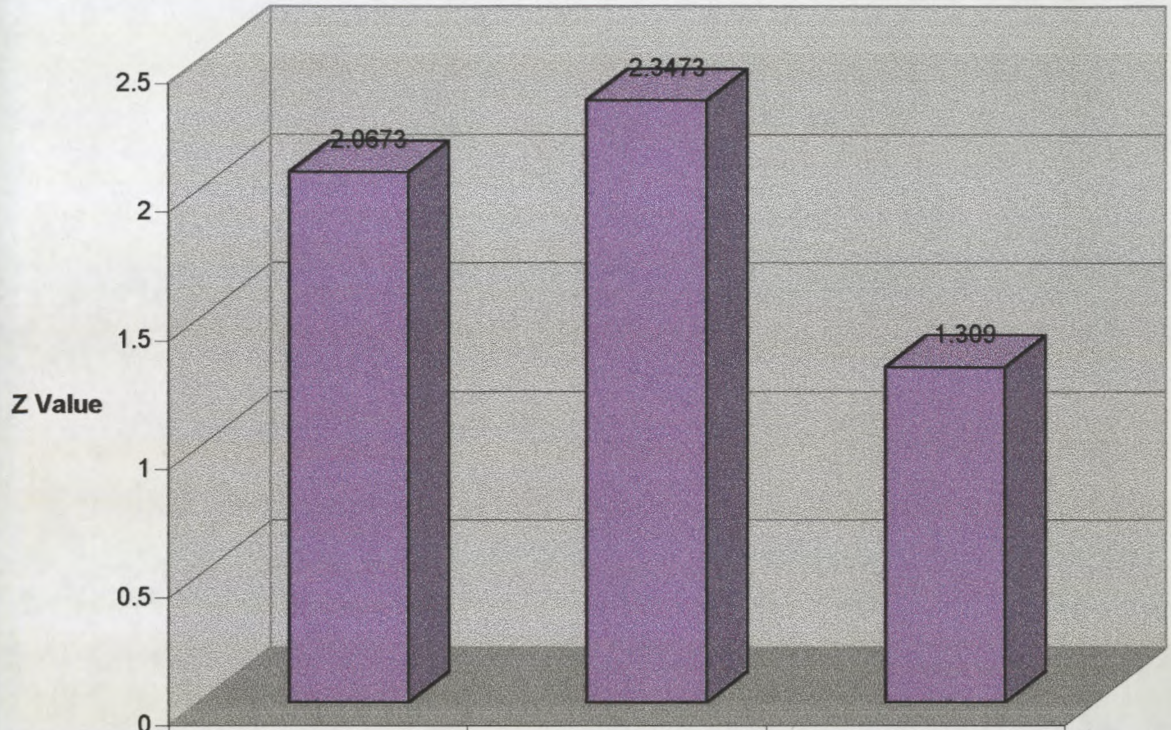
Table 24

Statistical analysis of the motion palpation correlation between the two examiners with regard to level, side and direction of loss of motion chosen in the symptomatic population (refer to figure 7).

	K	**Po**	**Pc**	**Se**	**Z**	**L**	**Confidence Interval** **K∈(K-L,K+L)**
Level	0.2899	0.5916	0.4249	0.1402	2.0673	0.2748	(0.015,0.5648)
Side	0.5126	0.7916	0.5725	0.2184	2.3473	0.428	(0.0845, 0.9407)
Direction	0.1939	0.6	0.5037	0.1481	1.3090	0.2904	(-0.0964, 0.4843)

Statistically significant correlation was found with regard to levels and side of the cervical segments chosen ($Z>1.96$), but not with regard to the direction of loss of motion chosen ($Z<1.96$).

Figure 7. Statistical analysis of the motion palpation correlation between the two examiners with regard to level, side and direction of loss of motion chosen in the symptomatic population.



	Level	Side	Direction
Symptomatic Population	2.0673	2.3473	1.309

Table 25

Statistical analysis of the motion palpation correlation between the two examiners with regard to level, side and direction of loss of motion chosen in the asymptomatic population (refer to figure 8).

	K	Po	Pc	Se	Z	L	Confidence Interval K∈(K-L,K+L)
Level	0.2405	0.6	0.4733	0.1886	1.2747	0.3697	(-1292, 0.6102)
Side	0.3595	0.6833	0.5055	0.3013	1.1932	0.5905	(-0.0231, 0.9501)
Direction	0.0792	0.4833	0.4388	0.2044	0.3874	0.4006	(-0.3214, 0.4798)

No statistically significant correlation was found with regard to levels, sides or the direction of loss of motion chosen ($Z<1.96$).

❖ A summary of the above 3 tables can be seen in figure 9 on page 80.

Figure 8. Statistical analysis of the motion palpation correlation between the two examiners with regard to level, side and direction of loss of motion chosen in the asymptomatic population.

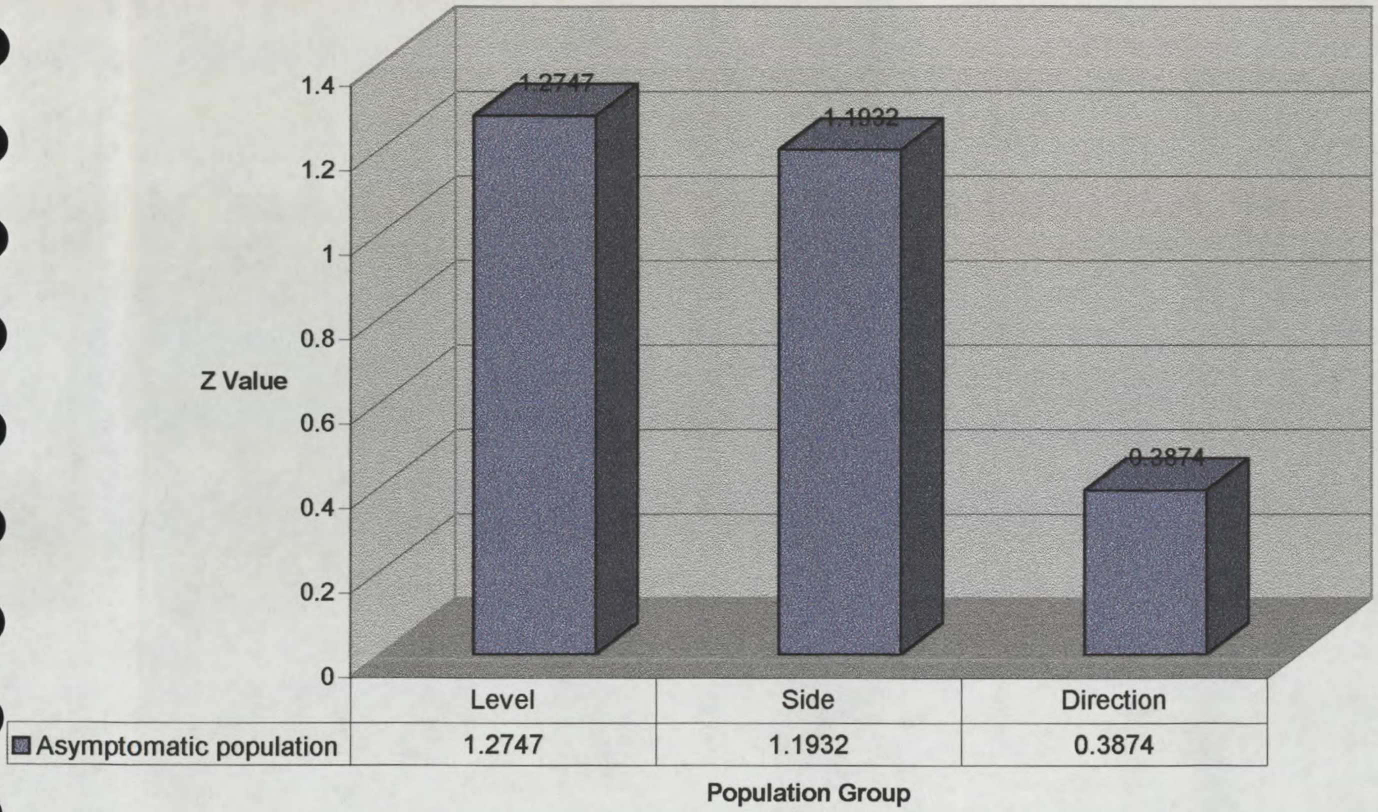
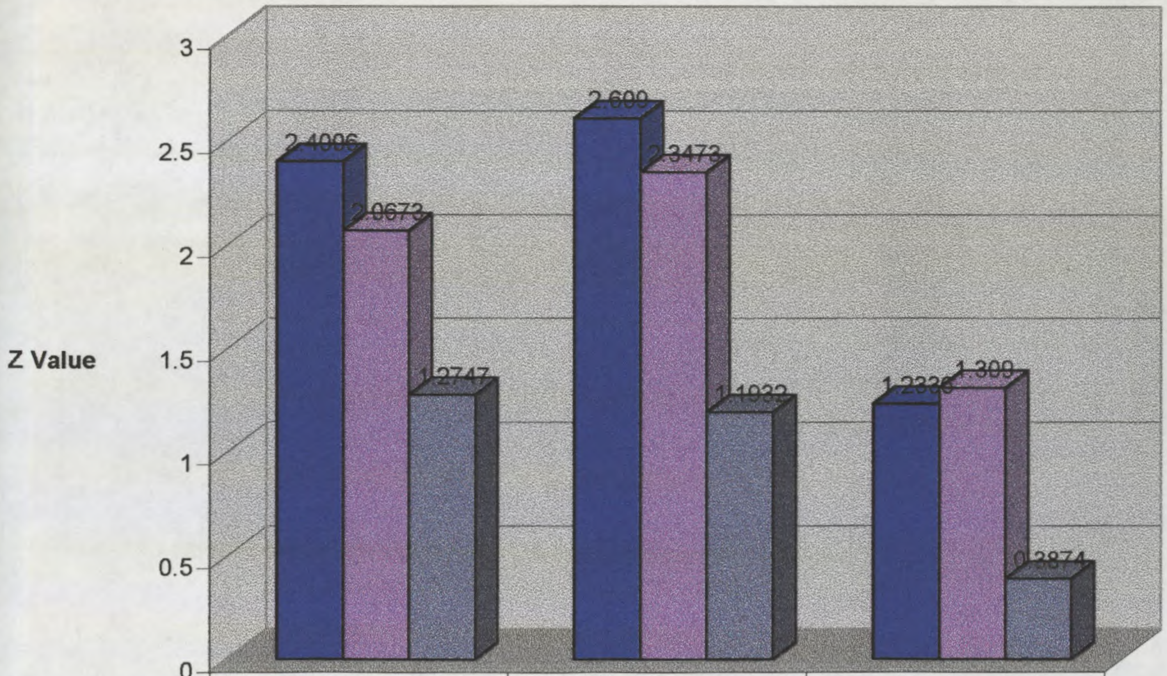


Figure 9. Summary of the motion palpation correlation between the two examiners with regard to level, side and direction of loss of motion in the total population, as well as the symptomatic and asymptomatic populations separately.



	Level	Side	Direction
Total Population	2.4006	2.609	1.2336
Symptomatic Population	2.0673	2.3473	1.309
Asymptomatic Population	1.2747	1.1932	0.3874

Population Group

Table 26

Cumulative statistical analysis of the motion palpation correlation between the two examiners in the total population.

a) statistical correlation of levels chosen

b) statistical correlation with regard to side chosen, for only those visits wherein perfect correlation existed with regard to levels chosen

c) statistical correlation with regard to direction of restricted motion chosen, for only those visits wherein perfect correlation existed with regard to levels as well as side chosen (refer to figure 10).

	K	**Po**	**Pc**	**Se**	**Z**	**L**	**Confidence Interval** $K \in (K-L, K+L)$
a) Level	0.2719	0.5944	0.4429	0.1132	2.4006	0.222	(0.0499, 0.494)
b) Side	0.5646	0.8037	0.5492	0.1758	3.2113	0.3446	(0.22, 0.9092)
c) Direction	0.2688	0.6046	0.4593	0.1303	2.0622	0.2554	(0.0133, 0.5243)

Statistically significant correlation was found with regard to side, as well as direction of loss of motion of the cervical segments chosen ($Z>1.96$).

Figure 10. Cumulative statistical analysis of motion palpation correlation in the total population.

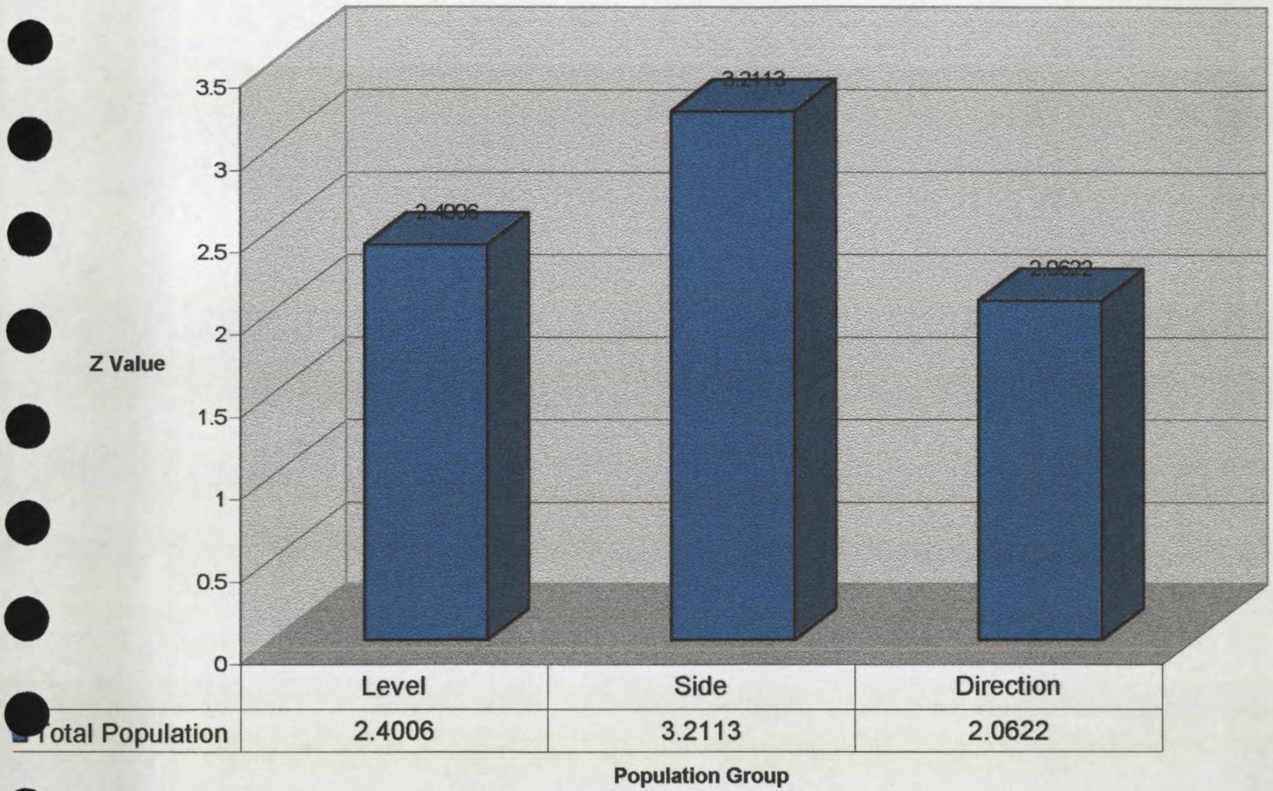


Table 27

Cumulative statistical analysis of the motion palpation correlation between the two examiners in the symptomatic population.

a) statistical correlation of levels chosen

b) statistical correlation with regard to side chosen, for only those visits wherein perfect correlation existed with regard to levels chosen

c) Statistical correlation with regard to direction of restricted motion chosen, for only those visits wherein perfect correlation existed with regard to levels as well as side chosen (refer to figure 11).

	K	**Po**	**Pc**	**Se**	**Z**	**L**	**Confidence Interval** $K \in (K-L, K+L)$
a) Level	0.2899	0.5916	0.4249	0.1402	2.0673	0.2748	(0.015, 0.5648)
b) Side	0.5376	0.8028	0.5734	0.2110	2.5474	0.4136	(0.1239, 0.9513)
c) Direction	0.1468	0.5438	0.4653	0.1428	1.027	0.2799	(-0.1331, 0.4267)

Statistically significant correlation was found with regard to side of the cervical segments chosen ($Z>1.96$), but not with regard to the direction of loss of motion chosen ($Z<1.96$).

Figure 11. Cumulative statistical analysis of motion palpation correlation in the symptomatic population.

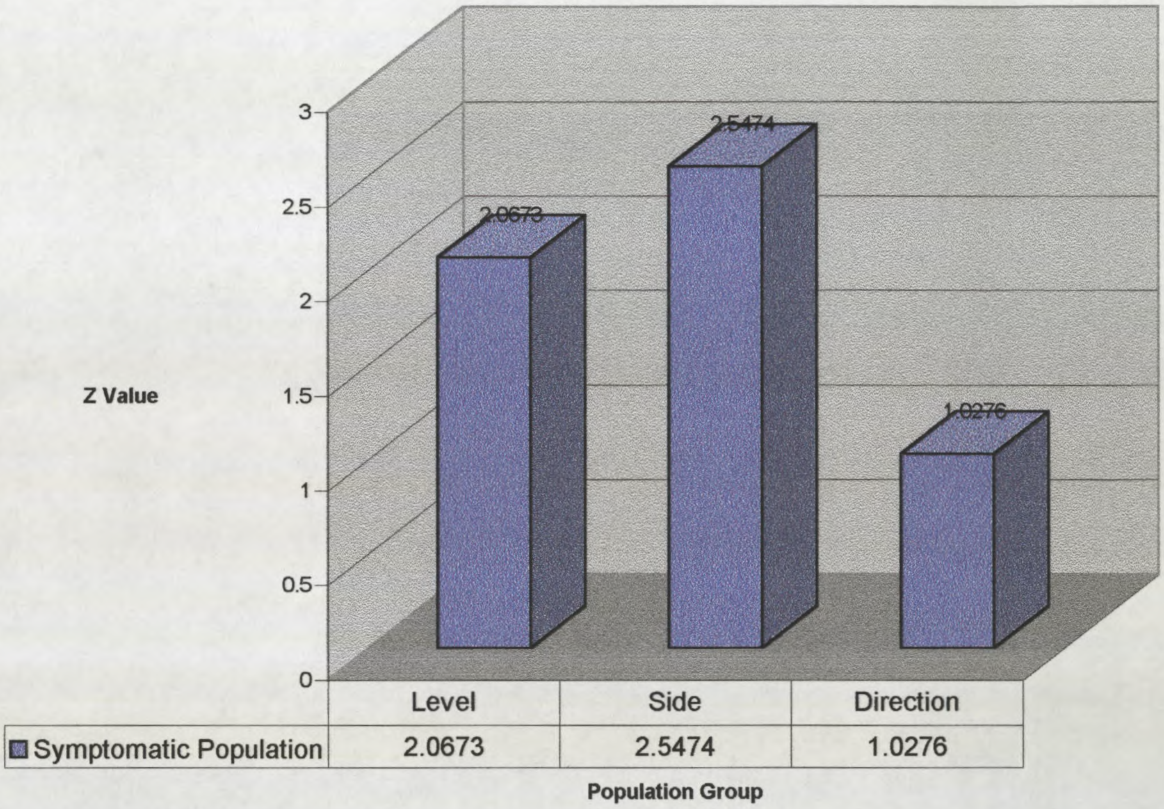


Table 28

Cumulative statistical analysis of the motion palpation correlation between the two examiners in the asymptomatic population:

a) statistical correlation of levels chosen

b) statistical correlation with regard to side chosen, for only those visits wherein perfect correlation existed with regard to levels chosen

c) statistical correlation with regard to direction of restricted motion chosen, for only those visits wherein perfect correlation existed with regard to levels as well as side chosen (refer to figure 12).

	K	**Po**	**Pc**	**Se**	**Z**	**L**	**Confidence Interval** $K \in (K-L, K+L)$
a) Level	0.2405	0.6	0.4733	0.1886	1.2747	0.3697	(-0.1292, 0.6102)
b) Side	0.5987	0.8055	0.5154	0.3115	1.9219	0.6105	(-0.0118, 1.2092)
c) Direction	0.0198	0.4137	0.4019	0.1941	0.1023	0.3805	(-0.3607, 0.4004)

No statistically significant correlation was found with regard to side of the cervical segments chosen, or with regard to the direction of loss of motion chosen ($Z<1.96$).

❖ A summary of tables 26, 27 and 28 can be seen in figure 13 on page 87.

Figure 12. Cumulative statistical analysis of motion palpation correlation in the asymptomatic population.

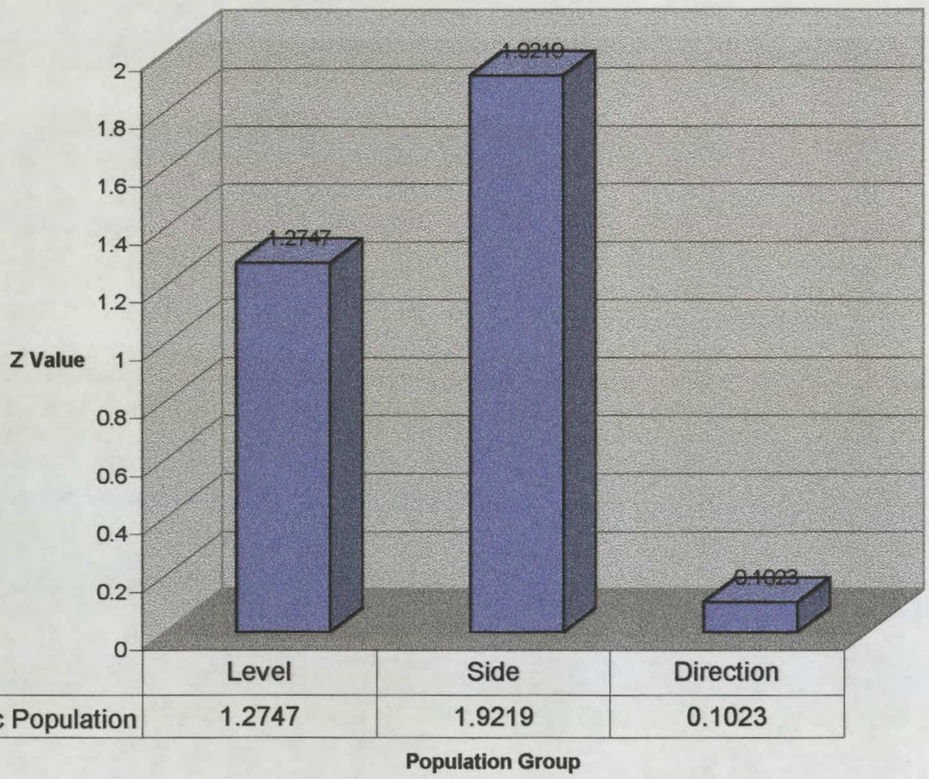
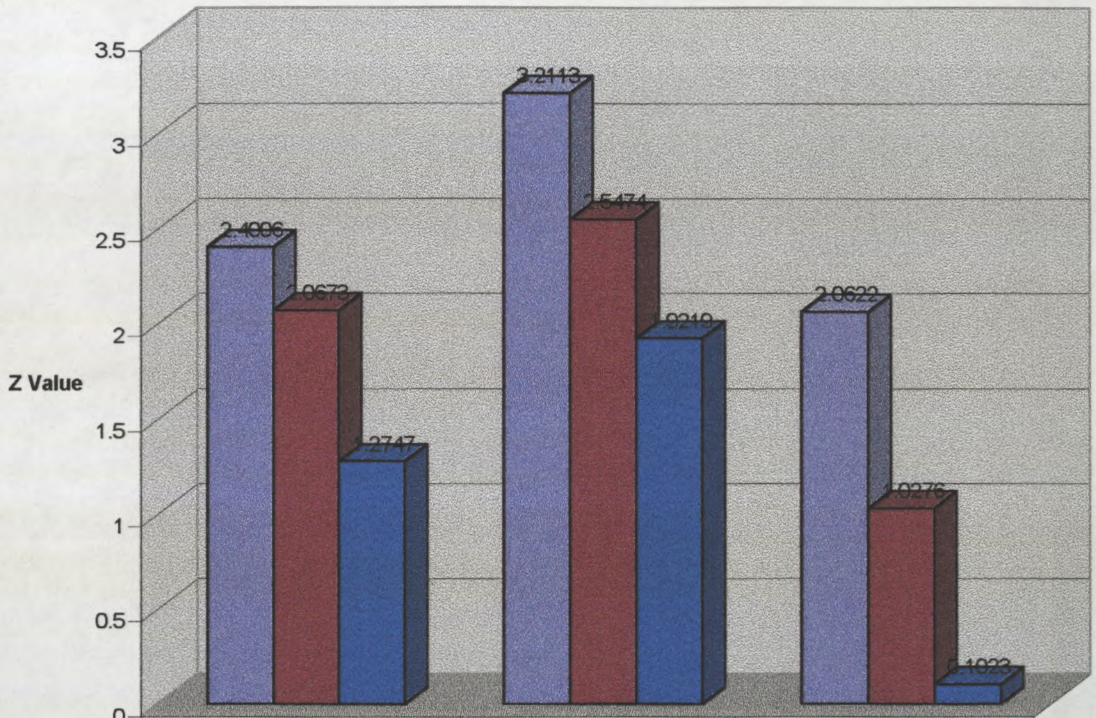


Figure 13. Summary graph illustrating the cumulative statistical analysis of motion palpation correlation in the total population, as well as the symptomatic and asymptomatic populations separately.



	Level	Side	Direction
Total Population	2.4006	3.2113	2.0622
Symptomatic Population	2.0673	2.5474	1.0276
Asymptomatic Population	1.2747	1.9219	0.1023

Population Groups

CHAPTER 5

DISCUSSION

This chapter constitutes a discussion based on the results obtained in the previous chapter. The sample size was divided randomly into two groups. One group received spinal manipulative therapy. The other group received placebo treatment in the form of de-tuned ultrasound. Both examiners recorded what they perceived to be the most fixated motion segment in the cervical spine. After treatment, the examiners were required to re-assess using motion palpation in order to record whether an improvement in the quality of end-feel was noted in the motion segment in question.

The efficacy of motion palpation as a post-adjustive tool was assessed using Pearson's chi-square method to assess it's sensitivity to change in a motion segment following manipulation. Table 18 represents data revealing the analysis of the end-feel response following manipulation in the total population. Results of the statistical analysis are tabulated in Table 21. At a 0.05 level of significance, the null hypothesis was rejected, and it was concluded that a strong association existed between receiving spinal manipulative therapy, and end-feel improvement. This implies that the blinded examiner was able to detect end-feel improvement in those patients that received spinal manipulative therapy, and no end-feel improvement in those patients that did not receive spinal manipulative therapy, to a statistically significant degree.

Tables 19 and 20 reveal the same data, but these tables contain data pertaining to the symptomatic group as well as the asymptomatic group separately. Results of the statistical analysis are tabulated in Table 21. At a 0.05 level of significance, the null hypothesis was rejected for the symptomatic group, and it was concluded that a strong association existed between receiving spinal manipulative therapy, and end-feel improvement. This again demonstrates that the blinded examiner was able to detect end-feel improvement in those patients that received spinal manipulative therapy, and no end-feel improvement in those patients that did not receive spinal manipulative therapy, to a statistically significant degree.

When assessing the asymptomatic population separately however, at a 0.05 level of significance, the null hypothesis was accepted, and it was concluded that a strong association failed to exist between receiving spinal manipulative therapy, and end-feel improvement. This demonstrates that there seemed to be end-feel improvement in the majority of the symptomatic group provided they had received spinal manipulative therapy. However, there seemed to be end-feel improvement in the majority of the asymptomatic group, whether they had received spinal manipulative therapy, or the placebo treatment.

The patient's responsiveness to the treatment (whether placebo or manipulation) was assessed by calculating the RRAM (relative response attributable to the manoeuvre). The results for the RRAM (seen in Table 22) were interpreted as follows:

1. More than half of the relative response in the total population was attributable to spinal manipulation (RRAM = 56.76%).
2. More than three quarters of the relative response in the symptomatic population, was attributable to spinal manipulation (RRAM = 77.14%).

3. Less than one quarter of the relative response in the asymptomatic population, was attributable to spinal manipulation (RRAM = 24.09%).

With regard to the total population, the response of the motion restriction to spinal manipulation (Rm) was 74%, in contrast with the 32% response (Rn) in the control group. This means that end-feel improvement was noted in 74% of the 90 observations in which patients received spinal manipulative therapy, whereas end-feel was noted in only 32% of the 90 observations in which patients did not receive spinal manipulative therapy. Once again, this data was separated into data pertaining to the symptomatic population, and to the asymptomatic population. In the symptomatic population, the response of the motion restriction to spinal manipulation (Rm) was 70%, in contrast with the 16% response (Rn) in the control group. This means that end-feel improvement was noted in 70% of the 60 observations in which patients received spinal manipulative therapy, whereas end-feel was noted in only 16% of the 60 observations in which patients did not receive spinal manipulative therapy. Thus, it can be seen that the response in this group to placebo treatment was far less than the group receiving spinal manipulation, and that the response dropped to half that of the response to placebo treatment in the total population.

In the asymptomatic population, the response of the motion restriction to spinal manipulation (Rm) was 83%, in contrast with the 63% response (Rn) in the control group. This means that end-feel improvement was noted in 83% of the 30 observations in which patients received spinal manipulative therapy, whereas end-feel was noted in 63% of the 30 observations in which patients did not receive spinal manipulative therapy. Thus, it can be seen that the response in this group to placebo treatment was very high when compared to that of the response to placebo treatment in either the total population, or the symptomatic population. This means that in 63% of these 30 observations, end-feel improvement was noted even in the group not receiving spinal manipulative therapy.

An important reason for the perceived improvement in the end-feel of the motion segment in the asymptomatic population, regardless of whether they received spinal manipulative therapy or placebo, could be due to the fact that the fixations were probably muscular fixation, and were therefore minor fixations. As can be extrapolated from Table 25, motion palpation correlation was not found to be reliable in the asymptomatic population. The fixations themselves were very difficult to motion palpate, so it was obviously even more difficult to assess for any change in the quality of this fixation after treatment. Although a difficult task to perform, it would be very beneficial if future studies could develop a grading system to assess fixations before and after treatment. This might prove impossible for the asymptomatic population, since the fixation itself was unable to be found and agreement upon. However, if this could be developed for the symptomatic population at least, it could prove to be a great asset to the motion palpation technique. The practical problem with this however, is that it will be very difficult to teach, as every palpators interpretation of the grade of the fixation might be different. It would also require a lot of practice if it is to be used for a research study. A positive point about developing this grading system, is that even though the inter-examiner reliability may prove to be low, it is only really required in practice that each practitioner develop their own grading system from which they can assess whether the fixation originally palpated has improved. In other words, for the purpose of improving methods to monitor patient progress in one's practice, the skill of assessing change in the motion segment needs to be mastered, not inter-examiner reliability.

At this point, it is quite important to report an interesting experiment performed in this study. At the first visit of all thirty patients, Examiner A made a note of whether the fixation palpated was major (if the patient was believed to be symptomatic) or minor (if the patient was believed to be asymptomatic). Examiner A was blinded as to the type of treatment received by each patient, as well as to whether the patient was symptomatic or asymptomatic. It is very interesting to note that in a high majority of cases, Examiner A recorded minor fixations for the asymptomatic population. However, major fixations were recorded for the symptomatic population. This lends support that Examiner A could determine whether the patient was a symptomatic patient, or an asymptomatic patient, just on the basis of motion palpation. Realizing that this is a difficult task, it becomes obvious that it was possible for examiner A to accomplish this due to sixteen years of clinical practice and lecturing experience, the latter of which involved hands on training of chiropractic students on the motion palpation technique. The purpose of including this experiment in this study, is to provide support that it is possible to master the art of motion palpation to such a high level. It is mentioned here with the hope that, upon reading this dissertation, other practitioners, and chiropractic students will be encouraged to try to develop their motion palpation skills to this level.

As was reported by De Boer et al. (1985), stress put on subjects by consecutive examination, might cause subluxations to occur, or as in this case 'remove subluxations that are already present'. Carmichael (1987) suggested this as well, stating that "the testing procedure when performed repeatedly may alter sacro-iliac mobility". In view of this information, another reason for perceived improvement in the quality of end-feel could be due to the repeated motion palpation performed on these minor fixations. Both examiners motion palpated initially to determine the most fixated joint, and then again, to check if there was a change/improvement in the quality of the motion segment after treatment. This resulted in each patient being motion palpated 4 times at each visit. This repeated motion palpation could possibly have 'removed the fixations' originally palpated. Other reasons could possibly include the light massage received from the de-tuned ultrasound head, or the change in position of the neck while walking to the ultrasound treatment room, while getting comfortable for the ultrasound treatment, or while waiting in the room to be re-motioned.

Haas (1995) has criticised past research on inter-examiner reliability of motion palpation, based on the fact that a kappa co-efficient was not used to statistically analyse the data. Therefore, Cohen's kappa co-efficient was used to measure the inter-examiner reliability of motion palpation. These results are represented in tables 23, 24 and 25. Statistically significant correlation was found ($Z>1.96$) with regard to levels of the cervical segments chosen (C0-C7), between the two examiners, when assessing the total population, and when assessing the symptomatic population separately. However, this was not demonstrated when the asymptomatic population was assessed separately.

With regard to levels chosen, it is interesting to note that examiners A and B correlated more on certain levels namely C0-C1, C1-C2, C6-C7 and C7-T1, as compared to the mid-cervicals. In fact, C3-C4 and C4-C5 were never chosen as the most fixated level in any patient by either of the two examiners. Fixations were present in these segments, however they were not perceived as the primary fixation in the cervical spine. The reason for this is unknown, but could possibly be due to the biomechanics as well as the higher stress loads in the mid-cervical region. This demonstrates that most fixations in this population were found in the upper and lower cervicals, rather than the mid-cervicals, which are often the more commonly manipulated segments by certain practitioners in the field.

A statistically significant correlation ($Z > 1.96$) with regard to which side the fixation was located (whether on the right or left) was noted between the two examiners, when assessing the total population and the symptomatic population. However, this was again not demonstrated when the asymptomatic population was assessed separately.

Statistically significant correlation ($Z < 1.96$) was noted with regard to direction (flexion, extension, lateral flexion, anterior to posterior rotation or posterior to anterior rotation) when assessing the total population, but not when assessing the symptomatic and asymptomatic populations separately. The deficiency in correlation with regard to direction of loss of motion could be due to the fact that it is possible for a joint to be fixated in more than one direction at any one time. Examiner B could have chosen one of these such directions of restriction present at the time, but due to inexperience, was unable to determine the primary direction in which the joint was restricted. This demonstrates that although a few years were sufficient for examiner B to learn which level, and which side to adjust, more experience is required to determine the finer detail, this being the primarily fixated direction that allows one to decide which direction to thrust in (the line of drive).

These above tables, lend support that when assessing the total population, as well as the symptomatic population separately, motion palpation was a sensitive diagnostic tool. However, support was provided that motion palpation was an insensitive diagnostic tool when attempting to assess for fixations in the asymptomatic population. With regard to direction of loss of motion, this study suggested that motion palpation was an insensitive diagnostic tool when assessing the total population, as well as the symptomatic asymptomatic populations separately.

Haas et al.(1995) criticised research done by Bergstrom and Courtis (1987) because the authors only evaluated the two criteria used in their study on separate occasions, and did not build their data in a serial examination. Thus, this building up of data in a serial examination was attempted in this study. In order to acquire a collective indication of motion palpation reliability, information regarding agreement with regard to the side chosen was extracted from those visits in which there was agreement with regard to the level chosen as seen in table 3. Of the total of 180 visits, correlation occurred (the same level was chosen by both examiners A and B at the same visit of the same patient) 107 times. The data captured at these 107 visits were used to check correlation with regard to the side chosen (right or left). This can be seen in table 6. Correlation was found 86 times out of the subtotal of 107. Once again, the data captured at these 86 visits were transferred onto table 7 to check the correlation for the direction of loss of motion chosen. Correlation for direction was found 52 out of the 86 total. This data underwent statistical analysis (Table 26). At a 0.05 level of significance, the null hypothesis was rejected, and it was concluded that significant correlation existed with regard to the side chosen. With regard to direction of restricted motion, the null hypothesis was accepted, and it was concluded that significant correlation did not exist.

In the same manner, a collective indication of motion palpation reliability was extracted in the symptomatic population, using the total of 120 visits (table 8). Out of the 120 visits, the same level was chosen by both examiners A and B 71 times. The data captured at these 71 visits were used to check correlation with regard to the side chosen (right or left). This can be seen in table 11. Correlation was found 57 times out of the subtotal of 71. Once again, the data captured at these 57 visits were transferred onto table 12 to check the correlation for the direction of loss of motion chosen. Correlation for direction was found 31 out of the 57 total. This data underwent statistical analysis (Table 26). At a 0.05 level of significance, the null hypothesis was rejected, and it was concluded that significant correlation existed with regard to the side chosen. With regard to direction of restricted motion, the null hypothesis was accepted, and it was concluded that significant correlation did not exist.

Similarly, a collective indication of motion palpation reliability was extracted in the asymptomatic population, using the total of 60 visits (table 13). Out of the 60 visits, the same level was chosen by both examiners A and B 36 times. The data captured at these 36 visits were used to check correlation with regard to the side chosen (right or left). This can be seen in table 16. Correlation was found 29 times out of the subtotal of 36. Once again, the data captured at these 29 visits were transferred onto table 17 to check the correlation for the direction of loss of motion chosen. Correlation for direction was found 12 out of the 29 total. This data underwent statistical analysis (Table 26). At a 0.05 level of significance, the null hypothesis was accepted, and it was concluded that significant correlation did not exist with regard to the side chosen, or with regard to direction of restricted motion chosen. The null hypothesis was accepted even with regard to levels chosen, and it was concluded that significant correlation did not exist.

Many studies have been attempted to assess the inter-examiner reliability of motion palpation. Some, as referenced in chapter two on page 19, have provided support that motion palpation is reliable, whereas others have not. The present study lends support that motion palpation is a reliable pre- and post treatment diagnostic tool where the symptomatic population is concerned. When assessing the asymptomatic population however, this study provided support that motion palpation was an unreliable diagnostic both pre- and post-treatment.

In the study performed by Mior et al. (1985) it was found that the inter-examiner agreement beyond chance was variable with a kappa value between 0.15 and 0.52. In a study done by Carmichael (1987) analysis of intra-examiner reliability, it was found that the Gillet test is fairly reliable, and inter-examiner reliability was only mildly supported. The two studies above used kappa co-efficient to analyse their data. In a study by Bergstrom and Courtis (1986), percentage agreement of motion palpation was assessed. The total number of possible positive findings were 500 (100 subjects x five lumbar vertebrae), out of which 372 were found. The mean percentage agreement was found to be 74.8 percent. In my study, the total number of observations were 180, therefore out of the total 180 possible correlations, 107 were found for level, 136 for side, and 101 for direction of loss of motion. The mean percentage agreement for level was 59.4%, for side was 75.5%, and for direction was 56.1%. This demonstrates that the highest percentage agreement between the two examiners was for side of the restriction, the next was for the level of the restriction, and the lowest was for the direction of loss of motion.

A study by Leboeuf et al. (1989) reported that motion palpation had a significantly higher intra-examiner reliability than inter-examiner reliability. Data was analysed in terms of percentage agreement, and kappa co-efficient was not used. In a study done by Love and

Brodeur (1987), analysis of the data using a Pearson product moment correlation (r) for each of the examiners, revealed statistically significant agreement for intra-examiner reliability. Inter-examiner reliability however, was not statistically significant. Boline et al. (1988) studied inter- and intra-examiner reliability for pain, paraspinal tonicity, and motion palpation. Their research revealed weak to no reliability depending on the evaluative procedure and articulation tested. Inter-examiner reliability at each joint was evaluated using kappa co-efficient. Thus, it can be seen that of these three studies, the study by Boline et al. was the only one to use the acceptable statistical method of analysis for motion palpation reliability.

In the present study, intra-examiner reliability was not assessed. Inter-examiner reliability as well as motion palpation's sensitivity to change in a motion segment was assessed. The present study lends support that in the cervical spine, motion palpation is a reliable pre- and post-treatment diagnostic tool where the symptomatic population is concerned. When assessing the asymptomatic population however, this study lends support that motion palpation was an unreliable diagnostic tool both pre- and post-treatment.

With the exception of the study performed by LeBoeuf et al. in which five treatment visits were required per patient, only one visit was required per patient in the other studies mentioned. The present study required that each patient be seen and treated six times. The reason for this is threefold:

1. This continuous treatment and assessment of research patients allowed one to mimic the treatment pattern received by patients out in the field. This allowed a clearer and

perhaps more objective analysis of the effect of treatment than would have been possible with just one treatment session.

2. With two thirds of the patients being walk-in symptomatic patients at the clinic, it seemed only ethical to ensure that they received treatment in a similar style to those patients not partaking in research studies. This meant more than just one treatment during the research study, and after the study was complete, offering to try other treatment methods available at the clinic (including manipulation for the placebo group, as well as mobilisations, stretches and strengthening exercises for the neck muscles, interferential current, and ultrasound to name a few), on any patients who had not been significantly relieved of their pain.

3. This being a pilot study, a small sample size of thirty patients were used. However, in order to compensate for this small sample size, each patient was treated six times, resulting in a total of 180 visits and therefore, 180 observations from which to collect and analyse data. At each of these 180 visits, both examiners were required to record what they perceived to be the most fixated motion segment at the time, and whether the quality of end-feel improved after treatment, or remained the same. Thus, 180 records were made per examiner. Two examiners were used in this study resulting in 360 records that underwent statistical analysis to assess inter-examiner reliability. This aided in making the findings of this study stronger than if the thirty patients were seen once, as is the case with many studies assessing the reliability of motion palpation. These studies however, generally compensate by including larger sample sizes.

Haas et al. (1995) questioned the generalizability of the study findings as the sample used in their study consisted solely of students, and therefore questioned the response rate in different patient populations. Based on the suggestions made in their article research was done on other patient populations consisting of mainly walk-in patients at the clinic as well as a small percentage of students. Different examiners were used in this study, and the present study was performed on the cervical spine as compared to the previous study done on the thoracic spine. This allowed the generalizability of the previous study findings to be determined. The present study provides support that motion palpation was sensitive to change after treatment, in the cervical spine, when performed on the symptomatic population, and when performed by the two examiners in the study. Thus, with regard to the symptomatic population, it can be seen that the present study supports the findings demonstrated in the study by Haas et al. (1995) that the overall improvement upon post-treatment motion palpation was noted in the group that was adjusted, as compared to those that were not adjusted.

Interpretation and discussion pertaining to tables 1-5 in chapter 4:

Table 1 reveals that there were many more females in the study, as compared to males. The distribution was thus uneven. Whether this was a coincidence or not is unknown, but the majority of people that phoned the clinic to enquire about the research in response to the advertisement, were females. This may not be the case in other research studies on cervical spine pain. If it is though, it might be possible to consider that more females suffer with neck pain than males. It could be possible, however, that although neck pain occurs in a higher percentage of males than is reflected in this study, they failed to respond to the advertisement due to other reasons such as unavailability of time, transport etc.

Table 2 reveals that a high percentage of subjects were in the 20-29 year age bracket. The age distribution was thus also uneven. Assessment of the symptomatic population alone revealed that only nine of the total twenty patients belonged to this age group. The distribution in this population was thus almost even. The problem was encountered when trying to obtain the ten asymptomatic patients. It seems obvious that subjects who are not suffering with neck pain do not have the time or inclination to volunteer themselves as patients to be included in the study. The chiropractic students at the Technikon however, are willing to assist fellow students performing research by volunteering as patients to be included in the study. It is in this manner that seven very helpful chiropractic students were included in the present study. Of the three remaining asymptomatic patients, two belonged to this age bracket as well. The uneven distribution therefore occurred in the asymptomatic population. This resulted in eighteen of the thirty patients in the study being from the 20-29 year age bracket.

Based on the 180 observations in Table 3 regarding levels chosen by the examiners, the following pattern can be noted:

- Level C1-C2 was by far the most commonly chosen. It was also the level most commonly associated with agreement between both examiners.
- Level C0-C1 was the second level commonly agreed upon by both examiners, followed by C6-C7, and then C7-T1.
- Levels C2-C3 as well as C5-C6 were never chosen by both examiners at the same visit.

- Level C4-C5 was never chosen as the motion segment with the most fixated joint. It was thus removed from the table altogether.
- This data indicates that inter-examiner reliability was much higher in the upper cervical spine, as compared to the lower cervical spine.
- The reason for this is not known, but it possibly indicates that motion in the higher segments is easier to feel than that of the lower segments. It could also be possible that these are the most commonly involved segments associated with neck pain.

Based on the 180 observations in Table 4 regarding the examiners choices as to which side the fixated was located in, the following pattern can be noted:

- The right side was more commonly chosen than the left. It was also the side more commonly associated with agreement between both examiners

Based on the 180 observations in Table 5 regarding direction of restricted motion chosen by the examiners, the following pattern can be noted:

- Lateral flexion was by far the most commonly chosen. It was also the direction most commonly associated with agreement between both examiners. A possible reason for this could be the anatomical position and biomechanics of the cervical spine. The articular pillars are more easily palpable from the lateral aspect of the spine bilaterally, due to the lateral projection of the transverse processes, as well as the decrease in muscular structures laterally as compared to posteriorly. Therefore, a fixation in lateral flexion would in effect be easier to determine via motion palpation. Biomechanically, lateral flexion is a coupled motion with rotation. This unique characteristic may predispose this motion to increased chances of mechanical fault and development of fixations. It is also possible that this movement is the most common fixation found in the cervical spine. However, further study is needed.

- Extension was the second direction commonly chosen and agreed upon by both examiners, followed by General fixation found at C0-C1.
- Anterior to posterior rotation and posterior to anterior rotation were chosen less commonly by the examiners, and were never chosen by both examiners at the same visit.
- Flexion was not chosen as the direction that the motion segment was most fixated. It was thus removed from the table altogether.

The following represent two cases that are important to mention:

1. In the case of the symptomatic patients in the age bracket of 60-69 years, it was found that despite the fact that they were being adjusted, no improvement was noted in the quality of end-feel by the blinded examiner. This is perhaps due to the fact that the extent of degeneration in the spine is much greater in elderly patients generally, compared to the degeneration in the spine of the younger patients.

   Another important factor that has possibly led to this scenario where no improvement was noted in the quality of end-feel after adjustment, is the type or chronicity of the fixation itself. As reported earlier on page 19, there are different types of fixations. The chiropractic thrust is very effective in setting the articulations in movement with the muscular type of fixation, only in the absence of ligamentous or articular fixations. An early physiological change seen in chronically fixated vertebral articulations is the shortening of ligaments. This type of fixation improve only slightly, immediately after each corrective treatment. The corrective effect of the chiropractic adjustment on the articular type of fixation is due to a forcing open of the articulation. The type of fixations present in these elderly patients were probably articular in nature, which usually require several manipulations before small amounts of movement, if any, can be felt in the joint.

2. Two symptomatic patients receiving spinal manipulative therapy showed no perceived change in the quality of end-feel upon re-motioning at each of the six treatments. At the end of the last visit, examiner A motion palpated the entire spine from the sacro-iliac joints to the cervical spine. Examiner A found at least two other fixations in the spine other than the cervical spine fixations. Examiner A adjusted these fixations, then adjusted the cervical fixation. It was amazing to note that upon re-motioning of the cervical spine, the fixation had cleared, or the quality of end-feel in that motion segment had improved. A possible reason for this is the theory of fixation complexes. It is possible to have fixations creating hypomobility in different areas that are inter-linked, creating a fixation complex or chain. In such a case, as seen in the example above, the correction of the fixation through manipulation in the cervical region alone, failed to improve the biomechanics of this motion segment. The other fixations possibly caused this particular fixation to recur. The hypomobility in the thoracic and

sacro-iliac region was indirectly linked to the hypomobility in the cervical spine. This was established at the end of the sixth visit, when correction of the lower fixations allowed the biomechanics of the cervical fixation to improve after adjustment. Thus, restoration of normal biomechanics and end-feel quality of the lower fixations indirectly led to the restoration of normal biomechanics in the cervical spine fixation.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Introduction.

The purpose of this study was to evaluate the efficacy and reliability of motion palpation as a post-adjustive diagnostic tool in the evaluation of the cervical spine. This study attempts to assess motion palpation's ability to determine change in a motion segment fixation following manipulation.

Panzer (1992) criticised the fact that clinical trials did not use palpatory findings to monitor spinal changes, and suggested that motion palpation should be applied, not only to clinical decision-making, but to patient monitoring as well. According to Ames (1987), one of the many observations obtained from motion palpation is the confirmation of effect after an adjustment. In keeping with this, the present study has attempted to monitor patient progress by motion palpating before and after treatment to determine whether any improvement has occurred in the motion segment in question.

Carmichael (1987), based on his research, was able to establish that in a clinic situation where the manipulative practitioner palpates the patient before and after a sacro-iliac manipulation, a meaningful post-adjustment assessment of the sacro-iliac mobility can be made. Similarly, the present study provides support that when assessing the symptomatic population, a meaningful assessment of cervical spine mobility can be made, when the practitioner palpates the patient before and after manipulation. It thus establishes that motion palpation is an effective post-adjustive tool that helps to determine whether the fixation has improved with the adjustment performed.

The fact that inter-examiner reliability showed statistically significant correlation within the symptomatic population of the study is a great asset to us, as it provides support that in a clinical setting, motion palpation is effective as a diagnostic tool in determining where to adjust.

Recommendations for future research based on the weaknesses in this study, include the following:

- Based on the unsuccessful treatment of the elderly patients in this study, it is recommended that more time be allocated when research is carried out on this age group, to allow a more in-depth assessment of the result of the manipulation on the quality of end-feel.

- Based on the observation mentioned in case two on page 102, it is recommended that a further study be performed on motion palpation, where the cervical spine is assessed for fixations, and these findings be used to assess motion palpation reliability. In order to assess it's sensitivity to change however, the examiner performing the adjustments should be allowed to adjust other areas of the spine that are fixated if the fixation in the cervical spine does not seem to be improving. The blinded examiner should then be allowed to once again only motion palpate the cervical spine to check if the quality of end-feel at that motion segment has improved, or remained the same.

- Although a very difficult task, to avoid the errors made in this research study as seen in case 1 and 2 discussed on page 101 and 102, it would be of great benefit to the researcher, if the type or chronicity of the fixation is taken into account when including patients into, or excluding patients from, the research study.

- Furthermore, the symptomatic patients included in the study must be asymptomatic in other areas of the spine. This might avoid errors such as the type discussed in case two (page 102), where, due to the presence of fixation complexes, fixations in other areas of the spine prevent the correction of the fixation in question.

- Statistical analyses performed on the asymptomatic population showed motion palpation was not reliable as a pre-adjustment tool, it's sensitivity to change after the adjustment was not accurate, and responsiveness after manipulation was not much better in the group receiving spinal manipulative therapy when compared with the group receiving placebo. Based on these results, it is recommended that the next study should include only symptomatic patients. This should increase the reliability of the motion palpation findings.

- This study assessed the reliability of motion palpation using two examiners. It is recommended that the next study should include more examiners to check if the reliability improves, remains the same, or reduces.

- It is highly recommended that future researchers should spend as much time or more on the rehearsal period, concentrating on aspects such which hand to use, how much force to apply, how long to motion palpate etc. The author strongly believes that if this time is allocated, motion palpation studies will prove to be more reliable.

- It is recommended that research on motion palpation reliability be performed on the extremities. There is limited research performed by chiropractors on extremities and it requires some serious attention. It will help establish that chiropractors are not only 'back doctors' as is assumed by much of the public, but that chiropractors are also successful at assessing and treating other areas of the body.

- An important error made in the present study was the exclusion of questionnaires such as the McGill pain questionnaire, and the Numerical Pain Rating Scale. Future research should include this to assess the relationship between improvement in symptomotology according to the patient, and improvement in the end-feel of the motion segment restriction. This would allow one to tie in the subjective response with the response as determined by the examiner.

- **Recommendations with regard to the sample population:**

❖ Due to the time constraint, this study only consisted of a sample group of thirty. A sample size of greater than thirty is recommended for future studies, as well as an increase in the number of visits per patient. This will increase the observations from 180 in this study to a higher number of observations.

❖ This study consisted of twenty two females, and only eight males. Future studies should attempt to include a more even distribution of males and females.

- In this study, eighteen of the total thirty were in the 20-29 year age bracket. The age brackets 30-69 consisted of only twelve of the total thirty. Future research should again attempt to include a more even age distribution.

Conclusion.

Statistical analysis indicates that motion palpation is not only a reliable diagnostic tool that can be used prior to treatment to determine where to adjust, but also, that it can be used as a post-adjustive diagnostic tool, to assess and confirm that 'the job has been done' and that the fixation has either been cleared or has improved by the manipulation performed in the cervical spine.

The results in this study reveal that there was very poor motion palpation reliability within the asymptomatic population compared to the symptomatic population. This emphasizes the point that in order for chiropractic students to really learn the art of motion palpation, practicing on symptomatic patients would be a more valuable exercise as compared to practicing on classmates, comprising of mostly asymptomatic subjects. This would also allow them to confirm that when expected to compare motion palpation findings with peers, the same motion segment can be chosen as the most fixated joint, by two or more examiners when assessing symptomatic patients.

It is believed by the author, that the 2 month rehearsal, as well as the 2 years of training received under Examiner A was the key factor that led to the good motion palpation correlation found in this study. This emphasizes the great need to consolidate our techniques, and form 1 universal method of motion palpation. If this goal is achieved, motion palpation studies worldwide will prove to be more reliable, and create a more positive attitude towards this aspect of the art of chiropractic. It is inevitable then, that chiropractic will be viewed by the public as well as other medical professions as a course that has a scientific basis, which is built upon the biomechanical structure and function of the body, and the maintenance and care thereof.

Furthermore, once the technique has been consolidated and a single universal method is created, greater emphasis on this motion palpation training in colleges will lead to a more standardised method of motion palpation worldwide, and therefore increase it's reliability. Chiropractors worldwide will have a greater confidence in this technique, and perhaps will begin using it in the clinical situation to determine where to adjust, as well as to re-motion to determine the effect of the adjustment. This will inevitably allow a higher standard of care for the patient.

Lewit and Liebenson (1993) stated that there is an acute need to objectively quantify a patient's progress, due to soaring health costs. In the era of the necessity to develop effective objective measurement to assess our patient's improvement, it would seem vital to our profession to be able to assess the effectiveness of manipulation. Since manipulation primarily affects the biomechanics of a joint, the tools used to assess any improvement, such as motion palpation, must be sensitive and accurate. This study provides support that motion palpation is an effective tool to assess this objective change in the cervical spine on symptomatic patients.

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