THE EFFECTIVENESS OF SPINAL MANIPULATION COMPARED TO PASSIVE OSCILLATORY MOBILIZATION IN THE MANAGEMENT OF CHRONIC MECHANICAL THORACIC SPINE PAIN

By

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DEDICATION

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ABSTRACT

The purpose of this study was to investigate the effectiveness of spinal manipulation compared to passive oscillatory mobilization in order to evaluate the more effective treatment in the management of chronic mechanical thoracic spine pain.

It was hypothesized that spinal manipulation and passive oscillatory mobilization would both be effective in the treatment of chronic mechanical thoracic spine pain.
It was further postulated that spinal manipulation would be comparatively more effective than passive oscillatory mobilization in terms of objective and subjective clinical findings.

This randomised controlled clinical trial consisted of a study population of 60, obtained by convenience sampling. Those patients diagnosed as suffering from chronic mechanical thoracic spine pain were randomly allocated to two groups of 30 each. One group received spinal manipulation and the other group passive oscillatory mobilization on the affected segments.

Both groups of patients received 5 treatments over a two-week period.
The subjective data was obtained by the use of the short-form McGill Pain Questionnaire and the Numerical Pain Rating Scale-101 Questionnaire. These were filled in by the patient before the first, third and fifth treatments. The objective data was acquired through the use of the algometer. Readings were taken before and after the first, third and fifth treatments.

Intra-group analysis of the short-form McGill Pain Questionnaire was done using the Wilcoxon Signed Ranks Test. The paired t-test was used for the Numerical Pain Rating Scale -101 Questionnaire and the Algometer Readings (intra-group analysis).
Inter-group analysis of the short-form McGill Pain Questionnaire was done using the Mann Whitney unpaired U test. The unpaired t-test was used for the Numerical Pain Rating Scale-101 Questionnaire and the Algometer Readings (inter-group analysis).
α was set at a 0.05 level of significance. The results were illustrated by means of tables and

bar-charts.

The results indicated that for intra-group comparison there was a significant improvement in both the spinal manipulation and mobilization groups for the short-form McGill Pain Questionnaire and the Numerical Pain Rating Scale-101 Questionnaire for the period between treatments 1 & 3, 3 & 5 and 1 & 5. This suggested that both spinal manipulation and passive oscillatory mobilization are effective manual interventions for reduction of quality of patients pain responses and pain intensity measurement. With regard to the algometer readings, only the mobilization group showed a significant improvement for the period between the first and the third treatments, the third and the fifth treatments and the first and the fifth treatments for measurements taken after the treatments. This was also evident for the period between the third and the fifth treatments for the mobilization group for measurements taken before the treatments. The reasons for this is unknown.

For inter-group comparison, the results revealed a significant difference between the two groups before the first, third and fifth treatments for the short-form McGill Pain Questionnaire.

For the Numerical Pain Rating Scale-101 Questionnaire, a significant difference was only evident between the two groups before treatments one and three.

Spinal manipulation proved to be more effective than mobilization for the subjective data on quality of patients pain responses and pain intensity measurement.

For the algometer readings, no difference was evident before treatment one, but a significant difference in favour of the spinal manipulation group was noted after the first treatment.

It was concluded that whilst both treatments protocols are effective interventions in the treatment of chronic mechanical thoracic spine pain with regard to the subjective data, overall, spinal manipulation appeared to have a more beneficial effect than passive oscillatory mobilization.

Although this study was limited by its single researcher design, it supports the existing body of evidence in favour of spinal manipulative therapy.

TABLE OF CONTENTS

CHAPTER ONE

Introduction

CHAPTER TWO

Review of The Related Literature

CHAPTER THREE

Materials and Methods

CHAPTER FOUR

The Results

CHAPTER FIVE

Discussion

CHAPTER SIX

Recommendations and Conclusions

ADDENDA

LIST OF TABLES

List of Figures

DEFINITIONS OF RELEVANT TERMS

Thoracic Spine:

This is a transitional zone between the cervical and lumbar regions. Anatomically, the thoracic spine is from T1 to T12 (Flynn 1996 : 3,87).

Manual Therapy:

Therapeutic application of manual force. Spinal manual therapy broadly defined includes all procedures in which the hands are used to mobilize, adjust, manipulate, apply traction, massage, stimulate or otherwise influence the spine and paraspinal tissues with the aim of influencing the patients's health (Gatterman 1990:410).

Manipulation

Confusion exists concerning the terms manipulation, mobilization and adjustment (Haldeman 1992:460). In this study, the terms manipulation and adjustment have been used synonymously.

Manipulation is defined as a passive manoeuver in which specifically directed manual forces are applied to vertebral and extravertebral articulations of the body, with the object of restoring mobility to restricted areas.

1. ***Long-lever Manipulation*** : High-velocity force exerted on a point of the body some distance from the area where it is expected to have its beneficial effect.
2. ***Short-lever Manipulation*** : High-velocity thrust directed specifically at an isolated joint (Gatterman 1990 :410).

Mobilization:

This is a treatment modality in which the practitioner introduces passive rhythmic oscillations within the segmental range of motion or at the restrictive barrier (Flynn 1996 : 173).

Mechanical Thoracic Spine Pain:

For the purpose of this study, it is pain caused by a posterior facet syndrome in the thoracic spine.

Facet Syndrome:

Facet syndrome may be broadly defined as pain or dysfunction arising primarily from the zygapophyseal joints and their immediately adjacent soft tissues (Gatterman 1995:415). It is characterized by the following symptoms and signs:

- joint dysfunction at the affected level
- positive Kemp's test
- pain over the affected joint
- local tenderness
- diminished spinal range of motion, especially extension (Schafer and Faye 1990 : 217; Haldemann 1992 : 207).

Joint Dysfunction:

This implies the loss of one or more movements within the normal range of motion (Schafer and Faye 1990 : 27).

Contra-indication:

Any condition, especially any condition of disease, that renders one particular line of treatment improper or undesirable (Gatterman 1990:407).

Myofascial Trigger Point:

A hyperirritable spot, usually within a taut band of skeletal muscle or in the muscle's fascia, that is painful on compression and that can give rise to characteristic referred pain, tenderness and autonomic phenomena. Types include active and latent.

Active: It is symptomatic with respect to pain; it refers a pattern of pain at rest and/or on motion that is specific for the muscle. It is always tender, prevents full lengthening of the muscle, weakens the muscle, usually refers pain on direct compression, mediates a local twitch response of muscle fibers when adequately stimulated, and often produces specific referred autonomic phenomena.

Latent: It is clinically quiescent with respect to spontaneous pain; it is painful only when palpated. It may have all the other clinical characteristics of an active trigger point, from which it is to be distinguished (Travell and Simons 1983 1 : 1,2,3).

Articulation:

Place of union or junction between 2 or more bones of the skeleton (Gatterman 1990:405).

Biomechanics:

The study of the structure, function and mechanical aspects of human motion. It is concerned mainly with external forces either of a static or dynamic nature dealing with human movements (Bergmann 1993:755).

Differential Diagnosis:

The determination of which of two or more diseases with similar symptoms is the one from which the patient is suffering (Illustrated Stedman's Medical Dictionary 1982).

Motion Palpation:

Palpatory diagnosis of passive and active segmental joint ranges of motion (Gatterman 1990:412).

CHAPTER ONE

INTRODUCTION

1.1 The Problem and its Setting

According to Souza (1997:71), thoracic pain may be as common as cervical and lumbar pain but it is less dramatic due to the chronic consequences of postural imbalances.

Complaints of pain in the thoracic area are most often caused by dysfunctional spinal or rib cage mechanics. The cause of chest wall pain in patients with negative cardiopulmonary findings can also often be attributed to dysfunctional vertebral or rib mechanics (Flynn 1996 : 147). If the diagnosis of biomechanical joint dysfunction goes undiagnosed, this can lead to unnecessary worry for the patient, as a well-known source of pain in the thoracic region is that of the cardiovascular system (Gatterman 1990:176).

In reviewing the literature relating to the thoracic spine, it is apparent that in comparison to the cervical and lumbar regions it has largely been neglected. This may be attributed to the technical difficulties associated with movement analysis in this region and the belief that the thoracic spine is less commonly implicated in clinical pain syndromes (Edmonston and Singer 1977). However, thoracic spine pain has been found to play a much more important role in the differential diagnosis of chest pain than expected, it being third in frequency (Bechgaard 1981). Thoracic pain is a common complaint that deserves wider recognition (Edmonston and Singer 1997, Dreyfuss et al.1994 and Bruckner et al. 1987).

Manual therapy consists of various treatment protocols which utilize the hands and are directed to the neuromusculoskeletal system (Gatterman 1990:49).
Manipulation and mobilization, which also fall under the realm of manual therapy, are treatments commonly employed for joint pain, particularly spinal joint pain, by chiropractors, physiotherapists, osteopaths and physicians (Meirau et al.1988). In their

study on the comparative effects of manipulation and mobilization on metacarpophalangeal coaptation and mobility, Mierau et al. (1988) concluded that manipulation and mobilization are distinct therapies with different effects on joint function and that these effects in clinical trials of manual therapies should not be considered equivalent as they have been in the past.

Di Fabio (1992), in a review of the efficacy of manual therapy, provided evidence that manual therapy can be an effective modality when used to treat patients with somatic pain syndromes. However, ambiguous findings in many of the clinical trials prevented him from drawing definite conclusions. A review of the past clinical trials reveals that manipulation may have a slightly more beneficial effect than mobilization. However, more clinical trials with better research methodology are required to validate or refute these findings (Di Fabio 1992, Assendelft et al., 1992, Anderson et al. 1992, Hurwitz et al. 1996 and Mohseni-Bandpei et al. 1998).

To the author's knowledge, Schiller (1999) was the first to investigate the efficacy of spinal manipulative therapy in the management of mechanical thoracic spine pain. Schiller (1999) further recommended a study to investigate treatment differences between mobilization and manipulation for thoracic spine pain. Schiller's (1999) pilot study has opened up the way for further research into the clinical evaluation of thoracic spine pain management. This study will contribute to the current body of knowledge on thoracic spine pain and in turn aid health providers in making informed decisions on treatment protocols.

In view of the prevalence of back pain and its impact in so many social spheres, the ability to decrease an episode of back pain, even by a few days, can have major ramifications (Schiller 1999). It is therefore necessary to determine if any one procedure is more successful in producing a faster recovery so as to be able to decrease the treatment period and hence the financial and psychological burden on the patient, medical aids and society.

1.2 Aims, Objectives and Hypotheses of the Study

The aim of this study is to investigate the effectiveness of spinal manipulation compared to passive oscillatory mobilization in terms of objective and subjective clinical findings in order to evaluate the more effective treatment in the management of chronic mechanical thoracic spine pain.

The **first objective** is to evaluate the relative effectiveness of spinal manipulation and passive oscillatory mobilization utilizing objective measures.

The **second objective** is to evaluate the relative effectiveness of spinal manipulation and passive oscillatory mobilization utilizing subjective measures.

The First Hypothesis

It was hypothesized that pressure threshold measurement in the thoracic spine would be improved by the application of spinal manipulation and passive oscillatory mobilization.

The Second Hypothesis

It was hypothesized that the patients' perceptions of the quality and intensity of pain in the thoracic spine would be improved after the spinal manipulation and mobilization.

The Third Hypothesis

It was hypothesized that spinal manipulation would be more beneficial than passive oscillatory mobilization in terms of improving pressure threshold measurement and the patients' perceptions of the quality and intensity of pain in the thoracic spine over a two week period.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2.1 Introduction

This chapter deals with relevant aspects of mechanical thoracic spine pain in terms of incidence, prevalence, basic anatomy and biomechanics, diagnostic criteria, differential diagnosis and treatment. In addition, the subjects of spinal manipulation and mobilization are presented in detail and pertinent clinical trials reviewed.

2.2 Incidence and Prevalence of Thoracic Spine Pain

A cross-sectional survey was conducted by Drews (1995) in order to identify and compare characteristics of chiropractic patients and their complaints at the chiropractic teaching clinic at Technikon Natal and private chiropractic practices in South Africa. Thoracic complaints were found to be more common at the teaching clinic (29,6%) than private practices (23,5%). Private practitioners saw more acute and subacute conditions than did the students at the teaching clinic. Chronic complaints were the commonest in both groups.

A similar study was conducted by Walsh and Jamison (1992) in Australia. They reported on the patient profile of a private practitioner in each of the three geographical areas served by the student clinics of the Philip Institute of Technology. Thoracic problems were also more commonly found in the teaching clinics (16.5) as compared to the private clinics (10.2, 11.4 and 7.4). Again, the greatest proportion of patient complaints in all the clinics were of a chronic nature, whilst acute conditions were 2-3 times more prevalent in the private clinics than in the teaching clinics.

Mior and Diakow (1987) conducted an epidemiological survey into the prevalence of back pain amongst Canadian chiropractors. There were 329 respondents, 288 (88%) male and 41 (12%) female. Thoracic pain was most common amongst female respondents whilst male chiropractors complained most frequently of lumbar pain. The combined frequencies of regional complaints was 59% in the lumbar spine, 50% in the thoracic spine and 30% in the cervical spine. The authors stated that the overall prevalence of back pain among chiropractors is not only in the upper end of the scale reported for the general population, but it also appears to be the highest among the health professions yet studied (Doctors 57%, hospital nurses and physiotherapists 52%).

A study was conducted among 1178 school children (mean age : 12.8 years) of both sexes in order to determine the prevalence of back pain. The pupils were required to answer a previously validated questionnaire. The cumulative prevalence of back pain was 51.2%. lumbar pain (36.8%), lumbar and leg pain (4.2%) and thoracic pain (34.0%) were more common than cervical pain (26.5%) (Troussier et al. 1994).

A study was conducted by Bechgaard (1981) in order to determine the frequency of segmental thoracic pain in patients complaining of chest pain. A sample of 1097 patients admitted to a cardiological and medical department were investigated. Specific examination of the thoracic vertebrae and segments were carried out with minimal risk to possible coronary patients. It was found that segmental thoracic pain accounts for 13% of chest pains making it the third most common chest pain (behind coronary thrombosis pain 39% and angina pectoris 20%) (Bechgaard 1981).

From the above it can therefore be concluded that thoracic spine pain, although not as frequent as particularly lumbar spine pain, presents itself often enough to warrant investigation.

2.3 Relevant Anatomy of the Thoracic Spine and Rib Cage

Evaluation of the thoracic spine and rib cage requires an appreciation of the anatomy and biomechanics of this unique spinal region (Flynn 1996:147). Such knowledge and understanding will ensure optimal management of patients. Only relevant aspects of the anatomy and biomechanics (to follow) of the thoracic spine and rib cage, pertaining to this study, will be discusssed.

The thoracic region of the spine is a transitional zone between the cervical and lumbar regions. The thoracic spine is attached by the ribs to the sternum and has a high degree of inherent stability and rigidity (Flynn 1996:3,87). The osteocartilaginous thoracic cage is formed by part of the vertebral column (12 thoracic vertebrae and intervertebral discs); 12 pairs of ribs and costal cartilages and the sternum. The ribs and costal cartilages form the largest part of the thoracic cage (Moore 1992:33).

Within the thoracic spine there are 12 vertebrae, which diminish in size from T1 to T3 and then increase progressively in size to T12 (Magee 1992:216). The moveable vertebrae are connected by resilient intervertebral discs, which play an important role in movements between the vertebrae, and in absorbing shocks transmitted up or down the vertebral column. The moveable vertebrae are also connected to each other by paired, posterior zygapophyseal joints (facet joints) between the articular processes and by strong anterior and posterior longitudinal ligaments. These ligaments, extending the length of the vertebral column, are attached to the intervertebral discs and vertebral bodies. The intervertebral ligaments and joints generally prevent excessive flexion and extension of the vertebral column. Thoracic vertebrae are generally classified as typical or atypical according to their rib attachments. The typical thoracic vertebrae are the 2nd through the 8th. The typical thoracic vertebral body is heart shaped when viewed from above or below. The pedicles are short, while the laminae are only slightly longer, forming a circular neural canal in this region. The articular facets face posteriorly and laterally, becoming more vertical as they approach the coronal plane in the lower thoracic region. The transverse processes are relatively long and angled dorsolaterally at about 45° to the midsagittal plane of the body. The spinous processes are long, slender and triangular on cross-section. T1 to T4 vertebrae have some features of cervical vertebrae. T9 to T12 are also atypical in that they have tubercles similar to lumbar vertebrae.

Thoracic vertebrae are unique in that they have facets on their bodies and transverse processes for articulation with the ribs (T11 and T12 are exceptions). Two demifacets are located laterally on the bodies of T2 to T9. The superior demifacet articulates with the head of its own rib and the inferior demifacet articulates with the head of the rib inferior to it. The costal facets of the other vertebrae vary somewhat. T1 has a single costal facet for the head of the first rib and a small demifacet for the cranial part of the 2nd rib. T10 has only one costal facet which is partly on its body and partly on its pedicle. T11 and T12 have only a single costal facet on their pedicles.

There are usually 12 ribs on each side of the thorax. They are elongated and flat and curve anteriorly and inferiorly from the thoracic vertebrae. The 1st 7 pairs of ribs are called true ribs as they are connected to the sternum by their costal cartilages. The 8th to 12th pairs of ribs are false ribs as each one is connected by its costal cartilage to the cartilage of the rib superior to it. The 11th and 12th pairs of false ribs are often called floating ribs as they are unattached anteriorly. The 3rd to the 9th ribs are typical whilst the 1st, 2nd, 10th and 12th pairs are atypical. A typical rib had a head, neck, tubercle and shaft. The head of a rib is wedge shaped and has 2 articular facets for articulation with the numerically corresponding vertebrae and the vertebrae superior to it. These facets are separated by the crest of the head. The neck is short and flat and located between the head and tubercle. The tubercle is on the posterior surface of the junction of its neck and shaft. The tubercles of most ribs have a smooth convex facet, which articulates with the corresponding transverse process of the vertebrae.

The first rib is the broadest and most curved of all the ribs. It is clinically important because so many structures cross or attach to it. The 2nd rib has a curvature similar to the 1st rib, but is thinner, much less curved and is about twice as long as the 1st rib. The 10th rib articulates with T10 vertebrae only. The 11th and 12th ribs are short and have a small costal cartilage with a single facet on their heads and have no neck or tubercle (Moore 1992:3, 323, 331-2 and Gatterman 1990:176-7).

3 joints which are located posteriorly in the thoracic region and are of relevance to this

study will be discussed. These are the zygapophyseal joints (facet joints), costovertebral joints and the costotransverse joints.

Zygapophyseal Joints/ Facet Joints:

The articular processes (zygapophyses)arise from the junction of the pedicle and lamina (on the thoracic vertebrae). The superior articular processes project superiorly and the inferior processes project inferiorly. Each process has an articular facet. The articulation between the superior and inferior articular facets at the zygapophyseal (facet) joints helps to prevent anterior movement of a superior vertebra on an inferior one. The articular facets allow some flexion and extension as well as varying degrees of lateral flexion and rotation.

Costovertebral Joints

Typically the head of a rib articulates with the sides of the bodies of 2 thoracic vertebrae. This articulation is the costovertebral joint.

Costotransverse Joints

The tubercle of a typical rib articulates with the facet on the tip of the transverse process of its own vertebra to form a synovial joint (Moore 1992:33,39).

An investigation into the role of the posterior elements, costovertebral joints and rib cage in the stability of the thoracic spine in eight canine rib cage-thoracic spine complexes was conducted by Oda et al. (1996). In their study, resection of the posterior elements and bilateral costovertebral joints produced a large increase in the range of motion and neutral zone. This indicated that stability of the thoracic spinal motion segments is significantly diminished when the posterior elements and bilateral costovertebral joints are injured. It was concluded that the costovertebral joints and rib cage play an important role in stabilizing the thoracic spine especially in lateral bending and axial rotation and that the state of the costovertebral joints should be assessed in evaluating the stability of the thoracic spine.

The quantitative three-dimensional surface anatomy of 144 thoracic vertebrae was studied by Panjabi et al. (1991). It was found that the thoracic spine may be divided into 3 distinct regions according to width-to-depth ratio's : upper T1-T4, middle T4-T9/T10 and lower T10-T12. The middle thoracic region is characterized by a relatively narrow end-plate and spinal canal. Although rib articulations add significant stiffness to the region, the small spinal canal makes this region susceptible to cord impingement. The blood supply to this region is also the least profuse.

The thoracic kyphosis is formed during the embryonic stage and is called the primary curve (Gatterman 1995:384). The normal thoracic kyphosis is due to the slight wedged configuration of both the vertebral bodies and intervertebral discs (White III and Panjabi 1990:328). Panjabi et al. (1991) found the kyphotic curve for the entire thoracic spine to be approximately 45,6°; the vertebral wedge angle was found to be 3,8° per vertebra. According to Edmonston and Singer (1997) muscle activation has little effect on the thoracic kyphosis which is determined more by the osseous symmetry of the vertebral bodies. Because of this physiologic kyphosis, the thoracic spine is more prone to be unstable in flexion (White III and Panjabi 1990:328).

According to Edmonston and Singer (1997) thoracic disc height, relative to vertebral body height, is less than that in the cervical and lumbar regions. The ratio of disc diameter to height is 2-3 times higher in the thoracic than the lumbar segments. This reduces the mobility of a functional spinal unit in the thoracic spine.

Dreyfuss et al. (1994) conducted a study to determine whether the thoracic zygapophyseal joints are potential pain generators. Provocative intra-articular injections of the thoracic zygapophyseal joints were conducted on 9 asymptomatic volunteers. It was concluded that the thoracic zygapophyseal joints can cause both local and referred pain in a reproducible manner. In all subjects tested, each joint caused the most intense area of evoked pain one segment inferior and slightly lateral to the joint injected with a contrast medium only. The thoracic zygapophyseal joints are smaller and hold less volume than their cervical and lumbar counterparts. Hence it appears that thoracic zygapophyseal joint pain is more localised and occurs closer to its origin than zygapophyseal pain in other spinal regions.

Erwin et al. (2000) investigated the histology of the human costovertebral complex and found that all costovertebral joints contained innervation within the anterior capsule and synovial tissues. The authors concluded that the costovertebral joint has the requisite innervation for pain production in a similar manner to other joints of the spinal column.

From the above it can be seen that the thoracic region of the spine is different as compared to the cervical and lumbar regions due to the attachment of the rib cage elements. Hence an extrapolation of results found in similar studies conducted on the cervical and lumbar spine could not be made.

2.4 Relevant Biomechanics of the Thoracic Spine and Rib Cage

The thoracic region of the spine differs from the cervical and lumbar regions in that its spinal mechanics are directly influenced by the attachment of the ribs and sternum (Flynn 1996:147). The thoracic spine is the least mobile part of the spinal column. This is primarily due to the attachment of the rib cage, along with narrower discs and elongated spinous processes (Gatterman 1990:182). The physiologic priority appears to be protection of visceral organs rather than mobility (Souza 1998:74). The attached ribs, although individually quite flexible, offer increased stiffness and strength to the vertebral segments (Schafer 1987:421). According to Panjabi and White III (1990), there are 2 mechanisms through which the ribs tend to increase the stability of the thoracic spine. The first involves the articulation of the head of the rib to the articular facets of adjacent vertebral bodies. The second is related to the presence of the entire thoracic cage. The thoracic cage effectively increases the transverse (x,z plane) dimensions of the spine structure. This increases the moment of inertia, resulting in added resistance to bending in the sagittal and frontal planes, as well as resistance to axial rotation.

The compressive load at T1 is about 9% of body weight and increases to 33% at T8 and 47% at T12 (Edmonston and Singer 1997). According to Panjabi et al. (1991) the vertebral bodies bear the majority of this load and to accommodate this, the height, end-plate cross-sectional area and bone mass of the vertebral bodies increases caudally, particularly in the middle and lower levels.

The amount and type of motion of the thoracic vertebral motion segments is determined by the angulation and spatial orientation of the facet joints. Orientation of the facet joints in the coronal plane decreases from approximately 20° in the upper thoracic region to 15° or less in the lower segments. The superior facets are orientated backward and slightly outward and upward with an angulation of approximately 60° to the medial sagittal plane. This angulation facilitates rotation of the vertebral motion segments, which decreases from approximately 14° at the T1-T2 vertebral motion segment to less than 5° at the T11-12 vertebral motion segment. The average rotation at T5-6 and T7-8 vertebral motion segments is 10°. Coupled with rotation is lateral bending, which is greatest at the T11-T12 motion segment, averaging between 13 and 14°, and least at T5-6, averaging 5°. It is generally 2-3° greater in the other vertebral motion segments.

Flexion and extension is the least from T1-2 through T5-6, averaging less than 5°. It approaches 8° at T7-8 through T9-10, reaching nearly 19° at the T11-12 vertebral motion segment with the facets orientated more in the sagittal plane (Gatterman 1990:182).

An in vivo study was conducted by Willems et al. (1996) on 60 normal subjects in order to provide preliminary data on three-dimensional thoracic spine kinematics. Axial rotation was found to be the dominant motion of the thoracic region followed by sagittal and coronal plane motion. The middle thoracic region (T4-8) accounted for half of the total thoracic rotation range with the lower thoracic region (T8-12) exhibiting least axial rotation. Sagittal and coronal plane motion increased in a cephalocaudad direction. All primary planes of motion were accompanied by motion in other planes. Sagittal plane motion showed the least associated motion. Coupling was most evident between lateral

flexion and axial rotation.
An ipsilateral pattern predominated in the middle and lower thoracic regions, when either lateral flexion or axial rotation was the primary motion.

During extension, the articular facets limit motion by bony impingement of the articular processes and by jamming of the spinous processes. During flexion, the spinous process's interspace widens and the articular surfaces of the inferior facets slide upward. On lateral flexion of the thoracic vertebrae, the facets on the side of flexion approximate with the superior facet sliding downward. On the contralateral side, the superior facets slide upward. Rotation of each vertebral motion segment in the thoracic region is accompanied by a similar movement in the corresponding ribs. This rotation is limited by the attachment of the ribs to the sternum. Due to the orientation of the thoracic facets, minimal translation is coupled with rotation in this region. The axis of rotation is the point of intersection of perpendicular lines drawn from the facets. This allows little rotation of the vertebral bodies and twisting of the intervertebral disc, instead of the shearing forces typically found in the lumbar region.

Respiratory excursion is a function of the combined movement of the ribs. Each rib possesses its own range and direction of movement, with the axis of movement lateral to the costotransverse articulation. During inspiration, the upper ribs thrust upward like the movement of a bucket handle increasing the anteroposterior diameter of the chest while the lower ribs open like callipers, which increases the lateral diameter of the chest. The mobility of the ribs varies considerably. The first ribs are more fixed than the others, due to the weight of the upper extremities and the strain of the ribs beneath. Movement of the second rib is slight on quiet respiration. Mobility is increased successively down to the last two which are freely moveable. Since these ribs have free anterior extremities they are fixed by the quadratus lumborum muscle to form fixed points of action for the diaphragm when the other ribs are elevated (Gatterman 1990:182-186).

2.5 Mechanical Thoracic Spine Pain

Mechanical thoracic spine pain refers to pain caused by a posterior facet syndrome in the thoracic spine. Facet syndrome may be broadly defined as pain or dysfunction arising primarily from the zygapophyseal joints and their immediately adjacent soft tissues (Gatterman 1995 : 415). This syndrome is caused by rotational strain to both the facet joints and the annulus fibrosis. Dysfunction of the facet joints produces most of the symptoms, and treatment is mainly directed toward relief of this problem (Kirkaldy-Willis and Burton 1992:248).

2.5.1 History and Etiology

According to Gatterman (1990:186) the etiology of thoracic vertebral and costovertebral syndromes is generally a sudden, unguarded movement. The patient may have a history of explosive coughing or sneezing or may report a sudden stabbing pain following lifting or reaching overhead (Maurer 1976). A crushing blow to the chest (as in a motor vehicle accident) can also cause these syndromes (Gatterman 1990:186). Whiplash injuries and traction injuries to the upper extremities can cause fixation of the first and second ribs. Dysfunction in this region may also be caused by work-related injuries resulting from carrying heavy weight on the shoulders or prolonged pulling . Lower rib lesions may occur during motor vehicle accidents where a lap seat belt that restrains the pelvis allows the trunk to be thrown forward and rotated to one side (Grieve 1981:14-16, 234-235).

2.5.2 Signs and Symptoms

The most common symptom of vertebral and costovertebral joint dysfunction is unilateral pain in the thoracic spine. The pain is often described as sharp and stabbing, and is increased by deep inspiration, coughing and sneezing. Lesions of the rib heads commonly accompany thoracic vertebral problems with characteristic intercostal muscle spasm. Continuous soreness at the costovertebral angle, with pain radiating around to the lateral or anterior chest wall are common complaints (Gatterman 1990:186).

2.5.3 Diagnostic Criteria

According to Triano, (1992) the following criteria have to be met, in order for a patient to be diagnosed with mechanical spine pain:

1) Midline back pain.
2) Nondermatomal referred pain that is difficult to localize.
3) No signs of nerve root tension.
4) No major neurological deficit.
5) Pain with compression into spine extension.
6) Reduced range of motion.

Orthopaedic tests such as Kemps test (Schafer and Faye 1990:217) and facet joint challenge (Gattermann 1990:84) are usually positive.

Modifying the acronym PARTS from Bourdillon and Day, Bergmann has identified the 5 diagnostic criteria for the identification of joint dysfunction (Bergmann et al. 1993:63). *These are as follows:*

A) P: Pain and Tenderness

This is evaluated in terms of location, quality and intensity. The patient's description of the pain and its location is obtained. Observation and palpation of osseous and soft tissue is performed in order to detect the location and intensity of tenderness.

B) A: Asymmetry

This includes observation of posture and gait and palpation (including static) for misalignment of vertebral segments and extremity joint structures.

C) R: <u>Range of Motion Abnormality</u>

Changes in active, passive and accessory joint motions are noted. These changes may be reflected by increased, decreased or aberrant motion. It is thought that a decrease in motion is a common component of joint dysfunction. Range of motion abnormalities are identified through motion palpation and stress radiography.

D) T: <u>Tone, Texture and Temperature Abnormality</u>

Changes in the characteristics of contiguous and associated soft tissues, including skin, fascia, muscle and ligaments are noted. Tissue tone, texture and/or temperature changes are identified through observation, palpation, instrumentation and tests for length and strength.

E) S: <u>Special tests</u>

These include tests such as the slump test, passive scapular approximation and first thoracic nerve root stretch.

2.6 Differential Diagnosis of Thoracic Spine Pain

Any pain that arises in the thoracic region can be a diagnostic challenge. Unlike the cervical and lumbar spine, the clinical differentiation between musculoskeletal and visceral conditions can be rather confusing (Lawrence et al. 1996:115). Musculoskeletal disorders can imitate cardiopulmonary symptoms, intra-abdominal pain, or other visceral etiologies (Scaringe and Ketner 1999).

One of the most important and concerning differential diagnoses of thoracic spine pain is that the pain could be originating from the cardiovascular system. As such, the symptoms of thoracic and chest pain are a significant source of patient anxiety and concern because it brings with it the fear of a serious cardiac event. As a result, the evaluation of chest pain consumes our economic and medical resources. Although we are certainly well justified in considering the need for cardiac evaluation whenever a patient presents with chest pain, it is also important to remember the myriad of other conditions, including musculoskeletal disorders, that can produce similar symptoms (Kaye 1993). This viewpoint is also held by Scaringe and Ketner (1999) who state that the inability to alleviate shoulder, arm or neck pain may rest with misdiagnosed mechanical spinal and rib cage disorders. Unfortunately, musculoskeletal chest wall disorders are often unsuspected causes of chest pain (Fam 1988).

The misdiagnosis of chest pain can easily happen as it mimics a diverse number of musculoskeletal conditions, one of which is thoracic spine dysfunction. Such a misdiagnosis can cause unnecessary worry as the ominous significance of chest pain looms (Gatterman 1990:186).

It is usually possible to differentiate cardiac from noncardiac chest pain on the basis of clinical characteristics and a detailed physical examination. Diagnostic studies are generally necessary only when the origin of the chest pain remains in doubt (Kaye 1993).

2.7 Treatment : Manual Therapy

Manual therapy, which falls under the realm of conservative treatment, has been utilized by different civilizations for many centuries (Haldeman 1992:3-13).
The term manual therapy describes the various procedures by which treatment using the hands is directed to the neuromusculoskeletal system (Gatterman 1990:49). Many techniques are considered manual therapy procedures, and these techniques often include soft tissue manipulations, massage, manual traction, joint manipulations (short-or long-lever dynamic thrust), joint mobilization, pressure techniques such as ischaemic compression and reflex therapies (i.e, Logan basic) (Di Fabio 1992 and Gatterman 1990:49).
A discussion of each of the above techniques is beyond the scope of this thesis. Therefore only the treatment performed in this study will be discussed.

2.7.1 Studies involving Manual Therapy

According to Koes et al.(1992) manual therapy has proven to be one of the most effective treatments for non-specific neck pain.

A randomized clinical trial was conducted by Koes et al. (1992) in order to determine the effectiveness of manual therapy, physiotherapy and treatment by the general practitioner(G.P) for nonspecific back and neck complaints. During a 2 year period, 256 patients with pain or self-reported limited range of motion in the back or neck region for at least 6 weeks were selected by 40 G.P's. The patients were divided into 4 groups and given treatment for a maximum of 3 months. Group 1 received treatment consisting of exercises, massage and physical therapy modalities administered by a physiotherapist. Group 2 received manipulation and mobilization of the spine by manual therapists. Group 3 received treatment by a G.P consisting of prescription of medication, advice about posture, home exercises, participation in sports, bed rest, and other treatment modalities. Group 4 acted as a control group and received placebo treatment consisting of detuned short wave diathermy and ultrasound. The principle outcome measures were severity of the main complaint, global perceived effect, pain and functional status which was assessed at 3, 6 and 12 weeks follow-up.

The results indicated that improvement of the main complaint for both the manual therapy group and the physiotherapy group was larger than in the G.P. group at the 3 and 6-week follow-up. The placebo group also showed a larger improvement than the G.P. group but smaller than the manual therapy and physiotherapy groups. At the 12-week follow-up however, the differences amongst the groups was negligible. The assessment by the patient of the global perceived affect showed similar results.

No statistically significant differences were evident amongst the 4 groups with regard to pain severity and the Sickness Impact profile. Spinal mobility did not seem to change significantly in any of the groups, and its suitability for measuring progress in patients with chronic neck and low back pain was questioned. It was noted that the manual therapy group received the least number of treatments (5.4) as compared to the physiotherapy group (14.7), but no other significant differences were noted between the

manual therapy or physiotherapy groups at any of the follow-up measurements.
A one year follow-up on the above study was conducted by Koes et al.(1992). They concluded that after 12 months follow-up, both manipulative therapy and physiotherapy seem to be more effective than treatment by the G.P., or placebo treatments in patient's with persistent back and neck pain. Furthermore, the findings indicate a slightly better result for manipulative therapy compared to physiotherapy after 12 months follow-up.

Hurwitz et al. (1996) in a systematic review of the literature relating to cervical spine manipulation and mobilization critically appraised randomized controlled trials for study quality. The above study received the highest score of 73 points out of 100.
The authors concluded in their article that manipulation, mobilization or physiotherapy probably are all more effective than muscle relaxants or usual medical care in producing short-term pain relief among some patients with subacute or chronic neck pain and that manipulation probably is slightly more effective than mobilization or physical therapy. The authors stated that much more high quality research needs to be done before more definite recommendations can be made regarding the use of manipulation or mobilization for neck pain and head-ache.

A review on the efficacy of manual therapy by Di Fabio (1992) provided evidence that manual therapy can be an effective modality when used to treat patients who have somatic pain syndromes. However, equivocal findings on clinical trials of manual therapy prohibits one from drawing definite conclusions (Di Fabio 1992). Despite the fact that many of the clinical trials conducted in the past had methodological flaws which precluded the drawing of strong conclusions, it nevertheless appears that manipulation may have a slightly more beneficial effect than mobilization. However, more clinical trials with better research methodology are required in order to validate or refute these findings (Di Fabio 1992, Assendelft et al. 1992, Anderson et al. 1992, Hurwitz et al. 1996 and Mohseni-Bandpei et al. 1998).

This clinical trial will contribute towards obtaining a clearer indication, in the context of the above discussion, as to whether manipulation or mobilization is more beneficial in the treatment of mechanical thoracic spine pain.

As even fewer randomized controlled trials involving spinal manipulation and mobilization have been conducted in the thoracic spine as compared to the cervical and lumbar regions and taking into account the fact that research is still warranted in these areas (i.e the cervical and lumbar regions), it stands to reason that research in the thoracic spine is also required.

2.8 Spinal Manipulation

According to Sandoz,(1976) an adjustment can be described as a passive manual manoeuvre during which an articular element is suddenly carried beyond the usual, physiological limit of movement without exceeding the boundaries of anatomical integrity. The usual but not obligatory characteristic of an adjustment is the thrust which is a brief, sudden and carefully dosed force delivered at the end of the normal passive range of movement and is usually accompanied by a cracking noise.

According to Gatterman, (1995) the postulated specific effects adjustments have on facet articulations are as follows:

- Release of entrapped meniscoid (Giles 1989, Jones 1989, Rahlmann 1987, Giles 1986, Giles 1992, Giles 1985, Lewit 1985 and Bogduk and Jull 1985).
- Reduction in articular cartilage displacement by chronically entrapped meniscoid (Lewit 1985).
- Pain relief by co-activation of various receptors (Bergman 1993 and Gillette 1987).
- Reduction of intervertebral foramen stenosis caused by segmental hyperextension (Cox 1990).
- Reduced intracapsular or extracapsular adhesions (Jones 1989, Rahlmann 1987 and Giles 1992).
- Relief of abnormal tension on joint capsule (Jones 1989).

- Reduction of postimmobilization collagen cross-linking (Rahlmann 1987).
- Reduction of local vascular stasis (Giles 1992).
- Release of osseous mechanical locking.

According to Haldeman (2000), there is now sufficient scientific investigation to develop working models to explain the effects of the adjustment. However, there is insufficient evidence to state that any particular theory can be considered valid.

Contra-indications to Spinal Manipulation:

Adjustive therapy is contra-indicated when the therapy may produce an injury, worsen an associated disorder, or delay appropriate curative or life-saving treatment (Bergmann 1993:132).

More specific contra-indications include the following:

- rheumatoid arthritis and instability or acute inflammation
- acute inflammatory state of ankylosing spondylitis
- severe degenerative joint disease
- thoracic disc protrusion or herniation
- neoplasms
- osteoporosis
- progressive spondylolisthesis with clinical signs and symptoms indicating radicular compression
- in the acute phase after trauma
- psychogenic disturbances (Haldeman 1992 : 557-572).

The most common conditions contra-indicating manipulation of the thoracic region are rib fractures and sprains of the costochondral, costosternal and interchondral joints (Gatterman 1990:187).

A survey conducted by Adams and Sim (1998) with regard to the practice of manipulation by UK physiotherapists revealed that the thoracic spine was manipulated by the greatest proportion of users (97%) and was manipulated significantly more frequently than the cervical spine. According to the authors this may reflect the fact that few complications of thoracic manipulation have been reported in the literature.

2.8.1 Studies involving Spinal Manipulation

Schiller (1999) conducted a single-blind, randomized controlled pilot study on 30 patients to investigate the efficacy of spinal manipulative therapy (SMT) in the management of mechanical thoracic spine pain. Each group consisted of 15 patients between the ages of 16 and 60 years. The first group received thoracic spine manipulation whilst the second group received placebo treatment only. Both groups received a maximum of 6 treatments over a minimum period of 2 weeks. Thereafter a follow-up appointment was scheduled 1 month after the final treatment to assess the long-term benefits of the 2 treatments.

Objective measurements collected were the thoracic spine ranges of motion with the BROM ll goniometer and pain threshold with an algometer.
The subjective information required completion of the Oswestry Back Pain Disability Index, short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101 questionnaire by the patient. The readings were taken and questionnaires assessed before the first and final treatment and again at the one-month follow-up consultation.

Analysis of the data revealed statistically significant differences on inter-group comparison at the final treatment on right and left lateral flexion, as well as the percentage pain experienced.
The intra-group analysis showed statistically significant improvements in the SMT group both subjectively and objectively between the first to final treatment and the first to the one-month follow-up. The placebo group analysis showed statistically significant improvements in subjective measurements only and for sensory pain only between the first treatment to the final treatment and for all subjective measures between the first

treatment to the one-month follow-up.

Schiller concluded that SMT has greater benefits than placebo treatment.
The author further recommended a study to investigate treatment differences between mobilization and manipulation for thoracic spine pain.

Gavin (1999) conducted a study on 78 healthy subjects to assess the effect of manipulation of restricted thoracic spine segments on thoracic active range of motion (AROM). The subjects were divided into three categories. Group 1 was the control, Group 2 received mobility testing only and Group 3 received mobility testing and joint manipulation to a restricted segment.
All subjects were pre-tested for AROM of T3-T8; they then either rested, received mobility tests, or were manipulated, after which post-test measurements were performed. Flexion and left and right lateral flexion were measured. In a comparison pre- versus post-treatment AROM, a significant difference was found in left lateral flexion only. According to the author, this demonstrated that one session of manipulation techniques can influence AROM in the mid-thoracic spine.

A study was conducted by Triano et al. (1992) to determine differences in treatment history with spinal manipulative therapy in 241 patients.
180 patients were diagnosed with mechanical spine pain, 42 for muscular and 17 for entrapment. Seven questionnaires were administered including the Oswestry questionnaire and Visual Analogue Scale at the beginning of the clinic visit, after the clinical evaluation, prior to any treatment and again after 6 weeks. The predominant mode of treatment was by manual manipulation, supported as needed by exercise and modalities of physical therapy. Patients were also commonly given home care recommendations to assist in their recovery.
According to the results, complaints of the thoracic spine responded twice as quickly to manipulation as did complaints of the cervical, lumbar and lumbosacral areas. Thoracic spine regions required about 3 treatments, while cervical required 5.9 and the lumbar region 6.7.

A double blind, randomized, controlled study on the effect of manipulation on patients suffering from chronic neck pain (mean duration of 6 years) was conducted by Sloop et al. (1982). Arm pain was also experienced by 37 of the patients. 21 patients received manipulation and an amnesic dose of diazepam, whilst the other 18 patients were assigned to the control group and received an amnesic dose of diazepam.

Analysis of the data revealed no significant difference between the 2 groups as a result of the treatment. However, 57% of the manipulated group compared to 28% of the control group, at three weeks, remarked that the treatment had helped them.
After the 12 week period, it was found that 7 of the 9 patients in the manipulation group felt that the treatment had helped them as compared to only 2 of the 6 patients in the control group. This was not, however, statistically significant.
It was therefore concluded by the authors that the value of a single adjustment in patients with chronic neck pain had not been established.

Kjellman et al. (1999) reviewed 27 randomised clinical trials on neck pain and treatment efficacy. Their methodology included use of a model called The Disablement Process. The authors utilized a scoring system, as in Koes et al. (1991) study, where the maximum score was 100 points. A score of 50 or greater indicated good methodological quality. The above study by Sloop et al. (1982) was given a score of 48 points. The authors concluded that few randomised clinical trials on neck problems are of high methodological quality and comprise a sufficiently long follow-up time.

A study was conducted by Sanders et al. (1990) in order to demonstrate the immediate effect of adjustments on low back pain. 18 patients between the ages of 22 and 56 years, who were 'naive' to adjustments and had had low back pain for less than 2 weeks were chosen. The patients stopped the use of medication 48 hours before the commencement of the study. The patients were divided into 3 groups of 6, with one group receiving spinal adjustments, a control group receiving no treatment and a "sham" group receiving only light touch. The L4/5 to S1 segments were adjusted. A five point visual analogue scale revealed a small but significant reduction in pain scores in the adjustment group.

Mohseni-Bandpei et al. (1994) reviewed 25 randomised controlled clinical trials on spinal manipulation in the treatment of low back pain. The authors concluded that the efficacy of manipulation for patients with acute or chronic low back pain has not been convincingly demonstrated through the literature. They stated that studies with a better research methodology are clearly needed and that special attention should be paid to the quality of the methodology and factors such as duration of complaints, age and occupation (which modify the effect of manipulation, exclusion, and inclusion criteria), an explicit definition of therapeutic procedure, blinding the therapist, patients and assessor, placebo group trusted by patients, and prevention of co-intervention during treatment and follow-up.

2.9 Mobilization

The system of mobilization has probably been used in various forms since ancient times, the refinement of this system was primarily from the work of Maitland and Kaltenborn (Flynn 1996:173).

Mobilization is described as a form of manual therapy applied within the physiological passive range of joint motion, characterized by non-thrust increase in passive joint play (Gatterman 1990:411). Mobilization is performed in such a manner (particularly in relation to the speed of the movement) that it is, at all times, within the ability of the patient to prevent the movement if he so chooses (Maitland 1986:4). In some circles, mobilization is considered a less traumatic treatment than manipulation (Cassidy et al.1992).

Techniques for mobilization of the thoracic spine are equally important to those for the cervical and lumbopelvic regions. Under certain conditions (e.g., geriatric patients, pregnant women, patients with breast sensitivities or rib sensitivities) patients cannot tolerate the adjustive thrusting (Haldemann 1992:491).

According to Morton (personal communication 2000), G.D.Maitland is regarded as one of the leaders in the field of manual therapy. As such, his techniques are widely used by the physiotherapy profession throughout the world. Strong emphasis is placed on the study of Maitland's techniques in the undergraduate years of physiotherapy study here in South Africa and post-graduate courses are offered to further educate physiotherapists in the art and skill of Maitland's techniques.
After taking the above into account, the Maitland technique of mobilization was selected to be used in this study from the myriad of other mobilization techniques that are available.

Maitland (1986 : 4) classifies mobilization into 2 types:

1. Passive oscillatory movements
2. Sustained stretching

Passive oscillatory movements may be performed slowly (one in 2 seconds), or quickly (3 per second), smoothly or staccato, with small or large amplitude, and applied in any part of the total range of movement. These movements may be performed while the joint surfaces are distracted or compressed.

Sustained stretching passive movements may be performed with or without tiny amplitude oscillations at the limit of the range.

For the purpose of this study, the author was advised to utilize passive oscillatory movements by an experienced physiotherapist (Morton personal communication 2000).

Principles of the Maitland Technique of Mobilization:

Mobilization procedures are generally graded in the following manner:

Grade 1 A small-amplitude movement or oscillation at or near the starting position of the range of motion.

Grade 2 A large-amplitude movement or oscillation that is into the restricted range of motion but does not engage the barrier.

Grade 3 A large-amplitude movement or oscillation that is into the restricted range of motion and engages the barrier.

Grade 4 A small-amplitude movement or oscillation at the restrictive barrier (Maitland 1986 : 96 and Flynn 1996:174).

Indications:

- restoring passive accessory motion
- reducing pain
- increasing segmental and total spinal range of motion (Flynn 1996:173).

Postulated Effects of Mobilization:

1) It affects the hydrostatics of the disc and the vertebral bodies.
2) It activates the type l and ll mechanoreceptors in the capsule of the facet joint influencing the spinal gating mechanism.
3) It alters the activity of the neuromuscular spindle in the intrinsic muscles of the segment subsequently affecting bias in the grey matter cells.
4) It assists the pumping effect on the venous plexus of the vertebral segment (Boyling and Palastanga 1994:646).

Contra-indications to Passive Mobilization of Joints:

This is essentially the same as for adjustments, however, according to Maitland, (1986:110) certain conditions may be contra-indicated for adjustments but not for mobilization, e.g., active arthritic, vascular and metabolic conditions. The reason for this being that mobilization is considered, by some, to be a more gentle technique in comparison to adjustments with the advantage of the patient being able to stop the treatment if desired.

2.9.1 Studies involving Mobilization

A randomised control trial was conducted by Brodin (1984) on 63 mechanical neck pain patients in order to determine the effectiveness of cervical mobilization in comparison with other therapies. The patients were randomly divided into 3 groups. Group 1 acted as a control group. Group 2 received information on cervical problems and was also given manual therapy (superficial massage, electric stimulation and slight relaxing traction) by a physiotherapist. Group 3 received the same information as Group 2 plus specific mobilization. In addition, all 3 Groups were advised to take a salicylate preparation during this period. Outcome measures included pain intensity recorded on a linear scale and cervical spine range of motion. This was recorded before the therapy started as well as after 1, 2 and 3 weeks of therapy and finally one week after therapy finished.

According to the results, one week after the final treatment, 48% of the mobilization group, 12% of the manual therapy group and 5% of the control group had no neck pain. Overall, 78% of the mobilization group experienced a decrease in pain as compared to 39% of the control group and 35% in the massage group. The difference was found to be statistically significant. ($P < 0.05$). Brodin (1984) concluded that mobilization was an effective form of treatment for mechanical neck pain, and although cervical range of motion increased initially, it tended to decrease once the treatment had ended. He further remarked that a relationship between increased mobility of the cervical spine and a decrease in pain could not be made in the outcome of patients suffering from mechanical neck pain.

Goodsell et al. (2000) conducted a study (cross-over design)to establish the short-term effects of lumbar posteroanterior mobilization in patients with low-back pain, compared to a control intervention. 26 patients with nonspecific low back pain were randomly divided into 2 groups. Both groups received both interventions, with the groups differing in the order they received them. Outcome measures included the McGill Pain Questionnaire, the Visual Analogue Scale, the inclinometer for range of motion assessment and a custom-made stiffness measurement device. Outcome measures were assessed before and after each intervention.

The mobilization technique employed was similar to Maitland's technique of mobilization.

The results indicated that no significant differences were found between the mobilization and control interventions in relation to posteroanterior response or range of movement. The score for pain on worst movement showed significantly greater improvement for the mobilization than for the control procedure.

The authors concluded that lumbar posteroanterior mobilizaton did not produce any objectively measureable change in the mechanical behaviour of the lumbar spine of patients with low back pain. They further attributed the improvement in some pain variables (in comparison with the control group) to a placebo effect.

Hurwitz et al.(1996) in a systematic review of the literature related to manipulation and mobilization of the cervical spine concluded that cervical spine manipulation and mobilization probably provides at least short-term benefits for some patients with neck pain and headaches.

2.10 Manipulation versus Mobilization

Three physical events in manipulation that differentiate it from mobilization are:

- as the elastic barrier of the joint is passed the articular surfaces separate suddenly
- a cracking noise is heard

- a radiolucent space appears within the joint (Gatterman 1990:50).

In their study on the comparative effects of manipulation and mobilization on metacarpophalangeal coaptation and mobility, Mierau et al. (1988) concluded that manipulation and mobilization are distinct therapies with different effects on joint function and that these effects in clinical trials of manual therapy should not be considered equivalent as they have been in the past.

2.10.1 Studies involving Manipulation and Mobilization

Terret and Vernon (1984) conducted a controlled study on 50 asymptomatic male caucasian subjects to determine the effect of spinal manipulation on paraspinal cutaneous pain tolerance levels. The subjects were randomly divided into 2 groups. Group 1 acted as a control group and received mobilization of the thoracic spine. The mobilization procedure consisted of a posterior-anterior joint springing action, starting from T1 down to T10. This passive joint play manoeuvre stressed the motion segment into the zone of 'end-feel ' at which point a slight and further springing pressure was applied. According to the authors, this served as the control procedure and as a localising procedure for the manipulation.

Group 2 received manipulations (cross bilateral) on the side of the greatest resistance, not necessarily (but mostly) on the side of the zone of increased pain.

Each patient's level of pain tolerance/threshold was measured before the treatment and after the treatment at intervals of 30 seconds, 2, 5 and 10 minutes.

Pain threshold was assessed with an electrical apparatus:Siemens Neurotron Stimulator.

The results indicated that the spinal manipulation group demonstrated a 140% increase in local cutaneous pain tolerance levels which was statistically significant ($p < 0.05$). The control group mean tolerance levels were unchanged indicating a sustained sensitivity of the cutaneous pain receptors in the paraspinal areas.

Cassidy et al. (1992) conducted a randomized controlled trial in order to compare the immediate results of manipulation to mobilization in neck pain patients.
They studied 100 consecutive outpatients suffering from unilateral neck pain with referral into the trapezius muscle. The manipulation group consisted of 52 subjects whilst there were 48 subjects in the mobilization group. The main outcome measures were the goniometric examination of cervical spine ranges of motion and pain intensity rated on the 101-point Numerical Rating Scale (NRS-101).
Both pre- and post-test measurements were conducted in a blinded fashion.
All treatments were given once and applied to the symptomatic side. The cervical mobilization involved the application of muscle energy technique whilst the single adjustment involved a rotary technique.

The results showed that both treatments increase range of motion, but manipulation has a significantly greater effect on pain intensity. Immediately after treatment, 85% of the manipulated patients and 69% of the mobilized patients reported improvement
However, the decrease in pain intensity was more than 1.5 times greater in the manipulated group (p=0.5)
The authors concluded that a single manipulation is more effective than mobilization in decreasing pain in patients with mechanical neck pain and that both treatments increase range of motion in the neck to a similar degree.

A study was conducted by Dawkins (1996) to determine the effectiveness of adjustments versus mobilization in the treatment of mechanical neck pain.
30 consecutive patients suffering from predominantly chronic mechanical neck pain were randomly assigned to either the adjustment or mobilization group (Muscle Energy Technique). Both groups received treatment twice a week for 3 weeks and were reassessed after a follow-up period of 3 weeks. Measurements of the cervical spine ranges of motion with the CROM goniometer and the completion of the Numerical Pain Rating Scale-101, CMCC Neck Disability Index and the short-form McGill Pain Questionnaire were performed before the first treatment, after the first treatment, after the 3 weeks treatment and after the follow-up period.

The results indicated that the mobilization group achieved significant improvements with regard to mobility of the cervical spine after the first treatment and the 3 weeks of treatment ($p < 0.05$). The adjustment group achieved significant improvements with regard to left and right lateral flexion after the 3 weeks of treatment ($p < 0.05$). The mobilization group had a greater improvement with regard to disability after the three weeks of treatment and follow-up period. The adjustment group had a greater reduction in pain after the first treatment, whereas the mobilization group appeared to improve over the 3 week treatment period. Both groups tended to deteriorate during the follow-up period. No statistically significant difference was noted within the 2 groups after the 3 weeks of treatment or after the follow-up period. A significant difference was noted between the 2 groups after the first treatment. From the results, it was apparent that mobilization, in the form of Muscle Energy Technique, is just as effective in treating chronic mechanical neck pain as are adjustments.

Meade et al. (1990) conducted a randomized comparison of chiropractic and hospital outpatient treatment on 741 patients with mechanical low back pain.
Patients aged 18-65 who had no contra-indications to manipulation and who had not been treated within the past month were accepted into the study.
Treatment was left to the discretion of the chiropractors who used chiropractic manipulation on most patients or of the hospital staff, who most commonly used Maitland's technique of mobilization or manipulation or both. Main outcome measures included changes in the score on the Oswestry Pain Disability Questionnaire and in the results of straight leg raising and lumbar flexion.

The results indicated that chiropractic treatment (high-velocity, low-amplitude adjustments in virtually all of the cases) was more effective than hospital outpatient management (Maitland's technique of mobilization, manipulation or both), mainly for patients with chronic or severe back pain. A benefit of about 7% points on the Oswestry Scale was seen at 2 years. The benefit of Chiropractic treatment became more evident throughout the follow-up period. Secondary outcome measures also showed that Chiropractic was more beneficial. The authors concluded that for patients with low back pain in whom manipulation is not contra-indicated, Chiropractic almost certainly

confers worthwhile, long-term benefit in comparison with hospital outpatient management. The benefit is seen mainly in those with chronic or severe pain. It was further stated that consideration should be given to introducing Chiropractic into the National Health Service, either in hospitals or by purchasing Chiropractic treatment in existing clinics.
Assendelft et al. (1992) in a later review of randomized clinical trials, stated that this study was the "best" randomized clinical trial ever planned, with regard to the methodology, on the topic of spinal manipulation as a treatment for low back pain.

Myburgh (1998) conducted a study to evaluate the relative effectiveness of spinal manipulation to specific passive mobilization (Maitland Technique) in order to determine which therapy method is more beneficial in treating uncomplicated mechanical low back pain. This randomised clinical trial consisted of a sample of 30 patients, diagnosed as suffering from a posterior facet syndrome of the lumbar spine, a sacro-iliac syndrome or a combination of the two conditions. According to their diagnosis, each group of 15 patients received the appropriate spinal manipulation or mobilization, with a frequency of 3 treatments per week for 2 weeks and a one-month follow-up consultation.
Subjective data was obtained from the response of patients to the Numerical Pain Rating Scale 101 questionnaire and the Oswestry Back Disability Index.
Objective data was gathered from goniometric and pressure algometer measurements. This information was collected before treatment at visits 1, 6 and at the one month follow-up consultation.

Intra-group comparison of the results indicated that only the manipulation group showed a significant ($p < 0.025$) improvement between the initial visit and the one month follow-up consultation with respect to the subjective data.
For the objective data, over the same time period, the mobilization group showed significant changes in flexion and right rotation values, as well as in pressure algometry measurements.
The manipulation group showed significant changes in all ranges of motion tested as well as pressure algometry measurements. The inter-group comparison revealed no statistically significant results, but due to the low power of the study the chance of a type

ll error was high, thus making the incorrect acceptance of the null hypothesis a possibility.

It was therefore concluded that both treatment groups responded equally well to the treatment protocol given. The author stated that further studies with larger sample sizes and greater specificity, utilizing these interventions are warranted.

It can be extrapolated from the study by Dawkins (1996) and Myburgh (1998) that both adjustments and mobilization may be equally effective in the treatment of uncomplicated mechanical thoracic spine pain, however one cannot draw a direct conclusion from this, as the thoracic region is a different region of the spine.

2.11 Conclusion

Thoracic spine pain may not be as common as cervical and lumbar pain, but it nevertheless can be as debilitating (Dreyfuss et al. 1994). Taking into account the fact that mechanical thoracic spine pain can be easily mistaken for visceral conditions, it is understandable why a misdiagnosis can result in unnecessary concern for the patient.

Manual therapy incorporates a wide variety of treatment protocols including manipulation and mobilization. Both manipulation and mobilization have been shown to have some benefits in the treatment of spinal dysfunction in terms of pain perception by the patient and range of motion. Manipulation has been shown to have a slightly more beneficial effect than mobilization. However, in the past more trials have been conducted utilizing manipulation. Mobilization, though, is a widely used method of treatment and thus, must be tested for its possible value (Frost and Klaber Moffett 1992). The relative effectiveness of these two treatments is important so as to determine one optimum treatment protocol.

There appear to be few recorded complications associated with adjusting the thoracic spine; mobilization is regarded as a more gentle form of treatment due to the lesser force directed to the joint and the ability of the patient to stop the treatment if desired. If passive oscillatory mobilization is found to be as effective as adjustments it may be the treatment of choice in patients suffering from an acute episode, or in patients who have risk factors that can be identified that are associated with adjustments. It should be borne in mind though, that the opposite may also be valid, in that manipulation would seem to instill greater mobility and pain relief immediately post-treatment.

This study will add to the available pool of knowledge on thoracic spine pain.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter includes a detailed description of the research methods employed in carrying out this study. It is presented in four sub-sections:

- Subjects
- Materials
- Procedures
- Data Analysis (Portney and Watkins 1993: 575-577).

3.2 Subjects

3.2.1 Sampling Procedure

Convenience sampling was employed in this study as a specific diagnosis was required for the study. Advertisements were placed in the local newspapers, on noticeboards at the Chiropractic Day Clinic itself, other Departments and areas on the Natal Technikon campus, tertiary institutions, local gymnasiums and community centres. Advertising was also conducted by word of mouth.

Patients then either phoned in enquiring about the study or presented to the Clinic with thoracic spine pain. Patients were then either telephonically interviewed or interviewed one-on-one to determine if they complied with the selection criteria of the study.

A slight modification of the fishbowl procedure was used in this study.
A sample size of 30 was utilized (study population = 60). The patients' were randomly allocated to two groups of 30 each. Group A was the spinal manipulation group and Group B was the mobilization group. Each patient was required to draw a folded piece of paper, from a box provided, with their eyes closed. There were 60 pieces of paper in the box; 30 marked "A", and 30 marked "B". The patient's who chose the piece of paper marked "A" received spinal manipulation, whilst the patients who chose the piece of paper marked "B" received mobilizations (Drew 1980:202).
Therefore in the context of the clinical trial sufficient sampling was conducted to ensure an experimental design.

3.2.2 Inclusion and Exclusion Criteria

a) The patient had to be between the ages of 16 and 60 years (Schiller 1999).

b) Only patients diagnosed as having mechanical thoracic spine pain were included in the study. Mechanical thoracic spine pain is characterised by the following symptoms and signs:
   - joint dysfunction at the affected level - pain and tenderness, abnormalities in alignment, joint mobility and tissue texture (Bergmann et al.1993:63).
   - positive Kemps test (Schafer and Faye 1990:217).
   - positive facet joint challenge (Gatterman 1990:84).
   - midline back pain
   - non-dermatomal referred pain that is difficult to localise
   - no signs of nerve root tension and no major neurological deficit.
   - reduced range of motion, especially extension (Triano et al.1992).

c) Patients' who received any other treatment for their condition or a co-existing condition were excluded from the study. This was done in order to limit the amount of variables in the study and hence increase the validity of the results.

d) Patients' who received worker's compensation, disability insurance or were involved in litigation for their thoracic spine pain were excluded from the study (Schiller

1999).

This was to avoid any legal complications during the course of the study.

e) Those patients' with active or latent myofascial trigger points were not excluded from the study (Schiller 1999). However, if myofascial pain and dysfunction syndrome was found to be the primary cause of the patient's symptoms and signs, then these patients' were excluded from the study. The reason for this being that myofascial trigger points in the paraspinal muscles can cause similar pain to that of apophyseal joint sprains (Travell and Simons 1983 1 : 645-646).

f) Patients' with evidence of contra-indications to spinal adjustments (Haldeman 1992:557-572) or mobilizations (Thomson et al. 1991:445) were excluded from the study.

g) Only patients' with chronic thoracic spine pain as defined according to the Quebec study were included., i.e. the duration of symptoms experienced by the patient must have been greater than 50 days (Leblanc 1987). Such a categorization contributed towards selecting a homogenous sample as recommended by Schiller (1999). Furthermore, it appears that mechanical thoracic spine pain of a chronic nature (as compared to acute, subacute or recurrent) is most common (Schiller 1999).

h) If radiographs were deemed necessary to confirm a diagnosis, these patients were automatically excluded. The reasoning behind this being that there are no characteristic radiologic changes associated with joint dysfunction (Mennell 1992:29).

The diagnosis of subluxation/dysfunction is primarily a clinical diagnosis based on the patient's presentation and on physical findings. Often, it is suspected after other conditions with a similar presentation have been excluded (Bergmann 1993 :62).

Those patients considered by the researcher to be suitable for the study were accepted; an initial consultation was then scheduled during which, an informed consent form (Addendum B) was signed by the patient. A case history, full physical examination and regional examination of the thoracic spine was then performed.

3.3 Materials

3.3.1 Objective Measurement

3.3.1.1 The Algometer

An algometer was utilized to assess the pressure threshold of each patient. Pressure threshold is referred to as the minimum pressure (force) that induces pain or discomfort. Pressure threshold has been shown to be useful for the evaluation of immediate effects to physiotherapy, and the adequateness of the intensity of treatment (Fischer 1987). After conducting his study on 50 patients, Fischer concluded that changes in pressure threshold, obtained under standard clinical conditions, can be regarded as reliable data and also correlates well with changes of clinical status.

Vernon et al. (1990) in their study on a group of 9 patients found the pressure pain threshold meter to be very useful in assessing the effect of a single manipulation as compared to a single rotational mobilization in the cervical spine of subjects suffering from chronic mechanical neck pain.

Rainwater III and McNeil (1991) described the instrumentation and mechanical workings of the "pressure threshold meter" as highly reliable and sensitive in their synopsis of the literature on the algometer.

Antonaci et al. (1992) in their study on 40 control individuals concluded that the assessment of pain perception threshold in the head using a pressure algometer may prove useful in clinical head-ache practice.

The pressure threshold measurement for each patient was obtained in the following manner:

The maximum area of pain over the facet joint was first identified. The rubber-tipped stylus of the algometer was then placed over this maximum area of pain with the researcher ensuring that the force dial was perpendicular to the skin surface. Steady, gentle pressure at a rate of 1 kilogram per square centimeter per second was applied by the examiner until the patient first felt pain, in which case he/she responded by saying "now". The stylus was then removed and the measurement recorded in kilograms per square centimeter.

A test run was first conducted on the palm of the patient's hand before the measurements were taken so as to familiarise the patient with the procedure.

If more than one painful area was present, measurements were taken from these areas and the average was calculated and utilized in data analysis.
The algometer was supplied by Wagner Instruments (P.O.Box 1217, Greenwich, CT 06836, USA).

3.3.2 Subjective Measurements

3.3.2.1 The short-form McGill Pain Questionnaire (Addendum G)

The short-form McGill Pain Questionnaire was used to evaluate the quality of the patient's pain responses. According to Melzack (1987) this questionnaire has become one of the most widely used tests for the measurement of pain and provides valuable information on the sensory, affective and evaluative dimensions of pain experience. Melzack (1987), in his study, concluded that this questionnaire takes about 2-5 minutes to administer, the words are simple and the intensity ranking of mild, moderate and severe understood by every patient who was tested.

Furthermore, the McGill Pain Questionnaire has been demonstrated to be a reliable, valid and consistent measurement tool. It is available for use in specific research settings when the time to obtain information from patients is limited and when more information than simply the intensity is required (Melzack and Katz 1999).

The questionnaire itself consists of 15 descriptions of pain, 11 sensory and 4 affective. Patients' were required to indicate their description of pain and to further rank it according to severity (mild, moderate or severe).

The pain responses were graded as:

0-----no pain

1-----mild pain

2-----moderate pain

3-----severe pain

A total out of 45 for the 15 types of pain listed, was calculated and converted into a percentage. This was utilized in the analysis of the data.

3.3.2.2 The Numerical Pain Rating Scale-101 Questionaire (NRS-101) (Addendum F)

The (NRS-101) was employed to measure subjective pain intensity. In a comparative study of 6 pain intensity measures, Jensen et al. (1986) found the NRS-101 to be the most practical index. It is extremely simple to administer and score and can be measured either in written or verbal form (Jensen et al. 1986).

In their study, to compare the responsiveness of three pain scales, Bolton and Wilkinson (1998) concluded that given the relative ease of use of the 11-point NRS, this scale is recommended for pain intensity measurement in most types of outcome studies.

The NRS-101 required the patient to rate their level of pain intensity on a numerical scale from 0 to 100 with 0 representing "no pain" and 100 representing "pain as bad as it could be".

The responses for least and worst pain were then added and divided by 2 to obtain an average. This average was then used for statistical analysis.

3.4 Procedures

The objective measurement was assessed before and after the first, third and fifth treatments whilst the subjective measurements were assessed before the first, third and fifth treatments.

At the first consultation, after the short-form McGill Pain Questionnaire and NRS-101 Questionnaire was completed, the algometer readings were taken and then motion palpation technique was carried out. This was performed as is referenced in Haldeman (1992:304-314) in order to determine the level (T1-T12), the side (right or left) and the direction (flexion, extension, right or left rotation or right or left lateral flexion) of the fixated joint. Other factors taken into account during identification of the affected joints were : pain and tenderness, asymmetry of vertebral segments, range of motion abnormalities, changes in the tone, texture and temperature of contiguous and associated soft tissues (Bergmann et al. 1993:63). After the symptomatic area had been identified, the patients' were then treated with their randomly selected intervention.

The adjustment group was positioned for their adjustment according to the diversified method of spinal manipulative therapy. The skin slack was first taken up and the researcher then gently sprung the joint to its end position. A thrust from this end position was then delivered using a high-velocity, low-amplitude, specifically directed force (Haldeman 1992:485).

The adjustment to be used was determined by the direction of loss of motion, i.e. 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 the techniques performed in the standing, supine, prone or seated positions as described by Bergmann et al. (1993:329-387):

- For restricted flexion and/or extension at segments between T1-T4, the bilateral thenar transverse (prone) and/or hypothenar spinous occiput (prone) were used.

- For restricted rotation and/or lateral flexion at segments between T1-T3, the thumb spinous prone/sitting or side posture were used. The hypothenar transverse (combination move and modified combination move) was used for segments between T1-T4.

- For restriction of flexion, extension, lateral flexion or rotation at segments between T4-T12 the bilateral thenar transverse (prone) or supine thoracic opposite side contact/same side contact or standing thoracic at segments between T3-T12 were employed.

- For restriction of lateral flexion and/or rotation at segments between T4-T12, the unilateral hypothenar transverse (prone) or hypothenar spinous transverse (prone) was used. The hypothenar transverse-sitting thoracic was used at segments between T3-T12.

- For restricted flexion, long axis distraction and extension malposition at segments between T3-T12, the standing thoracic long axis distraction was used.

According to accepted theory, the application of the above techniques is often accompanied by an audible cracking sound, which has been associated with the cavitation of an intra-articular gas bubble within the spinal zygapophyseal joints (Mierau et al. 1988, Sandoz 1969, Unsworth 1971, Meal 1986, Herzog 1993). Anecdotally, cavitation is believed to be an important aspect of spinal manipulative therapy, so much so that many clinicians rely on this sound to judge the effectiveness of their treatment, and may repeat a manipulation if they did not hear or feel cavitation occur (Herzog et al. 1993). Certain authors in the field of manual therapy are of the opinion that the audible cracking sound (cavitation) is essential to the success of the treatment (Sandoz 1976). However, others attach no special significance to the cracking sound (Grieve 1988:525-6). Mierau et al. (1988) consider the joint crack to be integral to the manipulative process and state that it is what separates manipulation in general from mobilization. Taking into account the above, the author felt that a cavitation sound was necessary for a successful manipulation technique. It appears that cavitation may be measured during spinal manipulative therapy using accelerometry and that a practitioner's perception of the occurrence of cavitation during spinal manipulative therapy is very accurate (Herzog et al. 1993).

Realizing that more than one technique is available to adjust a particular fixation, the decision on which technique to use was based on the success of the initial technique employed i.e. if the first technique failed (no audible sound), then the next technique was used.

The mobilization group received Maitland's technique of passive oscillatory mobilization as described in Chapter 2. The assistance of a physiotherapist, who trained directly under Maitland was sought prior to the commencement of this study. This was to ensure that correct application of the technique, as described by Maitland, was carried out.

In the thoracic spine region, the classic mobilization system of Maitland generally applies oscillations in the prone position (Flynn 1996 : 174).
Movement was produced by thumb pressures against the vertebrae and the direction chosen was in the direction that was stiff (Maitland 1986:95). The rhythm and grades of mobilization chosen for each patient was dictated by clinical findings. When pain was localized to the joint, the mobilization was done in the range that was pain-free but the movement was carried up to the point where pain began. When pain was felt at the beginning of the range, the mobilization was performed with very small rhythmical movements (grade l). As the technique increased the range of pain-free movement the mobilization was performed further into the range (grade ll). When resistance to movement was felt, there was a choice between a large- and a small-amplitude

movement. The small-amplitude stronger movements were used in the treatment of end-of-range pain. Large-amplitude movements were used when pain was felt through a large part of the available range. Cases with very little pain and predominantly restriction of movement were treated with grade IV movements.

Treatment consisted of approximately 3 or 4 mobilization sequences of the affected joint. One mobilization sequence consisted of 30 mobilizations which took 30 seconds to perform i.e., 1 mobilization/second. The number of mobilizations that were given in subsequent treatments were dependent on the patient's reaction to the previous treatment. If there was no undue reaction and the patient's symptoms and signs were not severe , much more was done than if the reverse was the case. Posterior-anterior central vertebral pressure, transverse vertebral pressure and posterior-anterior unilateral vertebral pressure were the 3 techniques that were utilized. Discrimination of the technique chosen was, as mentioned above, dependent on the patient's presentation (Maitland 1993 : 106, 107, 116, 242-248).

After the first treatment, the algometer readings were taken. Patients received 5 treatments over a 2-week period. According to Mathews (1995), widely diverse results have been obtained in terms of studies conducted on the frequency and duration of treatment. Triano et al. (1992) found that thoracic spine disorders needed a mean of 3 treatments for clinical resolution. However, Schiller (1999) found that most patients showed improvement after the 4th treatment but she also noted that most of her patients conditions were chronic in nature and may therefore have required more treatments to reach resolution. After taking the above into account the above treatment frequency was decided upon i.e., 5 treatments over a 2-week period. If any of the patients recovered fully before the fifth treatment, the treatment was discontinued but the patient was still monitored over the 2-week period.

3.4.1 Flow Diagram Outlining Sequence of Events in this trial:

Advertising for recruitment of patients.

Potential patients telephonically interviewed or interviewed one-on-one.

Patient accepted.

Patient rejected.

Random allocation to treatment group.

Informed consent form signed.

Case history, full physical examination and regional examination conducted.

Patient fulfills inclusion criteria and therefore accepted.

Patient rejected due to exclusion criteria.

short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101 Questionnaire filled in by patient before treatment one. Algometer readings also taken.

Treatment one commenced – either spinal manipulation or mobilization.

Algometer readings taken after treatment one.

Treatment two carried out.

Short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101
Questionnaire filled in before treatment three.
Algometer readings taken.

Treatment three carried out.

Algometer readings taken after treatment three.

Treatment four carried out.

Short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101
Questionnaire filled in before treatment five.
Algometer readings taken.

Treatment five carried out.

Algometer readings taken.

3.5 DATA ANALYSIS

A random sample of 60 patients were utilized in this study (n1 = 30, n2 = 30). The inclusion of continuous (Numerical Rating Scale-101 and Algometer Readings) variables and an ordinal (short-form McGill Pain Questionnaire) scale necessitated the use of parametric and non-parametric tests respectively.

The statistical package SPSS was used to analyse the data obtained from the Questionnaires and Algometer Readings.

3.5.1 Intra-group Comparison (Manipulation group and Mobilization Group)

The Wilcoxon Signed Ranks Test was used to determine whether any significant improvement occurred within each group with regard to the short-form McGill Pain Questionnaire.

The paired t-test was used to determine whether any significant improvement occurred within each group with regard to the Numerical Rating Scale-101 and Algometer Readings.

For each group, comparison of the aforementioned tests, for each variable, were made at the following treatments : 1^{st} and 3^{rd}, 3^{rd} and 5^{th} & 1^{st} and 5^{th}.

For each test, the null hypothesis (Ho) states that there is no improvement between the two treatments being compared for each of the variables.
The alternative hypothesis (HA) states that there is a significant improvement.

α was set at a 0.05 level of significance.

Decision Rule :

The null hypothesis is rejected at the α level of significance if $p/2 < \alpha$ where p is the observed significance level or p-value. Otherwise the null hypothesis is accepted at the same level ($p/2 \geq \alpha$).

3.5.2 Inter-group comparison (Manipulation group versus Mobilization group)

The Mann-Whitney unpaired U test was used to compare the adjustment and mobilization groups with regard to the short-form McGill Pain Questionnaire.

The unpaired/independent t-test was used to compare the adjustment and mobilization groups with regard to the Numerical Rating Scale-101 and the Algometer Readings.

The above tests were used to determine whether any significant difference existed between the two groups at the 1st, 3rd and 5th treatments for each of the variables.

For each test, the null hypothesis (Ho) states that there is no difference between the thoracic spine adjustment group and the passive oscillatory mobilization group with respect to each variable.

The alternative hypothesis(H_A) states that there is a significant difference.

α was set at a 0.05 level of significance.

Decision Rule :

The null hypothesis is rejected at the α level of significance if $p < \alpha$ where p is the observed significance level or p-value. Otherwise the null hypothesis is accepted at the same level ($p \geq \alpha$).

3.5.3 Descriptive Statistics

This consisted of the mean, standard deviation and standard error of the mean for each variable. These results were used for additional interpretation of the results.

3.5.4 Bar-Charts

Visual representation of analytical findings were given by the use of bar-charts to compare the adjustment and mobilization groups with respect to the variables of interest. The mean values were used to construct the bar-charts.

CHAPTER FOUR

THE RESULTS

4.1 Introduction

This chapter begins with a description of the patients excluded during the course of the study. A comparison of the demographic data between the two groups is then furnished. The results attained after the raw data was subjected to statistical analysis, as outlined in chapter 3, is then reported in tabular form with relevant interpretations in narrative text. This chapter concludes with visual representation, of the inter-group comparison mean values, in the form of bar-charts.

4.2 Description of Patients Excluded

During the course of this study 77 patients were examined. Of these, 60 patients attended all the treatment sessions, whilst the remaining 17 were excluded for the following reasons:

- Two patients had been involved in motor vehicle accidents and required radiographs to rule out the possibility of a fracture. This was part of the exclusion criteria.
- One patient's symptoms suggested possible prostatic pathology.
- One patient had thoracic spine pain, neck pain and bilateral upper limb pain with associated swelling.
- One patient had trapezius myofasciitis with an associated cervical spine disorder.
- One patient had myofascial pain and dysfunction syndrome only.
- One patient had an upper lumbar spine problem only.
- One patient's history was complicated and necessitated radiographs before treatment could be implemented. This was part of the exclusion criteria as mentioned above.

- Two patient's didn't have a thoracic spine problem upon examination, although they stated that they had been experiencing pain at the time that they phoned in. However a scheduled examination a few days later elicited no significant findings which tallied with the patients version of the pain having greatly resolved - 1 patient's pain had resolved on its own, whilst the other patient (naive to adjustments) stated that relief was obtained after his mother had "adjusted" his back.

The exclusion of 7 patients on whom treatment had already begun, occurred. All these patients were in the mobilization group. The reasons were, as follows:

- One patient had to undergo a hysterectomy and therefore didn't complete the last treatment.
- One patient didn't complete the final treatment as she felt the pain was too severe and she therefore opted for treatment by her general practitioner.
- Four patients cited family emergencies for their failure to complete all treatments.
- One patient didn't complete the treatment due to time constraints.

Key for Abbreviations used in the following tables:

Group A	:	Spinal Manipulation Group
Group B	:	Mobilization Group
S.D.	:	Standard Deviation
S.E.M.	:	Standard Error of Mean
Tx	:	Treatment

4.3 DEMOGRAPHIC DATA

Table 4.1 Age Distribution within sample of 60 patients

AGE	GROUP A	GROUP B	TOTAL %
16 - 26	18	15	55
27 - 37	6	5	18
38 - 48	4	6	17
49 - 59	2	4	10

Table 4.2 Gender Distribution within sample of 60 patients

GENDER	GROUP A	GROUP B	TOTAL%
male	15	16	52
female	15	14	48

Table 4.3 Race Distribution Within Sample of 60 patients

RACE	GROUP A	GROUP B	TOTAL %
Asian	17	16	55
Black	2	4	10
Caucasian	10	8	30
Coloured	1	2	5

Table 4.4 Occupation within sample of 60 patients

OCCUPATION	GROUP A	GROUP B
student	19	15
housewife	1	2
secretary	2	2
technician	1	1
sells cash registers	1	0
retired	0	2
fashion designer	1	0
unemployed	0	3
autoelectrician	1	0
payroll administrator	0	1
chiropractor	1	0
self-employed	0	1
building contractor	1	0
pastor	0	1
mechanical engineering tutor	1	0
school principal	0	1
supervisor-shopfitter	1	0
laboratory assistant	0	1

4.4 Results of Data Analysis

4.4.1 Intra-group Comparison

Table 4.5 Comparison of treatment results 1 & 3 , 3 & 5 and 1& 5 using the Wilcoxon Signed Ranks Test to analyse data obtained from the short-form McGill Pain Questionnaire for Group A.

	MEAN	S.D.	p-value	MEAN	S.D.	
Tx.1	16.32	14.02	0.000	9.26	11.36	Tx. 3
Tx. 3	9.26	11.36	0.003	6.07	11.48	Tx.5
Tx. 1	16.32	14.02	0.000	6.07	11.48	Tx. 5

The null hypothesis is rejected at the $\alpha = 0.05$ level of significance for comparison at all the stipulated consultations. This therefore demonstrates a significant improvement between treatments 1 & 3, 3 & 5 and 1 & 5 with regard to the subjective data on quality of patients pain responses for group A.

Table 4.6 Comparison of treatment results 1 & 3, 3 &5 and 1 & 5 using the paired t-test to analyse data obtained from the Numerical Pain Rating Scale-101 Questionnaire for Group A.

	MEAN	S.D.	S.E.M.	p-value	MEAN	S.D.	S.E.M.	
Tx. 1	44.58	15.77	2.88	0.000	33.60	15.56	2.84	Tx. 3
Tx. 3	33.60	15.56	2.84	0.000	22.38	18.36	3.35	Tx. 5
Tx. 1	44.58	15.77	2.88	0.000	22.38	18.36	3.35	Tx. 5

The null hypothesis is rejected at the $\alpha = 0.05$ level of significance for comparison at all of the stipulated consultations. This therefore demonstrates a significant improvement between treatments 1 & 3, treatments 3 & 5 and treatments 1 & 5 with regard to the subjective data on pain intensity measurement for Group A.

Table 4.7 Comparison of treatment results 1 & 3, 3 & 5 and 1 & 5 using the paired t-test to analyse data obtained from the Algometer Readings (before) for Group A.

	MEAN	S.D	S.E.M	p-value	MEAN	S.D.	S.E.M	
Tx. 1	2.49	0.82	0.15	0.732	2.54	1.06	0.19	Tx. 3
Tx. 3	2.54	1.06	0.19	0.240	2.71	1.31	0.24	Tx. 5
Tx. 1	2.49	0.82	0.15	0.101	2.71	1.31	0.24	Tx. 5

The null hypothesis is accepted at the $\alpha = 0.05$ level of significance for comparison at all of the stipulated consultations. This therefore implies that no improvement can be demonstrated between treatments 1 & 3, 3 & 5 and 1 & 5 with regard to the objective data (assessed before the treatments) on pressure threshold measurement for Group A.

Table 4.8 Comparison of treatment results 1 & 3, 3 & 5 and 1 & 5 using the paired t-test to analyse data obtained from the Algometer Readings (after) for Group A.

	MEAN	S.D.	S.E.M.	p-value	MEAN	S.D.	S.E.M.	
Tx. 1	2.66	0.92	0.17	0.466	2.78	1.18	0.22	Tx. 3
Tx. 3	2.78	1.18	0.22	0.918	2.79	1.29	0.23	Tx. 5
Tx. 1	2.66	0.92	0.17	0.407	2.79	1.29	0.23	Tx. 5

The null hypothesis is accepted at the $\alpha = 0.05$ level of significance for comparison at all of the stipulated consultations. This therefore implies that no improvement can be demonstrated between treatments 1 & 3, 3 & 5 and 1 & 5 with regard to the objective data (assessed after the treatments) on pressure threshold measurement for group A.

Table 4.9 **Comparison of treatment results 1 & 3, 3 & 5 and 1 & 5 using the Wilcoxon Signed Ranks Test to analyse data obtained from the short-form McGill Pain Questionnaire for Group B.**

	MEAN	S.D.	p-value	MEAN	S.D.	
Tx. 1	22.81	15.19	0.001	15.07	13.94	Tx. 3
Tx. 3	15.07	13.94	0.007	11.63	15.26	Tx. 5
Tx. 1	22.81	15.19	0.000	11.63	15.26	Tx. 5

The null hypothesis is rejected at the $\alpha = 0.05$ level of significance for comparison at all of the stipulated consultations. This therefore demonstrates a significant improvement between treatments 1 & 3, 3 & 5 and 1 & 5 with regard to the subjective data on quality of patients pain responses.

Table 4.10 Comparison of treatment results 1 & 3, 3 & 5 and 1 & 5 using the paired t-test to analyse data obtained from the Numerical Pain Rating Scale-101 Questionnaire for Group B.

	MEAN	S.D.	S.E.M.	p-value	MEAN	S.D.	S.E.M	
Tx. 1	53.32	14.95	2.73	0.002	43.05	18.67	3.41	Tx. 3
Tx. 3	43.05	18.67	3.41	0.001	30.97	22.64	4.13	Tx. 5
Tx. 1	53.32	14.95	2.73	0.000	30.97	22.64	4.13	Tx. 5

The null hypothesis is rejected at the $\alpha = 0.05$ level of significance for comparison at all of the stipulated consultations. This therefore demonstrates a significant improvement between treatments 1 & 3, 3 & 5 and 1 & 5 with regard to the subjective data on pain intensity measurement for group B.

Table 4.11 Comparison of treatment results 1 & 3, 3 & 5 and 1 & 5 using the paired t-test to analyse data obtained from the Algometer Readings (before) for Group B.

	MEAN	S.D	S.E.M	p-value	MEAN	S.D.	S.E.M	
Tx. 1	2.2	1.06	0.19	0.515	2.3	1.04	0.19	Tx. 3
Tx. 3	2.3	1.04	0.19	0.001	2.77	1.27	0.23	Tx. 5
Tx. 1	2.2	1.06	0.19	0.010	2.77	1.27	0.23	Tx. 5

The null hypothesis is accepted at the $\alpha = 0.05$ level of significance for comparison at consultations 1 & 3 and 1 & 5 but rejected for consultations 3 & 5.

This therefore implies that no improvement can be demonstrated between treatments 1 & 3 and 1 & 5 but that a significant improvement exists between treatments 3 & 5 with regard to the objective data (assessed before the treatments) on pressure threshold measurement for Group B.

Table 4.12 **Comparison of treatment results 1 & 3, 3 & 5 and 1 & 5 using the paired t-test to analyse data obtained from the Algometer Readings (after) for Group B.**

	MEAN	S.D.	S.E.M.	p-value	MEAN	S.D.	S.E.M.	
Tx. 1	2.14	0.97	0.18	0.038	2.44	1.2	0.22	Tx. 3
Tx.3	2.44	1.2	0.22	0.001	3.07	1.44	0.26	Tx. 5
Tx. 1	2.14	0.97	0.18	0.000	3.07	1.44	**0.26**	Tx. 5

The null hypothesis is rejected at the $\alpha = 0.05$ level of significance for comparison at all of the stipulated consultations. This therefore implies that a significant improvement exists between treatments 1 & 3, 3 & 5 and 1 & 5 with regard to the objective data(assessed after the treatments) on pressure threshold measurement for Group B.

4.4.2 Inter-group Comparison (Group A versus Group B)

Table 4.13 Comparison of Group A and Group B using the Mann-Whitney unpaired U test to analyse results obtained from the short-form McGill Pain Questionnaire at treatments 1, 3 and 5.

	GROUP A			GROUP B	
	MEAN	S.D.	p-value	MEAN	S.D.
Tx. 1	16.32	14.02	0.020	22.81	15.19
Tx. 3	9.26	11.36	0.012	15.07	13.94
Tx. 5	6.07	11.48	0.008	11.63	15.26

From the above table it can be seen that there is a significant difference between groups A and B at treatments 1, 3 and 5 with regard to the subjective data on quality of patients pain responses. Therefore, the null hypothesis is rejected for the short-form McGill Pain Questionnaire at the $\alpha = 0.05$ level of significance for treatments 1, 3 and 5.

Table 4.14 Comparison of Group A and Group B using the unpaired t-test to analyse results obtained from the Numerical Pain Rating Scale-101 at treatments 1, 3 and 5.

	GROUP A				GROUP B		
	MEAN	**S.D.**	**S.E.M.**	**p-value**	**MEAN**	**S.D.**	**S.E.M.**
Tx. 1	44.58	15.77	2.88	0.032	53.32	14.95	2.73
Tx. 3	33.60	15.56	2.84	0.037	43.05	18.67	3.41
Tx. 5	22.38	18.36	3.35	0.112	30.97	22.64	4.13

There is a significant difference between Groups A and B at treatments 1 and 3 with regard to subjective pain intensity measurement data. However, at the final treatment, there is no difference between the two groups.

Therefore, at the $\alpha = 0.05$ level of significance the null hypothesis is rejected for the Numerical Pain Rating Scale-101 at treatments 1 and 3 and accepted at treatment 5.

Table 4.15 Comparison of Group A and Group B using the unpaired t-test to analyse results obtained from the Algometer Readings (before) at treatments 1, 3 and 5.

	GROUP A				GROUP B		
	MEAN	S.D.	S.E.M	p-value	MEAN	S.D.	S.E.M
Tx. 1	2.49	0.82	0.15	0.235	2.20	1.06	0.19
Tx. 3	2.54	1.06	0.19	0.382	2.30	1.04	0.19
Tx. 5	2.71	1.31	0.23	0.859	2.77	1.27	0.23

There is no difference between Groups A and B at treatments 1, 3 and 5 with regard to objective pressure threshold measurement data (assessed before the treatments). Therefore the null hypothesis is accepted at the $\alpha = 0.05$ level of significance for treatments 1, 3 and 5.

Table 4.16 Comparison of Group A and Group B using the unpaired t-test to analyse results obtained from the Algometer Readings (after) at treatments 1, 3 and 5.

	GROUP A				GROUP B		
	MEAN	**S.D.**	**S.E.M.**	**p-value**	**MEAN**	**S.D.**	**S.E.M.**
Tx. 1	2.66	0.92	0.17	0.038	2.14	0.97	0.18
Tx. 3	2.78	1.18	0.22	0.278	2.44	1.2	0.22
Tx.5	2.79	1.29	0.23	0.427	3.07	1.44	0.26

There is a significant difference between groups A and B at treatment 1 with regard to objective pressure threshold measurement data (assessed after the treatments). However, at treatments 3 and 5 there is no difference between the two groups.

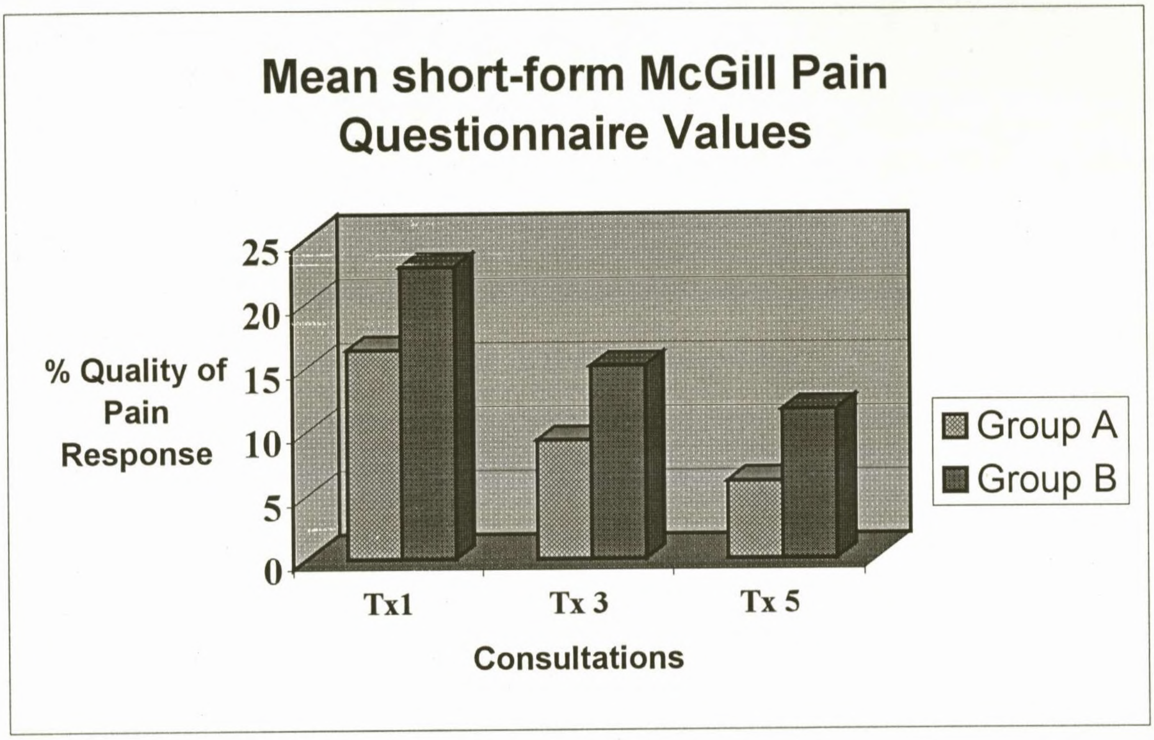
Therefore at the $\alpha = 0.05$ level of significance, the null hypothesis is rejected at the initial treatment and accepted for treatments 3 and 5.

4.5 Bar-Charts

Figures 4.1 - 4.4 are visual representations of the mean value changes of Group A and B found within the 1st, 3rd and 5th treatments.

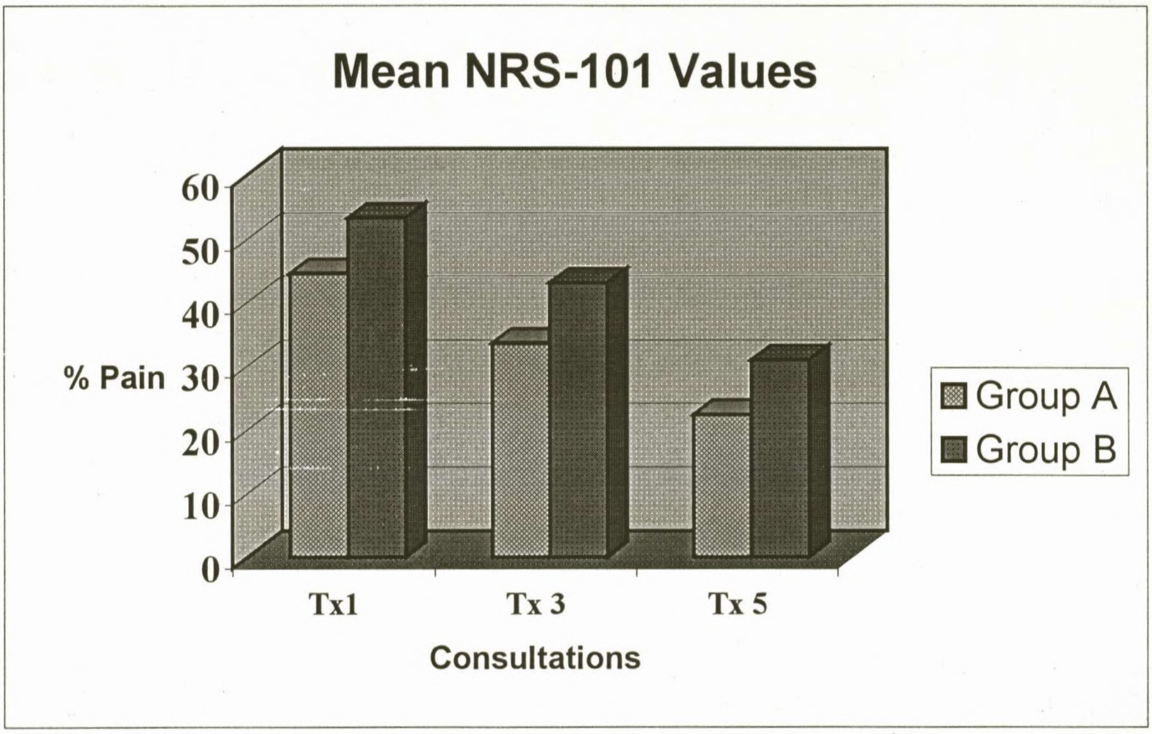
These graphs serve to indicate trends within the 2 groups.

Fig. 4.1



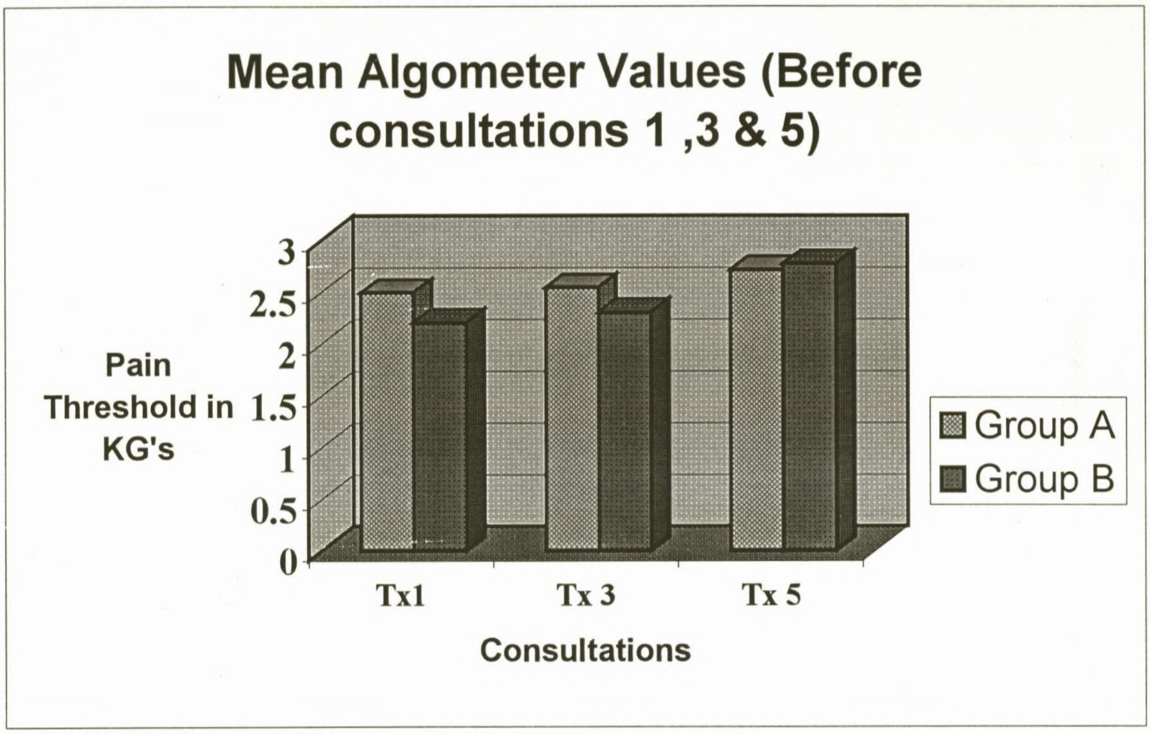
This figure indicates the changes in the mean percentage quality of pain response over the period of evaluation.

Fig. 4.2



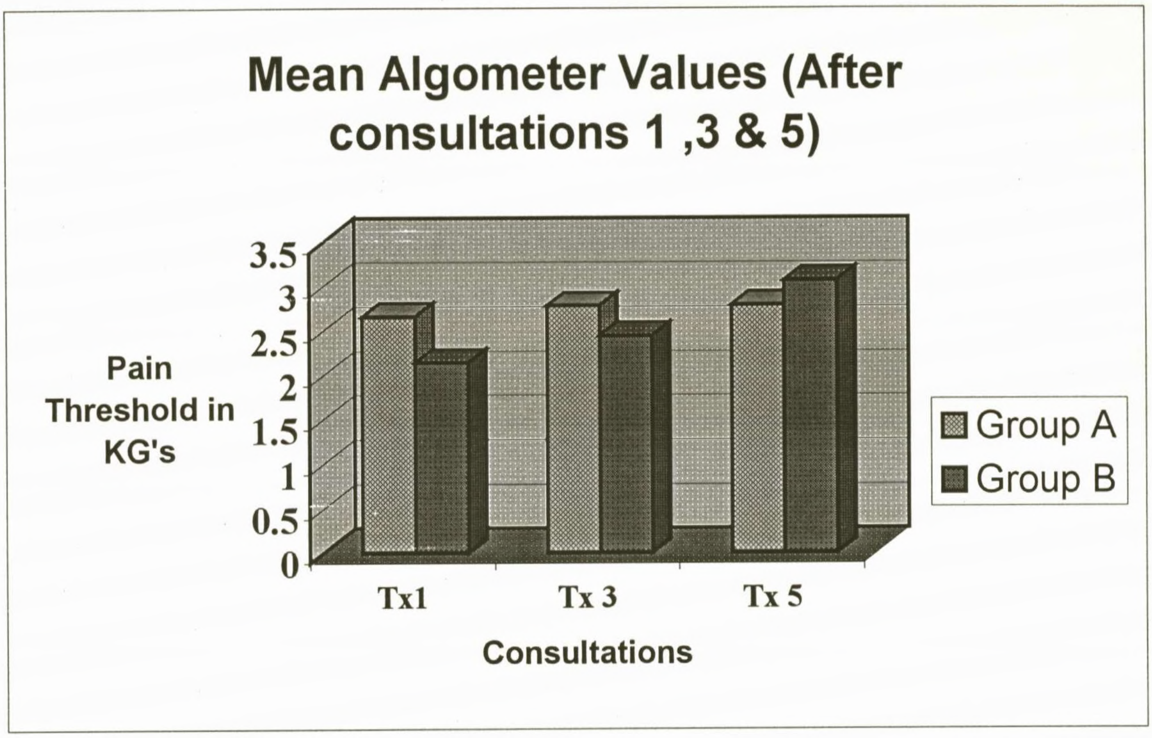
This figure indicates the changes in the mean percentage pain values over the period of evaluation.

Fig. 4.3



This figure indicates the changes in the mean pain threshold values before consultations 1, 3 and 5.

Fig. 4.4



This figure indicates the changes in the mean pain threshold values after consultations 1, 3 and 5.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

The results attained from the subjective and objective data, with regards to inter-group and intra-group comparison, as outlined in chapter 4 are discussed in this chapter. Chapter 6 then follows with details of recommendations for future studies and the study conclusions.

5.2 Intra-group Comparison

5.2.1 The Subjective Data

The statistical data are located in tables 4.5, 4.6, 4.9 and 4.10.

A significant improvement was noted in both the adjustment and mobilization group groups for the short-form McGill Pain Questionnaire and the Numerical Pain Rating Scale-101 Questionnaire. This occurred for the period between treatments one and three, three and five and one and five. This indicates that both groups were successful in significantly reducing the pain intensity measurement and quality of the patients pain responses.

Dawkins (1996) conducted a study to determine the effectiveness of adjustments versus mobilization in the treatment of mechanical neck pain. He found that a significant decrease for pain was experienced after the first treatment for both the adjustment and mobilization groups for the short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101 Questionnaires. The adjustment group experienced a further decrease in pain over the three week treatment period for both questionnaires as compared to the mobilization group.

Possible explanations for the differences would include the following:

a) Different sample sizes used.
b) Different types of mobilization techniques employed.
c) Different regions of the spine examined.

The results of this study, for intra-group comparison, were in contrast to that of Myburgh (1998), which was designed to determine the relative effectiveness of specific passive mobilization versus spinal manipulation in the treatment of uncomplicated mechanical low back pain. In Myburgh's study, only the manipulation group showed significant improvement for the Oswestry and Numerical Pain Rating Scale-101 Questionnaires as compared to the mobilization group. According to Myburgh, there was a strong possibility that certain significant results were missed with regard to the mobilization group, as the power values indicated a low power for the results gained for this group.

5.2.2 The Objective Data

The statistical data are located in tables 4.7, 4.8, 4.11 and 4.12.

No improvement could be demonstrated in the algometer measurements during the period between the first and the third treatments, the third and the fifth treatments and the first and the fifth treatments for the adjustment group (for both before and after the treatments).

In contrast, the mobilization group showed a significant improvement during this same period for measurements taken after the treatments. However, with regard to the measurements taken before the treatments, the mobilization group only showed a significant improvement for the period between the 3rd and 5th treatments.

The findings of this study with regard to pressure threshold measurement is in contrast to that of Myburgh (1998). In his study, a significant improvement in the algometer measurements were found during the period between the first visit and the one month follow-up for the mobilization group whilst the adjustment group showed a significant decrease in pain over the 2 week treatment period which was still evident 4 weeks after treatment was discontinued.

5.3 Inter-group Comparisons

5.3.1 The Subjective Data

The statistical data for the short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101 Questionnaire are located in tables 4.13 and 4.14 respectively.

Statistical analysis revealed that there was a significant difference between the 2 groups at the first, third and fifth treatments for the short-form McGill Pain Questionnaire.

Statistical analysis of the Numerical Pain Rating Scale-101 Questionnaire revealed a significant difference between the two groups at treatments one and three. However at the final consultation, both treatments were equally effective for pain intensity measurement.

A significant difference between the 2 groups before the 1st treatment for both the short-form McGill Pain Questionnaire and the Numerical Pain Rating Scale-101 Questionnaire suggests that the symptomatology caused by mechanical thoracic spine dysfunction differed between the 2 groups initially. A further comparison of the mean values for this first treatment suggests that the symptoms experienced by patients in the mobilization group were more severe than that of the manipulation group patients.

The manipulation group appeared to fare better than the mobilization group by treatments 3 and 5 with regard to the short-form McGill Pain Questionnaire.

The manipulation group again performed better than the mobilization group by treatment 3 for the Numerical Pain Rating Scale-101 Questionnaire, but this observation was nullified by treatment 5. It is possible that by the fifth visit, patients were unable to detect a subjective change in pain and therefore reverted to their previous rating comment.

This suggests that manipulation was more effective than mobilization for the subjective data on quality of patients pain responses and pain intensity measurement.

The finding that the manipulation group performed better than the mobilization group by treatment 3 for the Numerical Pain Rating Scale-101 Questionnaire is, to a certain extent, in agreement with the study by Cassidy et al. (1992). Their study evaluated the immediate results of manipulation to mobilization in neck pain patients, in which overall pain improvement in the Numerical Pain Rating Scale-101 Questionnaire was more than 1.5 times greater in the manipulated patients when compared to the mobilized patients after a single treatment.

The overall findings for the subjective data on inter-group comparison is in contrast to the findings of Myburgh (1998). Possible reasons for the difference would include the small sample size of 15 utilized in Myburgh's study, which thus increased the chance of a type ll error occurring, as well as not being able to indicate small but significant differences in the mean, which only appear with larger samples. Also, a different region of the spine was examined in this study and a different response could be reasonably expected.

In Dawkins (1996) study, it was found that the adjustment group performed better than the mobilization group after the 1st treatment only for both the short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101 Questionnaire, on inter-group comparison. This correlated with the findings of this study although comparative improvement in the manipulation group was still evident by treatments 3 and 5 for the short-form McGill Pain Questionnaire.

5.3.2 The Objective Data

The statistical data for the Algometer Readings are located in table 4.15 and 4.16.

On statistical analysis no difference could be detected between the 2 groups before the 1st, 3rd and 5th treatments for the Algometer Readings.

Statistical analysis revealed that there was a significant difference between both groups after treatment one. However at consultations three and five both treatment protocols produced similar results for objective pressure threshold measurement.

No difference between the 2 groups of patients before the 1st treatment suggests that the severity of symptoms experienced by the 2 groups of patients was similar initially.
By the 3rd and 5th treatments (before) both treatment approaches were equally effective for objective pressure threshold measurement.

On statistical analysis, a significant difference between both groups could be detected after treatment one. Spinal manipulation seemed to reduce pain more effectively than mobilization immediately after the treatment for objective assessment.

However, by consultations 3 and 5 (after) both treatment protocols produced similar results for objective pressure threshold measurement.

The finding that spinal manipulation was more effective than mobilization in terms of pain threshold immediately after the first treatment is supported, to a certain extent, by the findings of Terret and Vernon (1984). Their study assessed the response of paraspinal cutaneous pain tolerance measurements to spinal manipulation. It was conducted on the thoracic spine (T1-T10). And spinal manipulation was compared to a control "mobilization" (P-A joint springing action) procedure. A statistically significant elevation of pain tolerance occurred after manipulation as compared to the "control" group. However, in contrast to this study, the manipulation group in Vernon's study maintained a distinct and progressive elevation in pain tolerance.
The following factors may account for the differences:

a) The use of a Siemen's Neurotron Stimulator in Terret and Vernon's (1984) study to assess pain tolerance as opposed to the algometer in this study.

b) Pain threshold, not pain tolerance was assessed in this study.

c) The mobilization protocol used in this study was more specific.

Further support is lent by Vernon et al's (1990) study. They evaluated 9 patients with chronic mechanical neck pain for pressure pain threshold (PPT) over standardised tender points in the paraspinal area surrounding a lesion that required spinal manipulation.
One group received an oscillatory mobilization (n=4) of the cervical spine (control procedure) whilst the other group (n=5) received a rotational manipulation of the cervical spine.
Pre-post measurements of PPT showed a mean increase in PPT of 40-56% for the manipulation group after only 1 treatment.

Vernon et al. (1990) stated that the above 2 studies provided preliminary support for the empirical finding of pain relief subsequent to manipulation and to the theory that this pain relief is a result of reflex mechanisms activated specifically by the dynamic thrust. They stated that this was especially so, since no subject admitted that manipulation was painful. However, in this study it was noticed that many of the patients in the manipulation group complained of local discomfort after the treatment.

Myburgh (1998) did not find any significant difference between the spinal manipulation and mobilization groups for the algometer readings in his study. This is in contrast to the findings of this study for treatment 1. This again could possibly be attributed to the small sample size of 30 used, which makes the chance of a type ll error occurring, possible.

A study conducted by Cote et al. (1994) to evaluate the pain threshold of selected myofascial points in subjects with chronic mechanical back pain after a single manipulation or mobilization failed to demonstrate any significant difference.
The small sample size of 30 and the generalized mobilization procedure could account for the difference.

5.4 Overall Conclusion of Results

The statistical analysis of the study indicated that both spinal manipulation and passive oscillatory mobilization are effective manual interventions for reducing pain intensity and quality of patients pain responses in the treatment of chronic mechanical thoracic spine pain.

Comparatively though, the manipulation group appeared to achieve better results overall, as compared to the mobilization group. Spinal manipulation therefore appears to be more beneficial than passive oscillatory mobilization in the treatment of chronic mechanical thoracic spine pain.

5.5 Limitations of the Study

5.5.1 Homogeneity

According to Mohseni-Bandpei et al. (1998) special attention should be paid to factors such as duration of complaints, age and occupation in order to obtain studies of higher quality. Similarity of relevant baseline characteristics was one of the criteria they used to assess the methodological quality of randomised controlled trials reviewed.
In this study, only patients with chronic thoracic spine pain were treated as recommended by Schiller (1999). This categorization helped to ensure a more homogenous study population which would therefore allow for greater accuracy and reliability of results.

From a review of the demographic data in this study it can be seen that the 2 groups were very similar in age, gender and race distribution but not that similar in terms of occupation.

The majority of the patients in this study fell into the 16-26 year age group. The following reasons could account for this:

1) This study was held at the Chiropractic Day Clinic which is situated on a Technikon campus and hence easily accessible to young students. The posture assumed by

the vast majority of students during studying very often leads to thoracic spine pain. This was confirmed by the work of Harms-Ringdahl and Ekholm (1986) who identified extreme flexion positions of the lower cervical-upper thoracic spine to be a cause of thoracic spine pain in healthy individuals. This may also be the reason why Drews (1995), in a cross-sectional survey, found that thoracic complaints were more common at this same Chiropractic Day Clinic as compared to private Chiropractic practices in South Africa.

2) No restrictions were imposed on the number of students (including chiropractic students) allowed into the study - hence a large number of chiropractic interns presented for treatment. This finding concurred with that of Mior and Diakow's (1987) study, which found that chiropractors have a high prevalence of back pain.

An uneven racial distribution within the sample of 60 patients was also evident. Possible reasons for this discrepancy could include the fact that chiropractic is still fairly new to the people of South Africa. Chiropractic may be more familiar to some race groups as opposed to others due to a number of reasons which may include socio-economic factors, level of literacy and belief systems of different cultures.

The discrepancies in the study population with regard to the age group and racial distribution could possibly influence the interpretation of results.

5.5.2 <u>Blinding</u>

According to Haldeman (1992:48), in order to reduce bias in any trial, especially in controlled trials, elimination of observer, therapist, investigator and subject bias is an important goal.

As this study was conducted solely by the author, the possibility of practitioner bias exists. It was not practically possible to include independent observers to assess outcomes before and after the treatments in this study. The patients in this study were also aware of their group assignment. Hence, the lack of independent observers and double blinding may reduce the validity of this study.

5.5.3 <u>Study Size</u>

According to Mohseni-Bandpei <u>et al.</u> (1998) in their review of randomized controlled trials, one of the most important flaws seen in the trials, included the sample size of the study population.

In this study, a sample of 30 patients in each group was utilized. This was certainly a larger study population as compared to Myburgh's (1998), Dawkins (1996) and Schiller's (1999) study. However, an even larger study population would have lent additional strength to the study. In this study, it was not practically possible to use a larger study population due to the restriction of the budget and time.

5.5.4 <u>Outcome Measurements and Compliance</u>

According to Koes <u>et al.</u> (1995) there is a consensus that outcome measures should be valid, precise and sensitive for measuring small, but clinically relevant changes.
We cannot be absolutely certain that the outcome measures employed in this study best fulfill the above characteristics. It has been shown in chapter 3 though, that the subjective and objective measurements used in this study represent valid methods of assessing changes within patients. Nevertheless, the possibility exists that clinical changes of dysfunctional joints of the thoracic spine undergoing adjustments or mobilization have been incompletely measured.

Another possible shortcoming is the incorrect completion of the questionnaires by the patients due to misunderstanding. In this study, the researcher explained how to complete the questionnaires to each patient. Whether the patient completed it as requested, and as honestly as possible, remains uncertain though.
The patients in this study also stated that they avoided other forms of therapy for their condition whilst part of the study. However the researcher cannot be sure of this.
These factors could have biased the subjective results bringing about error.

The objective measurements could have been subject to observer bias.
The algometer, which is a manual instrument, has increments of 2°and subtle changes in

the readings may not have been noticed by the observer. An electronic algometer would have provided more accurate readings. This was not possible in this study due to financial constraints.

5.5.5 Drop-Outs

As stated in chapter 4, seven patients on whom treatment had already begun, had to be excluded. All these patients were in the mobilization group. This could have possibly influenced the results of the study.

5.5.6 Experience

According to Haldeman, (1992 : 418) one of the limitations of a clinical trial is that the technique being tested is not carried out by a practitioner professionally trained in the art. In this clinical trial, the author recognizes that her limited experience in the Chiropractic field and Maitland technique of mobilization could reduce the validity of this study.

5.6 Clinical Significance of the Study

Both spinal manipulation and passive oscillatory mobilization proved to be effective manual interventions with regard to the subjective data in the treatment of chronic mechanical thoracic spine pain. Overall, spinal manipulation proved to be superior to passive oscillatory mobilization.

It was the author's clinical impression whilst conducting the study that passive oscillatory mobilization appeared to be far more time-consuming than spinal manipulation. This observation becomes important when running a practice when one is trying to deliver effective and efficient treatment to patients. Treatment that is less time-consuming but as effective, if not more effective could prove to be more cost-effective to both the therapist and the patient.

Based on the results of this study, spinal manipulation should be the therapists first choice, especially when it is not contra-indicated, in the treatment of chronic mechanical thoracic spine pain. Since passive oscillatory mobilization has been proven to be an effective manual intervention in this study, it would be recommended over other types of mobilization in cases where spinal manipulation is contra-indicated.

Schiller (1999) found that moderate local discomfort was common in patients treated with spinal manipulative therapy. This finding was also noted by the author in this study. The author concurs with Schiller (1999) in that patients should be informed of possible side-effects prior to the thoracic spine being adjusted.

In this study, chronic thoracic spine pain was defined as the duration of symptoms experienced by the patient must have been greater than 50 days (Leblanc 1987).
It was noted by the author that the majority of the patients in this study were not fully improved by the 5th treatment and hence would have required more treatment sessions for their condition to resolve completely.

It is the author's opinion that treating a condition that is chronic is far more complex due to the type of joint dysfunction occurring in and around the joint at that stage.
The more chronic patients could have possibly had ligamentous fixations (involving shortening of the ligaments and contracture formation of the joint capsules) (Schafer and Faye 1989).
Therefore a multi-faceted approach may be required in chronic cases with a number of protocols being employed in order to adequately resolve the problem. For example, the therapist may need to advise the patient on posture, ergonomics, nutrition, exercise, stretches home care, etc, apart from the main treatment protocol.

In cases where patients may present with a severe episode of pain, passive oscillatory mobilization can be employed as a first line of treatment. This is due to the gentle nature of the passive oscillatory mobilization technique and the possible exacerbation of the condition should a high-velocity, low-amplitude adjustive thrust be employed. In fact, many of the patients in the mobilization group in this study commented that they felt quite relaxed after the treatment and complaints of post-treatment soreness was in the minority as compared to the manipulation group. Once the patient has sufficiently improved to tolerate an adjustment or reached a stage where no more improvement can be gained then spinal manipulation can begin to be employed in the treatment sessions.

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

6.1 Recommendations

Should this study be repeated, the following improvements, as suggested below, are recommended by the author.

1. **Sample Size**

A larger sample size should be selected, possible incorporating a stratified randomization procedure taking into account age-group, racial distribution, gender and occupation. This would enable one to be certain of a sample that is representative of the population. It would also aid in obtaining more valid trial conclusions and increase the accuracy of statistical analysis.

2. **Homogeneity**

The severity of the patients symptoms should be taken into account. Patients should be divided into mild, moderate and severe categories. This would enable greater similarity in baseline characteristics and allow for greater accuracy and reliability of results.

3. **Blinding**

Bias can be eliminated by utilizing an independent observer (not involved in the treatment) to assess the algometer readings and collect the subjective data. This observer should not be aware of which group the patient falls into.
According to Assendelft et al. (1992), patient naivete should be used as a substitute in a pragmatic type study where another treatment group is used as a reference.
This can be carried out by not entering patients into the study if they received either adjustments or passive oscillatory mobilization within 5 months of the study.

4. **Placebo Group**

A placebo group should be utilized in the study.

5. **Accuracy of Measurements**

More sensitive instrumentation is required in order to be able to detect small, but significant changes within treatments and hence increase the accuracy of readings. This would also decrease the chances of a type 1 error occurring.

6. **Follow-up Period**

According to Mohseni-Bandpei et al. (1998) more effort should be made to establish long-term follow-up, because lasting improvement will be the most convincing estimate of cost effectiveness. A follow-up period of at least 6 months is recommended so as to establish the long-term benefits of both treatment protocols.

7. **Experience**

Limited experience of any undergraduate researcher may bias the results of a study. It is therefore suggested that this study be repeated by more experienced manual therapists. Furthermore, since the Maitland technique of mobilization is utilized more extensively by physiotherapists, it is suggested that should a similar trial be conducted, an experienced physiotherapist perform Maitland's technique of mobilization and a more experienced chiropractor perform the spinal manipulations.

8. **Cross-over Design**

A cross-over design should be considered with the 2 groups.
Those patients not showing adequate symptoms and signs of improvement can be changed over to the opposite group to see if any improvement occurs.

9. **Other studies on the Thoracic Spine**

The costovertebral joint has been considered a candidate for producing back pain and/or pseudo-angina that may be ameliorated by spinal manipulation (Erwin et al. 2000).
In their study, Erwin et al. (2000) demonstrated that the costovertebral joint has the requisite innervation for pain production in a similar manner to other joints of the spinal column.

In this study, the costovertebral joints and costotransverse joints were not treated in

order to limit the amount of variables and hence increase the strength of the study.
Another study should consider treatment of the costovertebral joints and costotransverse joint alone or in conjunction with the thoracic facet joints.
Research into the incidence and prevalence of, and risk factors for, thoracic spine pain in South Africa is also required.

This study should be repeated on a population suffering from acute or subacute uncomplicated mechanical thoracic spine pain, so as to determine whether the duration of the complaint plays any role in the effectiveness of the treatment.

10. **Range of Motion Assessment**

Assessment of range of motion is a basic evaluation technique used during a neuromusculoskeletal examination of the spine. Few studies have measured the thoracic spine or treatment of the thoracic spine when range of motion has been limited (Gavin 1999).
In this study, range of motion was not assessed. Consideration should be given to assessment of range of motion in a replication of this study.

Conclusion

This was a prospective, randomised controlled clinical study. All patients had to be diagnosed with mechanical thoracic spine pain according to certain criteria. The study population consisted of 60 patients, who were randomly allocated to 2 groups of 30 each.

Group A received spinal manipulation and Group B received passive oscillatory mobilization over the area of pain. Both groups received a maximum of 5 treatments over a 2 week period.

Analysis of the data for intra-group comparison revealed a significant improvement in both the manipulation and mobilization groups for the short-form McGill Pain Questionnaire and Numerical Pain Rating Scale-101 Questionnaire for the period between treatments 1 & 3, 3 & 5 and 1 & 5. This indicated that both groups were successful in significantly reducing the pain intensity measurement and quality of the patients pain responses.

With regard to the algometer readings, no improvement could be demonstrated in the manipulation group for the period between the 1st & 3rd treatments, the 3rd & 5th treatments and the 1st & 5th treatments (for both before and after the treatments). In contrast, the90 mobilization group showed a significant improvement during this same period for measurements taken after the treatments.
However, with regard to the measurements taken before the treatments, the mobilization group only showed a significant improvement for the period between the 3rd and 5th treatments.

With regard to inter-group comparison, analysis of the data revealed a significant difference between the 2 groups before the 1st, 3rd and 5th treatments for the short-form McGill Pain Questionnaire. A significant difference was also evident between the 2 groups before treatments 1 and 3 for the Numerical Pain Rating Scale-101 Questionnaire. However, by the final consultation both groups were equally effective for pain intensity measurement.

Spinal manipulation proved to be more effective than mobilization for the subjective data on quality of patients pain responses and pain intensity measurement.

Analysis of the objective data revealed no difference before treatment 1 but a significant difference after the 1st treatment was evident. This was in favour of the spinal manipulation group. This effect was nullified by treatment 3 and 5.

This study indicates that both spinal manipulation and passive oscillatory mobilization are effective manual interventions for reduction of quality of patients pain responses and pain intensity measurement. Comparatively though, spinal manipulation proved to be superior to passive oscillatory mobilization.

Although this study was limited by its single researcher design, it supports the existing body of evidence in favour of spinal manipulative therapy. This study should be used as a base to plan future studies utilizing larger sample sizes and bearing in mind the above recommendations.

Chronic mechanical thoracic spine pain is a much more complex condition as compared to an acute or subacute presentation. This is due to the pathological processes involved in the manifestation of chronic thoracic spine pain. These may include the formation of adhesions, shortening of the ligaments or contracture of the joint capsules.
As such the treatment becomes even more complex. Apart from the treatment protocol employed, the therapist should address other possible contributing factors such as posture, stress, inadequate exercise or nutrition. This may be the long-term approach to prevention. Furthermore, maintenance care may be necessary in chronic cases.

It is the author's opinion that in cases of chronic mechanical thoracic spine pain, treated with spinal manipulation or passive oscillatory mobilization, the patients should show some degree of improvement by the 4th session. If this does not occur further investigations into the possible cause of the condition should take place.

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Addendum A

RESEARCH INFORMATION SHEET

Dear patient,

Title of Study: **The effectiveness of spinal manipulation compared to passive oscillatory mobilization in the management of chronic mechanical thoracic spine pain.**

This research project forms part of the requirement for completion of my Master's Degree in Technology : Chiropractic.
I, Vanessa Kogilam Pillay, will be conducting the study and will be supervised by Dr C. Myburgh.

The research study itself, involves comparing 2 types of treatment protocols (passive oscillatory mobilization and spinal manipulation) for the treatment of chronic mechanical thoracic spine/mid-back pain.
You will be randomly allocated to either the mobilization or manipulation group. You will be questioned extensively on your mid-back condition and your health in general. A thorough physical examination will be conducted and you will also be required to complete questionnaires, and measurements will be taken intermittently over the treatment period. Should you decide to participate in the study, it is important that you not take any form of medication for your condition during the study; please try to be as accurate as possible when completing the questionnaires and rating scales. Management will involve approximately 5 treatments over a 2 week period. Treatment is free of charge. You can be rest assured that all information disclosed will be kept strictly confidential. Should you require any further information pertaining to this study, please do not hesitate to ask.

Your participation in this study will certainly aid in contributing to the current body of knowledge on this subject, aid health therapists in making informed decisions on treatment protocols and ultimately benefit you, the patient, who would be the recipient of better treatment.

I thank you in anticipation of your co-operation.

______________________ Date :__________

Vanessa Kogilam Pillay

Addendum B

INFORMED CONSENT FORM
(To be completed by Patient/Guardian)

Date : ______________________

Title of research project : **The Effectiveness of Spinal Manipulation compared to Passive Oscillatory Mobilization in the Management of Chronic Mechanical Thoracic Spine Pain.**

Name of Supervisor : **Dr C. Myburgh**

Name of Research Student : **Vanessa Kogilam Pillay**

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

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

Please print in block letters:

Patient/Subject Name : ______________________ Signature :__________

Parent/Guardian Name : ______________________ Signature : __________

Witness Name : ______________________ Signature : __________

Research Student Name : ______________________ Signature : __________

Addendum C

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient:____________________________ Date: ________________
file #:_______ X-Ray#:________________
Age:_______ Sex:_______ Occupation:________________
Intern:______________________ Signature:________________

FOR CLINICIAN'S USE ONLY
Initial visit clinician:________________Signature:________________

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

Case Status:

PTT: Conditional: Signed Off: Final Sign out:

Recommendations:

Intern's Case History

1. Source of History:

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

3. Present Illness:

- Location
- Onset
- Duration
- Frequency
- Pain (Character)
- Progression
- Aggravating Factors
- Relieving Factors
- Associated S & S
- Previous Occurrences
- Past Treatment and Outcome

4. Other Complaints:

5. Past Medical History:

- General Health Status
- Childhood Illnesses
- Adult Illnesses
- Psychiatric Illnesses
- Accidents/Injuries
- Surgery
- Hospitalizations

8. Psychosocial history:

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

9. Review of Systems:

- General
- Skin
- Head
- Eyes
- Ears
- Nose/Sinuses
- Mouth/Throat
- Neck
- Breasts
- Respiratory
- Cardiac
- Gastro-intestinal
- Urinary
- Genital
- Vascular
- Musculoskeletal
- Neurologic
- Haematologic
- Endocrine
- Psychiatric

6. Current health status and life-style:

- Allergies
- Immunizations
- Screening Tests
- Environmental Hazards (Home, School, Work)
- Safety Measures (seat belts, condoms)
- Exercise and Leisure
- Sleep Patterns
- Diet
- Current Medication
- Tobacco
- Alcohol
- Social Drugs

7. Immediate Family Medical History:

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

Addendum D

TECHNIKON NATAL

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Patient:____________________File#: ____________________Date:__________
Clinician:____________________Signature:____________________
Intern:____________________Signature:____________________

1. VITALS

Pulse rate:
Respiratory rate:
Blood pressure: R L
Temperature:
Height:
Weight:

2. GENERAL EXAMINATION

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

Urinalysis:

3. CARDIOVASCULAR EXAMINATION

1) Is this patient in **Cardiac Failure** ?
2) Does this patient have signs of **Infective Endocarditis** ?
3) Does this patient have **Rheumatic Heart Disease** ?

Inspection
- Scars
- Chest deformity:
- Precordial bulge:
- Neck -JVP:

Palpation:
- Apex Beat (character + location):
- Right or left ventricular heave:
- Epigastric Pulsations:
- Palpable P2:
- Palpable A2:

Pulses:
- General Impression:
- Radio-femoral delay:
- Carotid:
- Radial:
- Dorsalis pedis:
- Posterior tibial:
- Popliteal:
- Femoral:

Percussion: - borders of heart

Auscultation:
- heart valves (mitral, aortic, tricuspid, pulmonary)
- Murmurs (timing,systolic/diastolic, site, radiation, grade).

4. RESPIRATORY EXAMINATION

1) Is this patient in **Respiratory Distress** ?

Inspection
- Barrel chest:
- Pectus carinatum/cavinatum:
- Left precordial bulge:
- Symmetry of movement:
- Scars:

Palpation
- Tracheal symmetry:
- Tracheal tug:
- Thyroid Gland:
- Symmetry of movement (ant + post)
- Tactile fremitus:

Percussion
- Percussion note:
- Cardiac dullness:
- Liver dullness:

Auscultation
- Normal breath sounds bilat.:
- Adventitious sounds (crackles, wheezes, crepitations)
- Pleural frictional rub:
- Vocal resonance
  - Whispering pectoriloquy:
  - Bronchophony:
  - Egophony:

5. ABDOMINAL EXAMINATION

1) Is this patient in **Liver Failure** ?

Inspection
- Shape:
- Scars:
- Hernias:

Palpation
- Superficial:
- Deep = Organomegally:

- Pupillary light reflexes = Direct:
  = Consensual:
- Fundoscopy findings:

III Ocular Muscles:
Eye opening strength:

IV Inferior and Medial movement of eye:

V a. Sensory - Ophthalmic:
- Maxillary:
- Mandibular:
b. Motor - Masseter:
- Jaw lateral movement:
c. Reflexes - Corneal reflex
- Jaw jerk

VI Lateral movement of eyes

VII a. Motor - Raise eyebrows:
- Frown:
- Close eyes against resistance:
- Show teeth:
- Blow out cheeks:
b. Taste - Anterior two-thirds of tongue:

VIII General Hearing:
Rinnes = L: R:
Webers lateralisation:
Vestibular function - Nystagmus:
- Rombergs:
- Wallenbergs:
Otoscope examination:

IX & X Gag reflex:
Uvula deviation:
Speech quality:

XI Shoulder lift:
S.C.M. strength:

XII Inspection of tongue (deviation):

Motor System:

a. Power
- Shoulder = Abduction & Adduction:
  = Flexion & Extension:
- Elbow = Flexion & Extension:
- Wrist = Flexion & Extension:

- Masses (intra- or extramural)
- Aorta:

Percussion
- Rebound tenderness:
- Ascites:
- Masses:

Auscultation
- Bowel sounds:
- Arteries (aortic, renal, iliac, femoral, hepatic)

Rectal Examination
- Perianal skin:
- Sphincter tone & S4 Dermatome:
- Obvious masses:
- Prostate:
- Appendix:

6. G.U.T EXAMINATION

External genitalia:
Hernias:
Masses:
Discharges:

7. NEUROLOGICAL EXAMINATION

Gait and Posture
- Abnormalities in gait:
- Walking on heels (L4-L5):
- Walking on toes (S1-S2):
- Rombergs test (Pronator Drift):

Higher Mental Function
- Information and Vocabulary:
- Calculating ability:
- Abstract Thinking:

G.C.S.:
- Eyes:
- Motor:
- Verbal:

Evidence of head trauma:

Evidence of Meningism:
- Neck mobility and Brudzinski's sign:
- Kernigs sign:

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

II External examination of eye:
- Visual Acuity:
- Visual fields by confrontation:

- Forearm = Supination & Pronation:
- Fingers = Extension (Interphalangeals & M.C.P's):
- Thumb = Opposition:
- Hip = Flexion & Extension:
  = Adduction & Abduction:
- Knee = Flexion & Extension:
- Foot = Dorsiflexion & Plantar flexion:
  = Inversion & Eversion:
  = Toe (Plantarflexion & Dorsiflexion):

b. Tone
- Shoulder:
- Elbow:
- Wrist:
- Lower limb - Int. & Ext. rotation:
- Knee clonus:
- ankle clonus:

c. Reflexes
- Biceps:
- Triceps:
- Supinator:
- Knee:
- Ankle:
- Abdominal:
- Plantar:

Sensory System:

a. Dermatomes
- Light touch:
- Crude touch:
- Pain:
- Temperature:
- Two point discrimination:

b. Joint position sense
- Finger:
- Toe:

c. Vibration:
- Big toe:
- Tibial tuberosity:
- ASIS:
- Interphalangeal Joint:
- Sternum:

Cerebellar function:

Obvious signs of cerebellar dysfunction:
= Intention Tremor:
= Nystagmus:
= Truncal Ataxia:

Finger-nose test (Dysmetria):
Rapid alternating movements (Dysdiadochokinesia):
Heel-shin test:
Heel-toe gait:
Reflexes:
Signs of Parkinsons:

8. **SPINAL EXAMINATION:**(See Regional examination)

Obvious Abnormalities:
Spinous Percussion:
R.O.M:
Other:

9. **BREAST EXAMINATION:**

Summon female chaperon.

Inspection
- Hands rested in lap:
- Hands pressed on hips:
- Arms above head:
- Leaning forward:

Palpation
- masses:
- tenderness:
- axillary tail:
- nipple:
- regional lymph nodes:

Addendum E

REGIONAL EXAMINATION - THORACIC SPINE

Patient: ______________________ File #: __________ Date: __________

Intern: ______________________ Signature: ______________

Clinician: ______________________ Signature: ______________

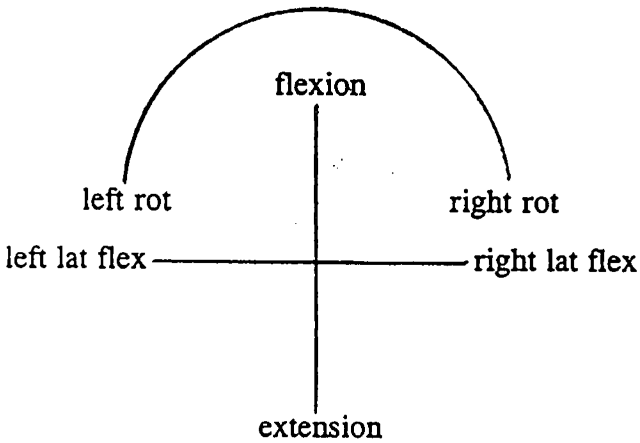
STANDING

Posture (incl. L/S & C/S):
Muscle Tone:
Skyline view - Scoliosis
Spinous Percussion
Breathing (quality, rate, rhythm, effort):
Deep inspiration

Scars:
Chest Deformity (pigeon, funnel, barrel):

RANGE OF MOTION

Forward flexion	20 - 45 degrees (15cm from floor)
Extension	25 - 45 degrees (15cm from floor)
L/R Rotation	35 - 50 degrees (15cm from floor)
L/R Lateral Flexion	20 - 40 degrees (15cm from floor)



RESISTED ISOMETRIC MOVEMENTS: (in neutral)

Forward flexion
L/R Rotation
Extension
L/R Lateral Flexion

SEATED:

Palpate Auxillary Lymph Nodes
Palpate Ant/Post Chest Wall
Costovertabral Expansion (3 - 7cm diff. at 4th intercostal space)
Slump Test (dural stretch test)

SUPINE:

Rib Motion

Soto Hall Test (#, sprains)

SLR

Palpate Abdomen

PRONE:

Passive Scapular Approximation

Facet Joint Challenge

Vertebral Pressure (P-A central, unilateral, transverse)

Active Myofascial Trigger Points:

- Rhomboid Major
- Lower Trapezius
- Serratus Posterior
- Pectoralis Major
- Quadratus Lumborum
- Rhomboid Minor
- Spinalis Thoracic
- Serratus Superior
- Pectoralis Minor

COMMENTS: ______________________________

____

NEUROLOGICAL EXAMINATION:

DERMATOMES

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
Left												
Right												

Basic LOWER LIMB neuro:

Dermatomes:

Myotomes:

Reflexes:

KEMPS TEST:

MOTION PALPATION:

Ribs: Calliper: Left:

Right:

Joint Play:

Bucket handle: Left:

Right:

Joint Play:

Motion Palpation: and Joint Play Left:

Right:

Basic Lumbar Exam:

History:

ROM:

Neuro/Ortho:

Basic Cervical Exam:

History

ROM:

Neuro/ortho:

Addendum F

THE NUMERICAL PAIN RATING SCALE 101

Patient Name: ______________________________

File No.:________

Date:____________

Treatment:_______

Please indicate on the line below the number between 0 and 100 that best describes the pain of your major problem **when it is at its least.** A zero (0) would mean "no pain at all" and one hundred (100) would mean "pain as bad as it could be". Please write only one number.

0 ____ 100

Please indicate on the line below the number between 0 and 100 that best describes the pain of your major problem **when it is at its worst.** A zero (0) would mean "no pain at all" and (100) would mean "pain as bad as it could be". Please write only one number.

0 ____ 100

Addendum G

SHORT-FORM McGILL PAIN QUESTIONNAIRE

Patient Name : ______________________________

File No : ______________ Date: ______________

Treatment : ____________

The following words are descriptions of pain that you may be experiencing. Please tick the column that best corresponds to your quality and intensity of pain. You may tick more than one column.

	NONE (())	MILD (1)	MODERATE (2)	SEVERE (3)
THROBBING				
SHOOTING				
STABBING				
SHARP				
CRAMPING				
GNAWING				
HOT-BURNING				
ACHING				
HEAVY				
TENDER				
SPLITTING				
TIRING-EXHAUSTING				
SICKENING				
FEARFUL				
PUNISHING-CRUEL				

Addendum H

ALGOMETER READINGS

Patient Name:______________________________________

File No.: _________

Date:____________

Treatment:_____

Location:__________________ Reading:__________________kg/cm²

Location:_____________________ Reading:__________________kg/cm²

Location:______________________ Reading:__________________kg/cm²

Location:______________________ Reading:__________________kg/cm²

Treatment:_________________________

Location:__________________ Reading:__________________kg/cm²

Location:_____________________ Reading:__________________kg/cm²

Location:______________________ Reading:__________________kg/cm²

Location:______________________ Reading:__________________kg/cm²