THE RELATIVE EFFECTIVENESS OF SPINAL MANIPULATIVE THERAPY COMPARED TO INTERFERENTIAL CURRENT THERAPY, IN THE TREATMENT OF MECHANICAL THORACIC BACK PAIN

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

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DEDICATION

I would like to dedicate this work to the two men in my life who have been by side every step of the way with their unconditional love and support.

To my father and my husband.

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ABSTRACT

The purpose of this study was to evaluate thoracic spine manipulation in comparison to interferential current therapy in order to determine the relative effectiveness of each treatment protocol in the management of mechanical thoracic back pain.

The design was that of a single blind, randomized, comparative pilot study. Sixty patients were selected from the general population, of which 30 patients made up group one and the other 30 patients made up group two.
After an extensive case history and physical examination the patients were diagnosed with mechanical thoracic spinal pain and then randomly divided into the two groups. The first group received spinal manipulative therapy and the second group received interferential current therapy.

All sixty patients received a minimum of three or up to a maximum of six treatments. The treatments were given two to three times a week.
Objective and subjective data was collected before the first, second and final treatment in order to assess the effectiveness of each treatment protocol.
The objective data consisted of thoracic range of motion using the BROM II goniometer and pain threshold using an algometer.
The subjective data was collected using the Short-form Pain Questionnaire, Numerical Pain Rating Scale -101 and the Oswestry Back Pain Disability Index Questionnaire.

The data gathered at the relevant appointments was then statistically analyzed, using a 95% ($\alpha = 0.05$) confidence level.
Inter-group analysis was performed using the Unpaired T- test and the Mann-Whitney U - test for the continuous and categorical variables respectively.

The Oswestry Back Pain Disability Index Questionnaire showed a statistical difference at the final visit when compared between the two groups.

The algometer and goniometer readings showed no statistical significance between the two groups when compared at the first, second and final treatments.

Intra-group analysis was performed using the Paired T - test and the Wilcoxon's Signed Rank test.
Statistical differences were noted in the intra-group comparisons of both groups, in both subjective and objective measurements.

In the intra-group objective measurement analysis, group one's goniometer changes showed more ranges of motion to be increased then the interferential group.
Spinal manipulative therapy increased ranges of motion in flexion, extension, right lateral flexion, left rotation and right rotation. Interferential therapy only affected left and right lateral flexion and right rotation.
Interferential therapy did show improvement in some range of motions but not as much as spinal manipulative therapy seemed to do.
The results seem to indicate that restoring the mechanical play in a dysfunctional joint with manipulation brings about efficient motion, decreases the surrounding muscle spasm and thus decreases pain (Mennell, 1990:7).

Both intra-group comparisons of algometer readings showed an improvement between the second and final visit as well as the first and final visit.

Intra-group comparison of all the subjective measurements in both the spinal manipulative and interferential therapy treatment groups showed statistical differences and improvements over the first, second and final treatment period.

Despite the improvements within each treatment group, the only statistical difference noted between the treatment groups was the Oswestry Back Pain Disability Index Questionnaire, which showed a significant change in the final visit. The statistical difference noted between the treatments was that manipulation was more effective in restoring the patient's function and

decreasing their disability by the end of the clinical trial than interferential current therapy.
All the other subjective data and objective readings showed no major statistical differences between spinal manipulative therapy and interferential current therapy.

The intra-group improvements though, of both manipulation and interferential current therapy proved that both therapies are effective in the treatment of mechanical thoracic back pain.
Future studies with more sensitive measuring instrumentation of the thoracic spine together with more limitations on possible occupations, gender and age groups will help isolate the strengths of these therapies. Blinding techniques need to be utilized to confirm the results and a one-month follow up will aid in determining the long lasting effects of manipulation and interferential current therapy in mechanical thoracic back pain.

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NRS-101: Numerical Rating Scale-101

IFC: Interferential current

SMT: Spinal manipulative therapy

DEFINITION OF TERMS

<u>Manipulation:</u>

A passive manual maneuver during which the three-joint complex (intervertebral disc and apophyseal joints) is suddenly carried beyond the normal physiological range of movement without exceeding the boundaries of anatomical integrity, with the object of restoring mobility to restricted areas. (Schafer and Faye. 1990, 34)

<u>Adjustment:</u>

The utilization of a short-lever technique to apply a specific, high-velocity, low amplitude controlled forceful thrust by hand or an instrument to a specific articulation. The articulation is carried beyond the normal physiological range of movement without exceeding the boundaries of anatomical integrity, in order to restore mobility to the restricted joint. (Leach, 1986:15)

<u>Fixation:</u>

The state whereby an articulation has become temporarily immobilized in a position that it may normally occupy during any phase of physiological movement (Haldeman, 1992: 623)

Goniometer:

An instrument for measuring angles (Gatterman, 1990: 408); in this study referring to a device specifically designed for measuring the angles of motion of the lower back and thoracic spine.

Mechanical spine pain:

Mechanical spine pain is the aberration of abnormal zygopophyseal joint play which is not under the control of the voluntary muscle system resulting in mechanical joint dysfunction (Mennell, 1990:9).

Thoracic spine:

The part of the vertebral column, which enters into the formation of the thorax. (Hensyl, 1990: 1450)

Interferential current therapy:

A form of electrical treatment in which two medium-frequency currents are used to produce a low-frequency effect. (Forster and Palastanga, 1985:107)

Joint dysfunction:

The loss of one or more movement within the normal range of motion, which is associated with pain. (Schafer and Faye, 1990: 27)

CHAPTER ONE

1.0 INTRODUCTION

1.1 THE PROBLEM AND ITS SETTING

On reviewing the literature on vertebral column anatomy and biomechanics, it is apparent that, in comparison to the cervical and lumbar regions, the thoracic spine has been largely neglected. This may be attributed to the technical difficulties associated with movement analysis in this region and the belief that thoracic spine is less commonly implicated in clinical pain syndromes (Edmondston and Singer, 1997:132).
There has been, though, a resurgence of interest in the thoracic spine from a clinical perspective that may be explained by: the recognition of the thoracic spine as an important source of local and referred pain, the role of the thoracic curvature in determining overall spinal posture and the influence of thoracic mobility on movement patterns in other regions of the spine and the shoulder girdle (Edmondston and Singer, 1997:132).

Thoracic pain, although less common, can be as disabling as cervical and lumbar pain (Dreyfuss et al. 1994:807). It is a common site of chronic myofascial pain syndromes and therefore there is a need for direct treatment to the soft tissue component via massage, trigger-point therapy and or electrotherapy modalities (Haldeman, 1992:493).
The entire thoracic region is prone to many muscle, ligament and spinocostal fixations. Most fixations found in the thoracic area are muscular in type (Schafer and Faye, 1990:143).

The value of chiropractic manipulative therapy in the management of "mechanical joint dysfunction" has been recognized since the coining of this phrase (Kleynhans, 1976:14 and Peters, 1984:99).
Despite manipulation receiving recent scientific attention in the treatment of mechanical back pain, it still is in need of more interdisciplinary teamwork to

unravel the interaction of biomechanics and physiology (Triano et al. 1992:24).

Another old and most effective modality used in physical therapy is electrical stimulation.
It is evident that despite the widespread agreement amongst physiotherapists that interferential therapy has a marked pain relieving effect, there is a paucity of objective investigations into this analgesic effect (Wells et al. 1991:165).
Several physiological effects clearly occur during interferential current therapy, but reliable clinical studies seeking to evaluate the claimed therapeutic benefits are reported infrequently (Goats, 1990:91).
On the evidence so far it seems to be a clinically valuable method of treatment, which certainly warrants further investigation (Wells et al. 1991:165).

Both spinal manipulation and interferential current therapy seem to be widely accepted and used for their pain relieving effects. Manipulation is also noted as the sole form of therapy in restoring movement to dysfunctional joints especially of mechanical back pain (Mennell, 1990:9).
The two therapies though seem to be lacking in extensive studies on their singular or combined therapeutic effects as well as on their effect on mechanical thoracic back pain.

1.2 THE STATEMENT OF THE PROBLEM

The purpose of this study was to evaluate thoracic spine manipulation in comparison to interferential current treatment, in terms of subjective and objective clinical findings, in order to determine the relative effectiveness of each treatment protocol in the management of mechanical thoracic back pain.

1.2.1 The first sub-problem

The first sub-problem of this study was to evaluate thoracic spinal manipulation in comparison to interferential current treatment, in terms of subjective clinical findings, in order to determine the relative effectiveness of each treatment protocol in the management of mechanical thoracic back pain.

1.2.2 The second sub-problem

The second sub-problem of this study was to evaluate thoracic spinal manipulation in comparison to interferential current treatment, in terms of objective clinical findings, in order to determine the relative effectiveness of each treatment protocol in the management of mechanical thoracic back pain.

1.3 HYPOTHESIS

1.3.1 The first hypothesis

It is hypothesized that thoracic spine manipulation in comparison to interferential current treatment will be more effective in the management of mechanical thoracic back pain, in terms of subjective clinical findings.

1.3.2 The second hypothesis

It is hypothesized that thoracic spine manipulation in comparison to interferential current treatment will be more effective in the management of mechanical thoracic back pain, in terms of objective clinical findings.

1.4 BENEFITS OF STUDY

This research project aims to shed some light on the effectiveness of manipulation versus interferential current therapy in the treatment of mechanical thoracic back pain. This should enhance the knowledge of the treating clinicians and provide a little more understanding into the two treatment protocols and where their value may lie in treating mechanical thoracic back pain.

Both treatment interventions and thoracic back pain are in greater need of further investigation and understanding.

Although widespread mechanical disorders and treatment options exist for the cervical and lumbar spine, the thoracic spine is conspicuously absent from the picture (Plaugher, 1993:525).
This research project could provide a basis for further studies and investigations into thoracic spine disorders, manipulative and interferential current therapy.

CHAPTER TWO

2.0 REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

"On September 18, 1895, Harvey Lillard called upon me. He was so deaf for seventeen years that he could not hear noises on the street. Mr Lillard informed me that he was in a cramped position and felt something give in his back. I replaced the displaced forth dorsal vertebra by one move, which restored his hearing fully" Dr D.D. Palmer said (Plaugher, 1993:525).

There has been a resurgence of interest in the thoracic spine from a clinical perspective (Edmondston and Singer, 1997:132).
Thoracic pain usually results in visceral diseases from within the chest or abdomen to be first considered and investigated. Musculoskeletal causes of chest pain are also common, but unless there is an obvious cause such as a rib fracture or metastatic deposits, they often remain undiagnosed (Bruckner et al. 1987: 286).

Spinal manipulative therapy has become one of the most sought after treatment choices for spinal pain and, despite the number of clinical trials that have been done, the mechanisms with which it works still remains unclear (Lee et al. 1993:302).

Interferential current therapy is also not a new form of therapy and yet, it too is lacking in sufficient clinical studies to provide adequate information on it's treatment efficacy and methodology especially in the treatment of mechanical back pain (Goats, 1990:91 and Wells et al. 1991:165).

2.2 INCIDENCE OF THORACIC BACK PAIN

Despite an intensive literature search of Medline, Mantis, journals and relevant books conducted by the researcher, no epidemiological survey addressing the incidence of the prevalence of thoracic spine pain alone could be found.

Although generally regarded as a benign condition, problems with the spine have been reported to be the most frequent cause of activity limitation in persons under the age of 45 years. Even in those aged 45-64, it was found to be ranked third after heart disease and arthritis (Mior and Diakow, 1987:305). These figures not only reflect the social impact of back pain but also it's economic impact. Annual health care costs, and losses in productivity attributable to back pain are in the billions. Furthermore recent studies have shown that the prevalence of back pain and its negative influence on the economy is on the rise (Mior and Diakow, 1987:305).

In a study done by Troussier et al. (1994:144) to determine the prevalence of back pain in 1178 school children, it is documented that the cumulative prevalence of back pain is 51.2 %. Lumbar pain made up 41% and thoracic pain 34%, which was more common than cervical pain of 25%.

In the USA, a comparative survey between six chiropractic college clinics indicated that the number of patients seen for lower back pain ranged between 31% - 41%, neck pain ranged between 19% - 27% and midback ranged between 10% -15% (Nyiedo et al. 1989:84).

In a study performed by Bruckner et al. (1987:286-288), seventy-three patients with mid-dorsal pain were seen in a rheumatology clinic by a single clinician over three years. The ages of the patients' ranged from 15-63 with the most common age being in the third decade. The female to male ratio for the whole group was 5:1. However, of the 37 patients under the age of 30, 35 (94.6%) were female. The sex ratio of those over 50 years was 1:1. Thirty percent of the patients were housewives, 21% secretaries and 11% nurses. Only 8% were heavy manual workers.

Mior and Diakow (1987:306) conducted an epidemiological survey on the prevalence of back pain in a sample of 320 Canadian chiropractors. The overall prevalence of back pain was 87%, with the male chiropractors complaining mostly of lumbar pain and the female chiropractors complained of thoracic pain. The combined frequencies of regional back complaints were 59% in the lumbar spine, 50% in the thoracic spine and 30% in the cervical spine. They also concluded that the overall prevalence of back pain among chiropractors is not only at the upper end of the scale reported for the general population, but also appears to be the highest among health professionals (dentists 57% and nurses 52%).

Military physicians are frequently confronted by the problem of overexertional thoracic back pain (Milgrom et al. 1993:187). Due to the lack of literature on the treatment of the thoracic spine, the military physicians employ treatment modalities that are derived from experience treating acute or chronic low back pain (Milgrom et al. 1993:187).

Bechgaard (1981:87-89) studied 1097 patients who presented to a coronary unit with clinical findings of a pain, which was dull and continuous and aggravated by an increase in intra-thoracic pressure caused by coughing and sneezing. There was frequently tenderness over T4-5 spinous process. Thoracic movement on one or two directions aggravated the pain. Of the 1097 patients, 143 of them (13%) had mechanical thoracic spinal pain. This was the third most common cause of chest pain in this group after myocardial infarction and angina.

According to Edmondston and Singer (1997:132), minimum attention has been placed on the incidence of the thoracic spine pain, its cause and treatment protocol.

The literature has indicated the widespread incidence and effect of thoracic back pain, amongst varied population groups, making research a necessity in this field of study.

2.3 ANATOMY AND BIOMECHANICS OF THE THORACIC SPINE

Although the thoracic spine is anatomically well defined, the structural and kinematic definitions are less well known (Edmondston and Singer, 1997:137). The morphological characteristics in the three regions of the thoracic spine result in the segmental ranges of movement and the nature of movement coupling (Edmondston and Singer, 1997:137).
There is considerable information on normal lumbar kinematics, which has been used to assist clinical diagnosis and therapy. Far less information though, exists on the nature of three-dimensional thoracic motion in vivo in either the normal or pathological state (Willems et al. 1996:311).

The thoracic spine has unique features. It provides the base for rib attachments, which gives it considerable stiffness, yet it is also the transition between the mobile cervical and lumbar spines. This transition is associated with changes both in the zygapophyseal joint orientation and in vertebral body dimensions. These changes regionalize the thoracic spine into upper, middle and lower divisions. This regionalization is also reflected in the distribution of primary movements (Willems et al. 1996:312).

The complex ligamentous attachments of the ribs to the vertebrae and intervertebral disc via the radiate ligament and the strong intercostal fascia, also contribute to the stability of the thoracic spine. The "mortise" type morphology of the zygapophyseal joints and the near sagittal alignment of the upper lumbar articulations enhances the torsional stiffness on the thoraco-lumbar junction region (Edmondston and Singer, 1997:133).

According to Evjenth and Hamberg (1984:95) and Willems et al. (1996:315) it may be possible to regard the upper thoracic spine as part of the cervical spine and to treat accordingly. The upper thoracic spine usually exhibits the ipsilateral coupling characteristics of the cervical region especially in lateral flexion and axial rotation.

In the a study done by Willems et al. (1996:312) sixty healthy subjects 30 male and 30 female aged between 18-24 were measured for primary and coupled movements in the upper, middle, and lower thoracics, T1-4, T4-8 and T8-12 by using an external, three-dimensional measurement devise.

Axial rotation was 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 the least axial rotation. Coupling was most evident between lateral flexion and axial rotation.

The thoracic spinal posture is likely to have an important influence on the range and pattern of movement, yet little is known of the relative influence of the factors, which determine the resting spinal curvature (Edmondston and Singer, 1997:134).

Although postural abnormalities have been considered important in the development of spinal pain, most quantitative studies have been unable to establish such a relationship (Edmondston and Singer, 1997:134).

The thoracic spine is a common site for normal variations in skeletal anatomy and joint morphology (Edmondston and Singer, 1997:135). For example, zygapophyseal joint asymmetry of greater then 20 degrees has been reported in greater then 30% of individuals at the thoracolumbar junction. The extent to which these features of degeneration and pathoanatomy are related to symptoms are unclear, yet studies of the cervical and lumbar regions indicate that structural changes do influence the range and patterns of spinal movement (Edmondston and Singer, 1997:135).

2.4 ETIOLOGICAL CONSIDERATIONS AND RISK FACTORS OF THORACIC BACK PAIN

As mentioned earlier the magnitude of back problems and its effect on the social and economic climate of countries makes it important to focus on the etiological factors of back pain (Mior and Diakow, 1987:305).
It has been reported that manual workers requiring manual handling tasks are three times more susceptible to injury and therefore research has concentrated on workers in heavy industry. It has though also been noticed that similar factors affecting these workers has also caused a rise in the risk of back pain in health professionals such as nurses, dentists, physiotherapists and chiropractors (Mior and Diakow, 1987:305).

In the study mentioned earlier by Bruckner et al. (1987:286), only 8% were heavy manual workers. The 21% of the group, which was made up of secretaries, recognized heavy lifting, bending and awkward postures as contributing factors to the mid-dorsal back pain.

Prolapsed thoracic intervertebral discs can give rise to chest pain, which may be acute or chronic, posterior or anterior, unilateral or bilateral and may also radiate to the abdomen or lower limbs. The incidence though of thoracic disc prolapse is extremely low, for example one per million of population per year. (Bruckner et al. 1987:286).

Pain is a possible influence on posture and postural "abnormalities" may contribute to the development of spinal pain syndromes. A clear relationship though between thoracic posture and pain has not yet been defined (Edmondston and Singer, 1997:133).

Edmondston and Singer (1997:135) postulate that the mechanical consequences of the changes in thoracic morphology and posture are likely to be important in the development of spinal pain.
Progressive wedging of the thoracic vertebral bodies with increasing age occurs in a majority of individuals. These changes result in a loss of

compliance much greater than that observed in the cervical or lumbar regions (Edmondston and Singer, 1997:135).

The kyphotic thoracic curve is dependent primarily on the shape of the vertebral bodies and discs and has a limited potential for spinal extension. Unless affected by Scheuermann's disease, an increased kyphosis in younger individuals may be due to poor habitual posture rather than structural changes or reduced joint mobility (Edmondston and Singer, 1997:135).

The role of thoracic zygopophyseal joint in thoracic pain syndromes has received little attention because only a few sources discuss these joints as sites of pain production (Dreyfuss et al. 1994:807).

Instead, the focus has been on other structures capable of causing thoracic pain such as the concept of intervertebral disc pathology, which has always overshadowed the role of the facet joints especially in lower back pain. The pendulum though has shifted away from the disc as a source of most back problems, towards an awareness that the entire intraspinal segment is important and that the facet joint plays a key role (Lippitt, 1984:746 and Dreyfuss et al. 1994:807).

The cause of restricted intervertebral mobility or joint fixation has generated much speculation. A number of speculations have been proposed. According to Rahlmann (1987:177) the four possible theories that keep coming up are:

1) entrapment of menisci
2) displaced intervertebral disc fragments
3) segmental or intersegmental muscle spasm
4) peri-articular connective tissue adhesions.

After extensive analysis of these theories it was difficult to single out one theory but that each theory may play a part in it's own circumstances.

The one common feature though which all the theories encompassed was the reflex muscle spasm (Rahlmann, 1987:177).

Muscle is able to change more quickly than the non-contractile tissues around a vertebral motion unit. This allows it to change length and tension levels rapidly thus being able to be influenced and altered by any false movement, poorly estimated movement, and on the therapeutic side by a manipulation (Rahlmann, 1987:185).

Mennell (1990:7) states that mechanical cause of pain from the synovial joints, known as joint dysfunction, always has three constant etiological factors associated with it:

a) intrinsic trauma
b) immobilization, with which disuse and aging must be considered
c) factors residual from the healing of some more serious pathological condition.

Kleynhans, (1976:90) classifies facet syndrome into three types according the etiologies:

1) traumatic
2) pathological
3) postural

A study done by Harms-Ringdahl and Ekholm (1986:117-126) determined whether maintained extreme flexion position of the lower-cervical-upper-thoracic spine in a sitting posture could induce pain and thus play a role in work related disorders with cervical and thoracic back pain.
This study showed that since sustained extreme joint or spinal positions can cause pain – locally and referred it is suggested that ergonomic analysis should be further studied for pain prevention and rehabilitation of patients returning to work.

2.5 PATHOPHYSIOLOGY

According to Peters (1984:85), facet syndrome pertains to a condition characterized by an overriding of the facets of adjacent vertebra, whereby the intervertebral foramina are narrowed from the superior to the inferior.
The term also relates though to a state of subluxation with tension, pressure, and stretching or irritation of the vertebral joint capsule, as the result of

postural strain or trauma, but without any narrowing of the related foramina (Peters, 1984:85).

Dishman, (1988:100) described a physiological motion known as joint play, which is an additional movement to active and passive motions. This form of movement cannot be produced by voluntary muscles. In fact voluntary movement depends on the integrity of joint play. Muscles that move the joint with joint dysfunction become hypertonic due to irritation and pain, therefore making the active range of motion restricted.

Prominent researchers in the field of spinal manipulation agree that a major component of the manipulable spinal joint biomechanical fault is hypomobility (fixation)(Dishman, 1988:100).

Pain arising from any synovial joint, from within it or around it, results in reflex muscle spasm in an attempt to prevent painful movement of the joint. Pain arising from the intervertebral disc also evokes the reflex splinting. Pain from muscle pathology produces local muscle spasm that secondarily produces loss of movement in the joint (Dishman, 1988:100).

Many researchers have stated that adhesions may restrict a vertebra and that trauma will produce adhesions between tendons, muscles and ligaments resulting in contractures of the soft tissues. This then results in the restricted mobility in the joint (Dishman, 1988:101).

Rosomoff (1980:102) believes that all spinal injuries must be accompanied by soft tissue pathology resulting in the breakdown of the cell membranes and the initiation of a cascade of chemical reactions. The substances released stimulate the nociceptors or the pain impulse. It is these chemicals that are inhibited by anti-inflammatories, ice and local physical therapies.

Secondary effects such as nerve root hyperalgesia and muscle contraction follow, producing restricted range of motion (fixations), which further creates pain. This is not a reflex muscle contraction as previously thought. It is a chemical reaction wherein the traumatized muscle releases calcium ions which combines with ATP (adenosine triphosphate) for an uncontrolled contraction with pain, tenderness, vasoconstriction, decreased blood supply and an energy deficit contracture. It is this inflammatory reaction that results in the restricted range of joint motion, thus the functional disability.

Other authors refer to the cause of restricted interarticular mobility as tightened or taut articular capsules, ligaments or fascia, resulting in shortened muscles from spasm or fibrosis, loss of glycosaminoglycan molecules, displaced disc fragments, disc resorption, tears or fibrosis of the annulus or the nucleus pulposis (Dishman, 1988:100).

The cervical and lumbar zygapophyseal joints have received considerable attention and are now accepted as potential pain generators. The thoracic zygapophyseal joint has not gained equal attention (Dreyfuss et al. 1994:811). A research study performed by Dreyfuss et al. (1994:811) showed that stimulation of these joints can cause local and referred pain of thoracic spine. This research involved eight patients of which four of them received right-sided T3-T4, T5-T6, T7-T8 and T9-T10 joint injections and the other four underwent left sided injections in the same segments. The zygapophyseal joints were injected with contrast medium only and the quality, intensity and distribution of evoked pain was recorded.
This asymptomatic group reported a 72.5% production of pain sensation and 27.5% of the joints injected evoked no pain. All subjects experienced referral patterns, which were reproduced and repeated in all subjects.
The research also showed that thoracic zygapophyseal joint pain is more localized and appreciated closer to its origin that zygapophyseal pain in other spinal regions (Dreyfuss et al. 1994:811).
This was hypothesized to be because there is diminished density of nociceptors in the joint capsule of the thoracic spine compared to the other spinal regions. "In addition, thoracic zygapophyseal joints are intrinsically smaller and hold less volume than their cervical and lumbar counterparts. This smaller size also causes a smaller density of nociceptive innervations as there is less area available capable of transmitting painful responses." (Dreyfuss et al. 1994:810).
Despite the possibility that thoracic facet joints may not be as uniformly capable of causing pain as the lumbar or cervical joints, this study's

conclusion is that they are still potential sources of thoracic pain and must be included in the differential of pain sources of the thoracic spine (Dreyfuss et al. 1994:811).

Physiological movement in the thoracic spine requires simultaneous coupled motion at the intervertebral joints and rib articulations. Joint degeneration and changes in skeletal structure or spinal curvature will influence the range of motion, nature of the movement restraint and the patterns of coupled movement (Edmondston and Singer, 1997:136).
As the discs degenerate and the thorax becomes more rigid and flexed, the coupled lateral translation will become increasingly limited. The rib movements that are required for normal movement coupling may become restricted such that the range of segmental rotation will decrease and the coupled ipsilateral lateral flexion may be lost or reversed. These changes associated with change will limit the potential to reverse these trends with manipulation. In such cases postural correction is achieved largely through compensatory changes in the lumbar and cervical regions and the shoulder girdle (Edmondston and Singer, 1997:136).

The upper thoracic segment can be regarded as part of the cervical spine and therefore treated as such. Therefore pathological changes in the cervical spine such as cervical spondylosis and cervical trauma will have a direct effect on the movement dysfunction and cause of pain in the thoracic spine (Edmondston and Singer, 1997:134).

2.6 DIAGNOSIS OF MECHANICAL THORACIC SPINE PAIN

Evaluating vital signs, cardiac signs, thoracic auscultation and percussion, light touch/pain tests, muscle strength grading, range of gross movement, inspection and static palpation are standard examinations. Thereafter the motions that must be evaluated in the thoracic spine are flexion, extension, right and left lateral flexion and bilateral rotation. In addition the movement of the costovertebral and costotransverse joints must not be excluded.

The most common fixations are commonly found at the upper and middle thoracic segments and the thoracolumbar junction. Joint play is more difficult to evaluate because of the increased stiffness of the thorax as compared to the cervical lumbar spine (Schafer and Faye, 1990:153).

Observation and palpation in the thoracic regional examination are of great diagnostic value in excluding visible joint swelling, gross abnormalities and temperature changes in the painful area, as these are not features of mechanical back pain (Schafer and Faye, 1990:2).

A typical patient with facet syndrome, according to Peters (1984:88) usually complains of a sudden onset of unilateral or bilateral spinal pain with or without radiating pain. There is marked muscle spasm with no neurologic symptoms. The pain is increased through all movements and is relieved by rest. Facet pain unlike disc pain is not increased by coughing or sneezing. Flexion can be less painful then extension due to the stretching of the capsules and jamming of facets that takes place in extension. Springing of the individual facets is often very painful and hyperaesthesia and tenderness of the paraspinal musculature and skin on the side of the lesion may be present.

According to Edmondston and Singer (1997:140), local tenderness, particularly over the spinous processes, is a common finding in the thoracic spine possibly due to the localization of the medial branch of the dorsal rami over the apex of the bony prominences.

Edmondston and Singer (1997:138), emphasize that careful observation is required during active movement testing to determine where movement is occurring.
Limitations of thoracic physiological segmental motion may be difficult to detect by manual palpation, as the segmental ranges of movement are quite small, especially in the sagittal plane (Edmondston and Singer, 1997:138).

The entire thoracic region is prone to many muscle, ligament and spinocostal fixations. Most fixations found in the thoracic area are muscular in type. The lower thoracic region (T9-T12) is probably more prone to fixation development than any other area of the thoracic spine. This is probably due to the abrupt change in facet planes between the superior and inferior processes of the transitional vertebra (Schafer and Faye, 1990:154).

Any abnormality of the facet joint can theoretically cause a facet type syndrome like inflammation or synovitis (traumatic, rheumatologic), segmental instability and degénerative arthritis (Lippitt, 1984:747).

There are a variety of diagnostic methods used by chiropractors to assess the patient's spine and to ascertain the need for manipulations. These include the pain description of the patient, palpation of vertebral prominences and soft tissues for pain, spasms and "misalignment"(static palpation), orthopedic tests, motion palpation, visual posture assessment, anatomical and functional leg length discrepancy, neurological examination, plain static erect and functional X-rays views, computed tomography and magnetic resonance imaging of the spine (Walker and Buchbinder, 1997:583).

In a study performed by Walker and Buchbinder (1997:583-589) a survey was done on 554 chiropractors who registered in Australia in May 1994, to determine which diagnostic methods of detecting the manipulative lesion was most commonly utilized and which did they feel was the most reliable.
Out of the 554 chiropractors that were asked to complete the relevant questionnaires, the researchers utilized 458 of the responses. The most commonly used method utilized was static palpation with pain descriptors, orthopedic testing and motion palpation soon after. Motion palpation though was regarded as the most reliable method of ascertaining the manipulative lesion (Walker and Buchbinder, 1997:583-589).
Dishman, (1988:103) also states that most experienced examiners who routinely perform motion palpation will agree that it is an essential method of locating fixations (hypomobilities) and laxity (hypermobilities).
Palpation of the musculoskeletal system, be it static, active or motion palpation is the most common tool of diagnostic assessment used by

practitioners of manipulative and physical therapy (Russell, 1983:182 and Haas et al. 1995:582).

There are at least two general varieties of palpations, which can be employed to identify areas of articular dysfunction. One is static palpation and the other is motion palpation (Russell, 1983:181).
Motion palpation can be further divided into passive and active type of motion palpation. It is the passive type that allows for palpation of the joint play, the end feel of a joint with its springy quality. The presence of normal passive motion in one direction of a motion plane and decreased motion in another is a dynamic indicator of joint fixation or subluxation (Russell, 1983:181).

Despite the wide spread use of articular palpatory techniques, there is little data available on the reliability and reproducibility of palpatory diagnosis and the validity of such procedures (Russell, 1983:182).
Haas et al. (1995:124) though, performed a research study that concluded that there is definite moderate responsiveness of thoracic – end play restriction to spinal manipulation and that end play and its change by manipulation is definitely detectable by manual palpation by chiropractors. As with all diagnostic procedures though, motion palpation must be combined with other methods of investigation (Russell, 1983:183).

According to numerous authors (Taylor et al. 1990: 82, Denslow et al. 1947:229, Terrett and Vernon 1984:217), areas of spinal joint dysfunction are also associated with a decrease in pain threshold of the paraspinal skin. Denslow and Korr (1947:229) go on to state that these areas of dysfunction demonstrate a sustained level of sympathetic hyperactivity that increase the sensory firing and therefore enhances pain. This phenomenon allows for another diagnosing technique, which chiropractors use called the skin rolling technique.

Twenty-five subjects took part in a study to determine whether skin rolling can be used as a diagnosing skill to detect fixations. All of them reported paraspinal tenderness on skin rolling. At the areas of tenderness a pressure algometer was used to determine the subject's pressure pain threshold. Static joint challenging was also utilized by an independent examiner to identify the levels of spinal joint dysfunction in the same subjects (Denslow et al. 1947:229).

A highly significant correlation was found relating a tender point on skin rolling to a spinal joint dysfunction within one vertebra above or below the level of the tender spot. Pressure algometer readings revealed a highly statistically significant decrease in pain threshold tolerance at the level of a tender skin roll as compared to control (non-tender) points (Denslow et al. 1947:229). These findings suggest a moderate level of support for the validity of the notion that spinal dysfunction is characterized by a loss of joint motion and contiguous paraspinal tenderness (Taylor et al. 1990:86).

2.7 PAST TREATMENT OF THORACIC BACK PAIN

The thoracic spine is the most often manipulated region of the spine, yet its fixations are frequently the least efficiently corrected (Schafer and Faye, 1990:143) due to repeated common points of confusion about the thoracic spine, it's biomechanics and fixations.

The thoracic spine is also a common site of chronic myofascial pain syndromes and therefore there is a need for direct treatment to the soft tissue component via massage and or electrotherapy modalities (Haldeman, 1992:47).

According to Schafer and Faye (1990:143), if practitioners follow a rational approach to thoracic fixations, unlike upper-cervical articular fixations, total fixations in the middle and lower thoracic spine may be corrected with one adjustment.

In a study done by Triano et al. (1992:24), of differences in the treatment history with manipulation for acute, subacute, chronic and recurrent spine pain, it showed thoracic disorders to require approximately half the care as lordotic spine regions.

Terrett and Vernon (1984:223) studied paraspinal tenderness in response to thoracic spine manipulation. They first determined a high association of tender

Terrett and Vernon (1984:223) studied paraspinal tenderness in response to thoracic spine manipulation. They first determined a high association of tender spots with local spinal joint fixations. Of 54 tender spots, 50 had accompanying fixations. Half of the study received a spinal manipulation, while the other half received a sham mobilization. Cutaneous pain tolerance levels rose 140% in the treatment group as compared to 5% in the controls after 10 minutes. This finding was statistically significant in showing the effect of manipulation on thoracic mechanical back pain (Terrett and Vernon, 1984:223).

The chemical reactions that occur during any spinal injury are usually inhibited by anti-inflammatories such as steroids and non- steroids as well as ice application and a number of local physical therapies (Rosomoff, 1980:102). Immobilization is also a traditional mode of treatment (Dishman, 1998:101). According to the fifteenth edition of the Merck manual, back pain following a strain or after an unusual activity is first treated with bed rest, local heat, massage, oral analgesics and muscle relaxants. Manipulation and diathermy modalities are also recommended (Berkow and Fletcher, 1987:1294).

2.8 EFFICACY OF SPINAL MANIPULATIVE THERAPY

For hundreds of years back pain has been treated manually by applying forces over parts of the spine. One commonly used form of manual treatment is spinal manipulation that involves a sudden forceful movement or high velocity thrust to specific tissues or joints of the spine (Lee et al. 1993:302).

In recent times over twenty controlled clinical trials have reported the usefulness of spinal manipulation, citing pain relief and reduction in disability as the most significant effects. However, the mechanisms for these changes remain unclear (Lee et al. 1993:302).

Herzog et al. (1995:233) stated that much has been written about reflex responses caused by spinal manipulative therapy, but there are no experimental reports showing responses in clinically relevant situations.

Joint afferent input might be a potent modulator of pain. It has been proposed that spinal manipulation activates peripheral receptors presumably in the joint or skin. This results in activation of central inhibitory mechanisms and thereby increases pain tolerance (Mayer et al. 1991: 203).

A number of theories of how spinal manipulative therapy affects the fixated segments have been analyzed. Taking the most common finding in a fixation or subluxation, muscle spasm, Korr (1975:100) believes that a muscle spasm is due to increased gamma firing and that in order to relieve the muscle spasm, the gamma gain must be reduced. He maintains that a high-velocity thrust accomplishes this by producing a barrage of spindle output. With this increased feedback, the central nervous system no longer needs to contract the intrafusal fibers and thereby reduces the gamma motoneuron activity.
Korr also proposed that the golgi tendon organs respond to muscle tension by inhibitory input to the "homonymous muscle's alpha motoneurons." A sudden stretch might generate enough muscular tension to activate this reflex pathway via the golgi tendon organ fibers (Korr, 1975:100).

Korr (1975:100) also hypothesized that the type III mechanoreceptors found in ligaments and which are slow adapting mechanoreceptors become activated only at the extremes of a joint's range of motion or during a powerful traction. These type III receptors are principally expressed as a profound inhibition to motor unit activity that is confined to some or all of the muscles operating over the joint in question. Therefore it seems feasible that a high-velocity manipulation done at the end of a joint's restricted range of motion could activate this inhibitory type III mechanoreceptor mechanism (Korr, 1975:100).

Subluxation complex is a distinct clinical entity which if not corrected leads to chronic degeneration diseases (Dishman, 1988:105).
The residual effect of chronic pathomechanics includes fibrosis, contractures, adhesions, deformity and structural derangements. This explains the need for repeated manipulative treatment of many years or perhaps lifetimes in the management of chronic joint diseases (Dishman, 1988:105).

As with any mechanical device, periodic maintenance is necessary (Dishman, 1988:105).

2.9 STUDIES INVOLVING SPINAL MANIPULATIVE THERAPY

Manual therapy described as high-velocity, short amplitude manipulation or adjustment is the remedy for spine related disorders that has received the most scientific attention and yet is still in need of more interdisciplinary teamwork to unravel the interaction of biomechanics and physiology (Triano et al. 1992:24).
The most appropriate means for observing and upgrading clinical judgments has been from the evaluation of prospective data. This has provided little evidence for the treatment of spine disorders and manipulation and where prospective studies were carried out, limited information necessary to understand differences in conventional treatment for spine disorders is provided (Triano et al. 1992:24).

As mentioned earlier, a number of controlled clinical studies have been conducted over recent times reporting the usefulness of spinal manipulation (Lee et al. 1993:302). Most studies have been performed in the cervical and lumbar region of the spine but a few have also included the thoracic spine.

In 1994 (233-236), Herzog studied the biomechanics of spinal manipulative therapy on the thoracic spine, by measuring the forces applied by the chiropractor to initiate a manipulation, the presence of cavitations, vertebral body movement and the reflex response of the back musculature. The treatments were conducted on three patients at the T4 level by one chiropractor (Herzog, 1994:233-236).
The amount of force seemed to increase with the increased stiffness of the segment. Cavitations took place at the facet joints as a result of the amount and speed of the external force (Herzog, 1994:233-236).
The study also concluded that SMT causes a reflex activation relaxing the back musculature, which was associated with the spindle proprioceptors.

Spinal manipulative therapy producing a cavitation is believed to relieve pain, relaxes hypertonic muscles, restores and increases segmental range of motion and re-establishes normal spinal function (Conway et al. 1993:210). Cavitation appears to be an important factor associated with spinal manipulative therapy, so much so that many clinicians judge success of a treatment by the sound of the cavitation (Conway et al. 1993:210).
It appears that cavitation is either a function of a complex interaction of many mechanical variables, or it is caused by different factors for different patient/treatment combinations (Conway et al. 1993:210).

In a study, done by Bruckner et al. (1987:286 -288) as mentioned earlier, involved seventy-three patients with mid-dorsal and /or unilateral chest pain seen over a period of three years.
All the patients received detailed advice on back care such as correct static and dynamic postures as well as safer lifting techniques. Two of the patients had improved at their second visit. The remaining seventy-one patients then received one or more courses of thoracic spinal manipulation. The overall response was good but twelve patients relapsed after initial improvement.

Bechgaard (1981:87-89) studied 1097 patients who presented to a coronary unit with similar clinical findings to the above study done by Bruckner et al. (1987:286-288).
These patients again had findings on examination suggesting a mechanical block and most responded to treatment with either manipulation or local paravertebral anesthesia (Bechgaard, 1981:87-89).

In 1993 (302-303) Lee et al. conducted a study to investigate whether spinal manipulation alters the posteroanterior stiffness of a manipulated region in the thoracic spine.
Thirty subjects with no history of thoracic pain or contraindications to manipulation participated. The manipulation technique, which was studied, was a posteroanterior thrust applied to the T4-5 spinal level. The effect of the manipulation was compared to a control intervention of supine lying.

The posteroanterior stiffness of all the subjects was measured at the T4 and T5 levels initially and remeasured after both the manipulation and control interventions. After the scores of both groups were computed and analyzed, the results revealed no statistical difference between the two groups. Although the posteroanterior stiffness at T5 was found to be significantly greater than at T4, it was concluded that in the case of asymptomatic subjects the results did not provide support for the hypothesis that posteroanterior stiffness is altered by manipulation.

The authors then went on to say that further research of this nature is needed on symptomatic patients and muscle activity measurements must be included. The mode of action of manipulation still remains unclear (Lee et al. 1993:306).

2.10 POSSIBLE COMPLICATIONS OF SPINAL MANIPULATIVE THERAPY

The increasing utilization of chiropractic has made it necessary to document potential complications and side effects of chiropractic adjustments in the same manner as any other health care professions (Haldeman and Rubinstein, 1993:47).

Chiropractic literature though claims emphatically that accidents are exceedingly rare when compared with complications from other therapeutic modalities. At the same time, knowledge of the iatrogenic effects of spinal manipulative therapy is incomplete (Michaeli, 1993:314 and Senstad et al. 1997:435).

Complications of chiropractic adjustments or manipulations can be considered either benign or catastrophic or as Kleynhans (1980:359) refers to them as "normal reactions" and "adverse reactions" or further subdivided into "functional" or "painful" reactions.

"Normal or adequate" reactions are described as subjective discomforts that do not influence the working ability with spontaneous remission at least two days after manipulation. "Adverse or exceeding reactions are objective worsenings of the pre-existing state with decreased work capacity and spontaneous remission exceeding two days.

Two potential causes of these complications are the use of long levers which can exert forces on non-symptomatic joints and the second possible cause is the manipulation of biomechanical dysfunctional but asymptomatic joints. Excessive force has been found to cause complications. It has also been found that the chiropractors do not explain to the patient the purpose of a particular treatment approach or it's mechanisms resulting patients misunderstandings (Haldeman and Rubinstein, 1993:49).

Thoracic adjustment complications can relate to the use of long lever techniques placing stress on areas that may already be compromised due to an earlier injury or as mentioned earlier excessive force especially on non-symptomatic joints (Haldeman and Rubinstein, 1993:49).
An example given by Haldeman and Rubinstein (1993:48) is a 29-year old female suffering from chronic lumbosacral pain and shoulder pain caused by a recent water-skiing accident. The thoracic spine was adjusted using an 'anterior move' resulting in pain in the anterior ribs. After been examined by a medical doctor she was diagnosed with upper rib cage strain/sprain due to the adjustment.

A survey was done in South Africa by Michaeli in 1993 (309-315), amongst 250 South African manipulating physiotherapists, to determine the incidence and nature of complications following manipulations to the cervical, thoracic and lumbar spine.

Sixty one percent of the physiotherapists took part in this survey. Of these physiotherapists, 90% used cervical manipulations, 90% used thoracic manipulations and 83% used lumbar manipulations. Twenty-nine patients who received spinal manipulations presented with 52 complications. Only four complications followed thoracic and lumbar manipulations. The rest were after cervical manipulations which included dizziness, nausea, severe headache nystagmus, blurring of vision, vomiting, brachialgia, brachialgia with neurological deficit, loss of consciousness and an acute wry neck. The thoracic complications included two fractured ribs due to excessive force.

Despite the approximate number of manipulations performed in the three regions the complications in the thoracic and lumbar region are significantly lower than that of the cervical spine.

A prospective study performed by Leboeuf – Yde et al. (1997:511-514) involved 66 of the 86 Swedish (78%) chiropractors in Sweden, and 628 patients altogether, which made up 1858 reported visits.
Each chiropractor was asked to recruit ten new patients and to fill in a questionnaire for each patient for six visits, reporting any side effects to the manipulative therapy they received.
The patient's sexes were evenly distributed. Forty-six percent of the patients were between 27 and 46 years old, 34% were between 47 and 60, 7% were younger and 13% older.
There were three distinct groups of reactions: a) the most commonly reported were local reactions in the area of the treatment, b) about 10% described pain outside the area of treatment such as fatigue and headaches and c) <5% included reactions like nausea, dizziness or "other". "Other" reactions were painful feet, cramp in the feet, pulling sensations in arms and legs, pressure in the head amongst others.
Almost all reactions arose on the day of or the day after treatment. Three quarters of the reactions were reported to have disappeared within 48 hours.

A very similar prospective study, reported on by Senstad et al. in 1997(435-441), involved 106 (70%) Norwegian chiropractors that participated in a survey, to analyze the incidence of complications after spinal manipulative therapy.
The sample group was made up of 556 women (53%) and 502 men (47%). Out of these patients 580 (55%) reported at least one reaction through out the observation period. Among the reported side effects, the most common was local discomfort, followed by headaches, tiredness and radiating discomfort. Reports of dizziness, nausea and "hot skin" were rare.
Most of the reactions (64%) began within 4 hours and most of them also (74%) disappeared within the first 24 hours. The reactions were mainly characterized as mild (35%) or moderated (50%).

Manipulation is starting to play an important role in the handling of spinal disorders thus making it imperative that a thorough examination is performed on the patient, eliminating any contra-indications to manipulation (Dvorak et al. 1993:138).

As with any mobilization technique, a favorable response will only be achieved if manual therapy is indicated based on the clinical examination, the technique is applied carefully and the response to treatment is monitored closely (Edmondston and Singer, 1997:141).

2.11 EFFECTS OF INTERFERENTIAL CURRENT THERAPY

Another widely used and effective modality utilized in physical therapy is electrical stimulation. The wide varieties of stimulation apparatus all have in common a single purpose: the stimulation of tissues for therapeutic responses.

In some acute cases, short-term use of appropriate electrotherapeutic modalities can be beneficial for some patients who otherwise may be unresponsive to care (Plaugher, 1993:525).

Alternating current of various frequencies or direct current with continuous or a train of pulses can be selected by the therapist.

Direct current and low-frequency alternating current (>1kHz) though encounters a high electrical resistance in the outer layers of the skin, which makes the treatment painful. Alternating currents of medium (>1kHz to <10kHz) or high frequency (>10kHz) meet little resistance and penetrate the tissues easily but these currents generally oscillate too rapidly to stimulate the tissues directly.

These difficulties were overcome in the early 1950's with the development of interferential current therapy. The equipment produces two alternating currents of slightly differing medium frequencies and is used widely to induce analgesia, elicit muscle contraction, modify the activity of the autonomic system, promote healing and reduce edema (Ganne, 1976:109 and Goats, 1990:87).

The term interferential therapy stems from the idea of two currents "interfering" with each other. This interference effect is produced in the tissues by the superimposition of the two medium frequencies. It is important to remember that it is the 'beat' frequency which is the biological frequency range and that the 4,000c.p.s., medium frequency current is used as the 'carrier wave' in order to overcome the electrical resistance of the skin (De Domenico, 1982:15).

In spite of the fact that interferential therapy has been available for some twenty-five years, it is only comparatively recently that it has begun to generate much international interest (De Domenico, 1982:15).
Belcher, (1974:29) states that many conditions have been found to be quickly and considerably relieved when treated with interferential current therapy.
Dynatron operator's manual (1996:117) states that interferential therapy may be applied for the purpose of providing relief from chronic, intractable and / or acute post-traumatic pain.
Ganne (1976:102) also agrees that interferential current therapy is undoubtedly an effective therapy for controlling pain.
Despite this though, Goats (1990:91) also states that although interferential therapy is often applied clinically to control pain few rigorous studies are reported that justifies this use.

The analgesic effect of interferential therapy has a number of mechanisms in doing so. Short duration pulses at a frequency of 100Hz stimulates large diameter nerve fibres which inhibit the transmission the small diameter nociceptive fibres thus inhibiting nociceptive traffic and closing the pain gait (Goats, 1990:89, De Domenico, 1982:16 and Forster and Palastanga, 1985:109).
Interferential current can also activate the descending pain suppression system by stimulating the small diameter fibres, which causes the release of endogenous opiate (enkephalin and endorphin) at a spinal level (Goats, 1990:90 and Forster and Palastanga, 1985:109).
A physiologic blocking of C and A nerve fibre transmission is also postulated as a mechanism of pain modulation.

The increase in local circulation may also help remove chemicals from the area that are stimulating nociceptors (Forster and Palastanga, 1985:110).
De Domenico, (1982:17) describes this clearing of pain producing substances to take place by the interferential current having a depressing effect on the A delta and C fibre activity. The muscular coat of the small arterioles of the body is innervated by sympathetic fibres and a depressive effect on this system is calculated to produce an increased blood flow through the part. Vasodilatation could be produced in the damaged area by inhibiting the sympathetic stimulation of the muscular coat of the small arteriole wall. This leads to a relaxation of the vessel walls and subsequently increases their diameter. In turn this leads to an increased blood flow through the part and eventually the removal of the pain producing substances from the area (De Domenico, 1982:17).

The placebo effect is a potent factor in the use of an interferential therapy unit (Goats, 1990:90 and De Domenico, 1982:18).
The fact that interferential current therapy relieves pain is empirically indisputable but there can be no doubt that the high technology involved with interferential treatment is both impressive and in some cases bewildering for the patient. The great array of colours, flashing light and curious noises will induce a certain amount of awe in the patient. In these circumstances it would not be surprising for most patients to feel that they were receiving an "effective" treatment for their pain (De Domenico, 1982:18).

Interferential therapy at a frequency of 100Hz is recommended for the reduction of acute oedema. Such stimulation activates the musculoskeletal pump and inhibits sympathetic activity, thus assisting the drainage of fluid from the affected area. Interferential currents also appear to have a direct effect upon the cell membrane and reduce the escape of intracellular fluid. Research also suggests that interferential therapy can effectively stimulate voluntary muscle, promote peripheral blood flow and accelerate bone healing (Goats, 1990:91).

Although several physiological effects clearly occur during interferential current therapy, reliable clinical studies seeking to evaluate the claimed therapeutic benefits are reported infrequently (Goats, 1990:91).

2.12 STUDIES INVOLVING INTERFERENTIAL CURRENT THERAPY

As mentioned earlier by Goats (1990:91), interferential therapy is often applied clinically to control pain, but few rigorous studies are reported that justifies this use.

Corin (1998:55) compared four electrodes versus pen-electrode interferential current therapy on active myofascial trigger points in the thoracic area. He proved that both methods were reliable forms of therapy although using a pen-electrode or probe allowed for treatment of very small areas. The pen-electrode also proved to be statistically more effective when comparing the algometer readings from that of the four-electrode interferential current treatment.

Hogenkamp et al. (1987:21) stated that "interferential application positioned near or on the vertebral column effectively treated local pain, hypertonia of the erector trunci muscles and aided in restoring disturbances in the neurovegetative balance. They found that by stimulating large-nerve fibers at the thoraco-lumbar level, segmentally, corresponding tissues such as, internal organs, circulation in the cranium and lower and upper extremities are directly influenced. An inhibition of the sympathetic reflex activity occurs, so that symptoms in the skin, muscles and internal organs due to an excessively high spontaneous activity of the sympathetic nervous system are counteracted.

As mentioned earlier, interferential therapy can also be used in the stimulation of motor nerves to re-educate muscles in neurologically handicapped patients (De Domenico and Strauss, 1985:229).
Pre-modulated interferential currents are used to produce strong, comfortable and efficient muscle contractions. The technique is simple and effective in producing a strong, well tolerated and versatile stimulation. The study showed

the therapy to be useful in muscle re-education, prevention of disuse atrophy, increasing muscle strength and endurance and modulating spasticity (De Domenico and Strauss, 1985:229).
Continuing advances are being made in interferential technology ensuring that the next generation of stimulators will include facilities required to utilize this technique to it's fullest (De Domenico and Strauss, 1985:229).

Nikolova-Troeva, (1967:581) applied interferential current to 77 patients with post traumatic lesions. She says, "The comparison between interference therapy and other physiotherapeutic methods shows that the curative effect of the interference current is far more pronounced than that of micro-wave therapy, diadynamic currents, ultra-short-wave therapy and ultra-sound. Another advantage of interference therapy is the fact that it can be applied in osteoporotic patients" (Nikolova-Troeva, 1967:581).

Another study was conducted by Nelson (1981:53-56) over a period of nine months between November 1977 and August of 1978 in the physiotherapy department of Sydney Hospital.
One hundred patients with a variety of musculoskeletal conditions were treated with interferential current therapy using a range of frequencies, intensities and treatment times.

The patients were divided into three groups. The first group was made up of patients with conditions present for more then six months. Group two included patients with conditions present for two weeks to six months and the third group was made up of patients with acute conditions which were present for less then two weeks.
The conditions which were present in the groups included, pain of spinal origin which was not responding to other therapies like chiropractic or acupuncture, osteoarthritis, joint pain after trauma, bursitis, tendonitis, tendon and muscle strains.
Treatment time varied from twelve to twenty minutes and therapy was given every day and in the acute cases it was given twice day. If no change was seen after three treatments the therapy was discontinued.

The results ranged from worse to complete recovery and were defined by subjective and objective means and by measuring the swelling and joint range of movement.
Group one, consisting of chronic type problems of six months duration and more showed 47% complete recovery, 31% slight to moderate improvement and 22% no change. Group two which consisted of conditions that have been present for two weeks to six months showed a 76.9% complete recovery, 7.7% slight to moderate improvement and 15.4% no change. The third group made up of acute cases of two weeks duration showed 100% complete recovery.
The results from this study were encouraging but could not be used to make a conclusive statement about the efficacy of interferential current therapy due to the absence of a control group. Nevertheless, interferential therapy definitely showed its effectiveness in many types of conditions from immediate sports injuries to intransigent chronic conditions (Nelson, 1981:53-56).

It is evident that despite the widespread agreement amongst physiotherapists that interferential therapy has a marked pain relieving effect, there is a paucity of objective investigations into this analgesic effect (Wells et al. 1991:165).

De Domenico, (1982:18) goes on to add that inferential currents are by no means a panacea and definitely have a number of limitations: however, when the technique is applied correctly and administered properly, excellent results can be expected.
It is clear that both the therapeutic and physiological effects of interferential currents require further research. On the evidence so far it seems to be a clinically valuable method of treatment, which certainly warrants further investigation (Wells et al. 1991:165).

2.13 POSSIBLE COMPLICATIONS OF INTERFERENTIAL CURRENT THERAPY

According to Forster and Palastanga (1985:111) the only real danger or complication of interferential current therapy is electrical burn if a bare

electrode touches the skin or if the electrodes on the skin are too close allowing a skin current to pass between them rather than through the deeper tissues.
It is also possible for other electromedical apparatus in the near vicinity to interfere with the delicate balance of interferential frequency therefore the interferential apparatus should be operated well away from other machines.

Ganne, (1976:107) states that patients should also be warned of the dangers of using a joint carelessly after a treatment because they will be free of pain.

2.14 CONCLUSION

Pain in the thoracic region is a common complaint, which can be disabling as cervical and lumbar pain. The examination and management of these conditions is dependent on a sound knowledge of the regional variations in the anatomy and biomechanics of the thorax. Consideration of the normal anatomy as well as the mechanical consequences of spinal degeneration is important for the appropriate selection, application and interpretation of physical examination procedures and treatment protocol (Edmondston, and Singer, 1997:141).
The thoracic spine is the most often manipulated region of the spine, yet its fixations are frequently the least efficiently corrected (Schafer and Faye, 1990:143) due to repeated common points of confusion about the thoracic spine, it's biomechanics and fixations.
In recent times over twenty controlled clinical trials have reported the usefulness of spinal manipulation, citing pain relief and reduction in disability as the most significant effects. However, the mechanisms for these changes remain unclear (Lee et al. 1993:302).

The thoracic spine is also a common site of chronic myofascial pain syndromes and therefore there is a need for direct treatment to the soft tissue component via massage and or electrotherapy modalities (Haldeman, 1992:47).

Interferential therapy would seem to represent a valuable adjunct to the medical and physiotherapy management of musculoskeletal pathologies. As research continues to clarify the precise characteristics of the current required to treat these various types of lesions successfully, interferential therapy will continue to grow in importance as a versatile and effective approach to therapy (Goats, 1990:91).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 INTRODUCTION

This chapter outlines the general procedure utilized in carrying out the research study. This includes the study design, the subjects (patients) used and a detailed account of the interventions they received. Measurements and observations obtained as well as statistical procedures for assessment of data are also discussed.

3.2 THE STUDY DESIGN

This study was designed as a randomized comparative clinical trial.

3.2.1 Objectives of the study

The aim was to compare two different treatment groups (spinal manipulative therapy versus interferential current therapy) and to identify the effectiveness of each treatment protocol (intra-group analysis) in terms of the objective and subjective measurements. An inter-group statistical analysis was also performed to determine whether one treatment protocol was more effective than the other. Thus, the more effective treatment method could then be used as either a primary treatment or as an adjunct to other treatment protocols for mechanical thoracic spine pain.

3.2.2 Selection of subjects

Patients were obtained by convenience sampling, using advertisements posted around the Technikon campus, other universities, on local community boards, local gymnasiums and word of mouth. The advertisements invited free participation in a clinical trial for people suffering from pain between the shoulder blades, midback pain and or posterior chest pain. No restrictions were placed on the patients' sex, age, racial group, occupation, income bracket or area of residence.

Any patients presenting to the clinic with sub-acute and chronic thoracic spine were considered as potential candidates for the study.
On initial contact with the patient the researcher made an appointment for the first consultation at the Technikon Natal Chiropractic Clinic.
At the first consultation the patients had a standard case history taken (addendum D), a full physical examination (addendum E), and a thoracic spine regional (addendum F), examination were performed.
To elicit the specific location and direction of the painful area and the joint dysfunction, the researcher performed a general and specific motion palpation technique of the thoracic spine.

3.2.3 Inclusion and exclusion criteria

1. Only patients diagnosed by the researcher as having mechanical thoracic spine pain were included in the study.

2. Patients were not allowed to take any analgesics or receive any other form of treatment for their thoracic back pain or any other co-existing condition during the trial period. If the patient did, they were excluded from the study.

3. Patients receiving workers compensation, disability insurance or involved in litigation for their thoracic spine pain were excluded from the study.

4. Any patient for whom spinal manipulation was contraindicated as described by Triano et al. (1992:352), and Gatterman (1990:55-62) was excluded from the study:
   - Osteomyelitis
   - Tuberculosis of the spine
   - Infectious arthritis
   - Vertebral malignancy

- Spondylolisthesis
- Severe osteoporosis

5. Any patient for whom IFC was contra-indicated as described by Goats, (1990, 87-92) and Ganne, (1976:107) was excluded from the study:

- acute inflammation
- fever
- tumour
- thrombosis
- pregnancy
- cardiac pacemaker
- where hemorrhage is a possibility

6. Patients with active or latent myofascial trigger points were not excluded from the study.

7. Using motion palpation, a thoracic fixation had to be found in one or more directions for inclusion of the subject into the study.

3.2.4 Allocation of subjects

Once the researcher together with the clinician's confirmation deemed the patient suitable for the study, the patient was informed as to the nature and reasons for the study.

If the patient agreed to participate in the research study they then were asked to complete and sign an informed consent form (addendum G), which explained the terms and conditions of the study. They were also given a letter of information (addendum H), which described the study in detail.

The patient was then randomly allocated into group one (manipulation) or group two (interferential current therapy) by having the patient draw a folded peace of paper from sixty pieces of papers in an envelope.

Thirty of the papers were marked SMT and the other thirty were marked IFC.

The patients who chose SMT received spinal manipulative therapy and the patients who chose IFC received interferential current therapy.

There was no patient blinding involved in this study as each patient was informed of the two treatments and to which group they had been allocated.

The treatment schedule was then drawn up with the patient. They were to come in for a minimum of three treatments and up to a maximum of six treatments. The treatments were given two to three times a week, varying the clinical trial time between two to three weeks depending on each patients subjective and objective response (Schiller, 1999:33 and Dr Jones, 2000)

3.3 THE DATA

The data in this study consisted of primary and secondary data.

3.3.1 The primary data

The objective means of measurement for this study were:

- the range of motion in the thoracic spine measured with a BROM II goniometer (addendum I).
- the patient's pain threshold over the most tender segment of the facet, costotransverse or rib fixation obtained from pressure readings utilizing a pressure algometer (addendum J).

The subjective means of measurement for this study were:

- the patient's perception of their intensity and quality of their pain giving a sensory dimension of the pain in the form of the Short-form McGill Pain Questionnaire (addendum A).
- the patient's perception of their pain intensity level in the form of Numerical Rating Scale-101 Questionnaire (addendum B).
- the patient's perceived amount of their disability in the form of Oswestry Back Pain Disability Index (addendum C).

3.3.2 The secondary data

This was obtained from journal articles, books and any literature related to thoracic back pain. The incidence, signs and symptoms, diagnosis and particularly the past and current treatment of mechanical thoracic spine pain was sought after to determine the most efficient method of treatment. Spinal manipulative therapy and interferential current therapy were closely looked at to determine their efficiency in treating this condition.

3.4 METHOD OF MEASUREMENTS

3.4.1 Subjective measurements

These consisted of the McGill Short-Form Pain Questionnaire, the Numerical Rating Scale-101 Questionnaire and the Oswestry Back Pain Disability Index.

3.4.1.1 McGill Short-Form Pain Questionnaire

The Short-Form McGill Pain Questionnaire measures the patient's perception of the intensity and quality of their pain giving a sensory dimension of pain (Melzack, 1987:197). "It is the most widely used measuring test for pain providing valuable information on the sensory, affective and evaluative dimension of pain experience." (Melzack, 1987:197).
The questionnaire took about 2-5 minutes to administer. It consists of fifteen types of descriptive words which were rated on an intensity scale of: 0 = none, 1 = mild, 2 = moderate and 3 = severe. The total score was then reflected as a percentage (Melzack, 1987:197).

3.4.1.2 Numerical Rating Scale-101 Questionnaire

The patient's perception of their pain intensity level is recorded on a numerical scale from 1 to 100, with 0 being no pain and 100 representing the worst pain. The patient indicates by means of a percentage on a 10cm line, when the pain was at it's worst and again on another 10cm line when the pain was at

it's least. The average of these two figures indicates the average pain experienced by the patient as a percentage.
The NRS-101 questionnaire is regarded as a superior measuring instrument as it is extremely simple to administer and score and it can be administered either in written or verbal form. It also does not have an age limitation, which other questionnaires seem to have, and there are very low tendencies for incorrect responses from the patients (Jensen et al. 1986:121).

3.4.1.3 The Oswestry Back Pain Disability Index

The Oswestry Back Pain disability questionnaire gave the researcher a percentage score of his level of function and disability. By disability, Fairbank et al. (1980:271) means the limitations of a patient's performance compared with that of a fit person.

The questionnaire is divided into ten sections, and each section contains six questions. Each statement describes a greater degree of difficulty in that activity than the preceding statement. The questionnaire takes 3,5 to 5 minutes to complete and one minute to score. Each section is scored on a scale of 0-5, 5 representing the greatest disability. The scores for all sections are added together, giving a possible score of 50. The total is doubled and expressed as a percentage. If a patient marks two statements, the highest scoring statement is recorded as a true indication of his disability.
This questionnaire has proven to be a valid measurement indicator of disability (Fairbank et al. 1980:271).

3.4.2 Objective measurements

These are made up of the range of motion in the thoracic spine measured with a BROM II goniometer and the patient's pain threshold over the most tender segment of the facet, costotransverse or rib fixation obtained from pressure readings utilizing a pressure algometer.

3.4.2.1 The BROM II goniometer

The BROM II device is a modified inclinometer and consists of separate flexion/extension and rotation/lateral flexion measuring units. The flexion/extension unit consists of a fixed base unit and extension arm: the movement is read from a protractor scale. The rotation/lateral flexion unit is made up of a horizontally mounted compass to measure rotation in the transverse plane and a vertically mounted, gravity-dependent inclinometer to measure lateral flexion in the coronal plane (Breum et al. 1995:498).

The BROM II goniometer is designed to measure the ranges of motion of the lumbar spine. In this study it was used to measure thoracic ranges of motion in flexion, extension, bilateral rotation and bilateral lateral flexion.
Unlike the lumbar spine the patients in this study were asked to sit while taking the measurement to stabilize the lower back and pelvis.
For extension the devises' extension arm was placed at C7-T1 level and held firmly in place by the researcher throughout the manoeuvre. The upper contact point of the base of the unit was strapped over the T12 level. The patient was then asked to maximally flex their neck and then their thoracic spine until the researcher stopped the movement once he visually saw the lumbar spine start to flex. At this point the readings were taken from the protractor scale on the flexion/extension unit of the BROM II.

For lateral flexion and rotation ranges of movement, the rotation/lateral flexion unit with the horizontally mounted compass was held firmly over the T12 level and the patient was asked to laterally flex on to both sides with the researcher making sure the movement did not go into the lumbar spine. This was repeated for thoracic rotation on both sides (Schiller, 1999:33).

The ranges of motion were measured in degrees according to the protocol laid out in the manufacturer procedure manual and recorded on the goniometer readings form.

For both intra- and inter-examiner agreement, the BROM II was found to be a reliable instrument of mobility for forward and lateral flexion. In contrast though, intra- and inter-examiner reliability for measuring extension and rotation received less support (Breum et al. 1995:501). In the same study though, Breum et al. (1995:501) also sated that despite the BROM's limitations in measuring extension and rotation these measurements must still be conducted on a sample of symptomatic patients, which may alter the reliability of the instrument.

3.4.2.2 Algometer

An algometer, also known as a pressure gauge has been successfully employed for the assessment of general and local pain sensitivity. It has been used to evaluate arthritis, fibrositis, abdominal pain and even in psychological research (Fischer, 1986:836).

The algometer is a force gauge fitted with a rubber disc having a surface of 1cm2. Pressure is applied to a defined surface on the body through the rubber disc. The gauge is calibrated in kg/cm2. The device consists of a body attached to a metal rod with a male tread on the end. Pressure exerted on the rod moves the indicator in a clockwise direction. Pressing the zeroing knob returns the indicator to zero after each measurement. The achieved force value is held until the zeroing knob is pressed (maximum hold function), allowing a redoing even after the meter is removed from the body (Fischer, 1986:836).

When the measurements were taken on the patients they were first educated on the gauge and how it worked. They were told that after determining the area of fixation, the algometer would be placed over the facet, costotransverse or rib articulation, over the region of maximum tenderness, which would be located by manual palpation and marked with a skin pen. The pressure would slowly be increased until the pressure sensation changed to pain (pain threshold point) at which stage the patient must verbalize that such a change has taken place. If a patient grimaces or pulls away this is considered a later sign of pain (pain reaction point) then a verbal response and measurements are to be retaken (Fischer, 1986:837, and Reeves et al. 1986:316).

The higher the pressure reading on the algometer, the less tender the area under Investigation is and the lower reading indicates a greater tenderness (Fischer, 1986:836).

According to Fischer (1986:838), the effects of treatments such as injections, physical therapy modalities or manipulation can be quantified and the reproducibility of the algometer measurement also indicates that the records of pain intensity are reliable.

3.5 THE LOCATION OF THE DATA

The primary data was obtained from three questionnaires, the Brom II goniometer readings and the algometer readings.
The data was collected just before the patient was given the first and second treatment and again prior to them receiving their last treatment.
The secondary data was sourced from current journal articles, books, interviews and the Internet (Medline and Mantis).

3.6 INTERVENTIONS

3.6.1 Experimental group 1: spinal manipulative therapy

The patients in -group one, who received thoracic spinal manipulations, did so on the levels where loss of motion or dysfunction was palpated using motion palpation.
The adjustments used, depended on the direction of loss of motion. Once the direction was determined, the joint was adjusted with the force into the restriction. The direction of drive should be in the direction of blocked mobility and in line with the articular plane (Schafer and Faye, 1990:37).

With all manipulative techniques the joint slack was taken out to the elastic barrier and high velocity low amplitude thrust was delivered at the level of the restricted motion (fixation).

A maximum of four fixations were manipulated at each visit and these were determined at the discretion of the researcher.

The manipulations that were employed were diversified techniques according to the "Compendium of Chiropractic Technique" (Szaraz, 1990:95 -125). The most frequently utilized techniques are briefly outlined below:

Hypothenar Thenar Transverse:

This technique, with a few variations in the patient's head positioning and doctor's stance, can be used for fixations found in posterior to anterior rotation and extension positions.

The patient is placed in a relaxed prone position on the table. The doctor is to stand in a square or in a lunge position at the side of the patient on the side of the fixation. The doctor then places his hypothenar eminence of his caudad hand on the fixated facet and his thenar eminence of the cephaled hand on the opposite facet of the same level. As the patient takes a deep breath the doctor applies a gentle pressure down onto the joints he will adjust in order to take out the joint slack, which is felt when the doctor feels a resistance (paraphysiological barrier) to his downward pressure. Thereafter at the end of the patient's exhalation a rapid body drop is applied by the doctor exerting a thrust through his hands down into the fixated joint causing a cavitation and an increase in joint movement (Szaraz, 1990:95 -125).

Unilateral Hypothenar Spinous/Facet:

The patient is placed in a prone position. The doctor stands on the side of the fixation and places his caudad hypothenar eminence onto the fixated facet or spinous process. The doctor's opposite hand reinforces the caudad hand by holding onto the wrist. The doctor then takes out the joint slack in the direction of the loss of motion, while the patient inspires. Once the doctor feels the joint's resistance, on the patient's expiration he applies a body drop thrust through his hands onto the fixated segment (Szaraz, 1990:95 -125).

Standing or Seated Sternal Spinous:

This technique can be used for all the ranges of motion that a facet may be fixated in by making a few small alterations in the doctor and patient's body positioning.

The patient may be seated or standing depending on his height compared to the doctor. The patient then crosses his arms across his chest so that the elbows are directly over each other.

The doctor stands behind the patient and places his sternum on the fixated facet or spinous process. The doctor then wraps both his arms and hands around the patient holding the patients crossed arms. The patient leans back into the doctor and positions the head according to the direction the facet or spinous process is fixated in. While the patient takes in a deep breath, the doctor then squeezes his sternum tightly over the contact point until he feels the joint slack is gone and then applies a very rapid thrust with his sternum into the fixation at the end of the patient's expiration (Szaraz, 1990:95 -125).

Seated or Supine Fist:

This technique can be used for fixations in rotation, extension, flexion, and lateral flexion by making slight changes in the doctor's hand and the patient's body positioning.

The patient is placed in a supine position with their arms placed across their chest in a crossed fashion so as to have the elbows directly over each other acting as a lever for the doctor.

The doctor then stands in a lunge position facing cephaled and with either his cephaled or caudad hand he places his fist on the fixated facet on the patients back. His knuckles will be on one side of the spinous process and his thenar eminence is placed on the fixated facet or spinous process. The patient then takes a deep breath as the doctor takes out the joint slack by applying an inferior to superior pressure down onto the spine. Once the doctor feels the joint's resistance, at the end of the patients expiration the doctor applies a body drop thrust through his arms down onto the fixated segment (Szaraz, 1990:95 -125).

Bilateral Thenar or Hypothenar Transverse/Facet:

The patient is placed in a prone position. The doctor is either in a lunge or a square position depending on the direction of the fixated segment, on the side of the fixation. The doctor then places both his thenar or hypothenar eminences on the fixated facet and the opposing facet. On the patient's inspiration, the doctor takes out the joint slack by applying a downward pressure onto the fixated facet and with a body drop, at the end of the patient's expiration he transmits the force through his hands to adjust the joint (Szaraz, 1990:95 -125).

Thumb Spinous:

This technique is used for a loss of lateral flexion and posterior to anterior rotation movement. The patient is prone with their head either laterally flexed or rotated depending on the direction of movement the segment has lost. The doctor can stand on either side of the fixation. The doctor then places his caudad thumb on the side of the spinous process, which is fixated, and the cephaled head reinforces the patient's head. The doctor then leans right over the patient while taking out all the joint slack until a resistance is felt and as the cervical spine is also distracted a short amplitude, high velocity thrust is applied to achieve the manipulation (Szaraz, 1990:95 -125).

3.6.2 Experimental group 2: interferential current therapy

Patients in-group two, received interferential current therapy using the Dynatron 850, and were treated with an alternating frequency of 5 -15Hz/80 - 120Hz.

Most patients were prone while being treated but a few patients preferred to be seated.

Four electrodes are used in two pairs, each pair being indicated by the colouring of the wire from the machine. With the current and timer at a zero setting, the electrodes of each pair were placed diagonally opposite one another in such a way that the interference effect or beat-frequency was produced in the tissues overlying the fixation or area of inflammation and pain found in the thoracic spine (Forster and Palastanga, 1985:108).
Once the electrodes are in place, the timer is switched on to a ten-minute treatment time and the frequency is slowly increased until the patient notifies the researcher of them feeling the current as a mild tingling sensation. The intensity of the current is increased gradually until the patient reports that a further rise would cause discomfort (Goats, 1990:88, Guffey, 1996:13 and Dynatron, 1996).
Cutaneous nerves accommodate rapidly to this stimulus and after a few seconds a larger current was applied (Goats, 1990:88).

The frequency was selected to a "high" setting of frequencies (80 -100Hz) to relieve pain together with a "sweep" mode resulting in a variation of interference frequencies that are rhythmic in nature and prevent adaptation to the stimuli (Forster and Palastanga, 1985:108 and Ganne, 1976:103).
Once the ten minute period was complete a further five minutes of treatment time was applied with the frequency setting at "low" (1-10Hz) which reduces inflammatory swelling.

3.7 STATISTICAL ANALYSIS

3.7.1 <u>The sample size of the study</u>

The sample size of the study was 30 patients per group.
Group 1 consisted of 30 patients who made up the first spinal manipulative treatment group. Group 2 consisted of the remaining 30 patients who made up the second interferential current treatment group.
Ten clinical experiments were done: flexion, extension, lateral flexion, right lateral flexion, left rotation, right rotation, algometer readings, McGill, NRS - 101 and Oswestry questionnaires.

For each clinical experiment, readings were taken three times, at the first, second and last consultation.

Flexion, extension, lateral flexion, right lateral flexion, left rotation, right rotation, algometer readings and NRS -101 are continuous variables.

McGill and Oswestry are categorical variables.

Continuous variables were analyzed using parametric methods, while categorical variables were analyzed using non-parametric methods of the sample size per group.

The SPSS statistical package was used for data entry and analysis.

3.7.2 Comparison between groups 1 and 2 with respect to continuous variables

The two-sample unpaired t-test was used to compare groups 1 and 2 with respect to each continuous variable.

The null hypothesis stated that there was no improvement between groups 1 and 2 with respect to the variable of comparison at the $\alpha = 0.05$ level of significance.

The alternative hypothesis stated that there was an improvement between the two treatment protocols at the same level of significance.

Decision rule:

The null hypothesis was rejected at the α level of significance if $p < \alpha$ where p was the observed significance level or probability value. Otherwise, the null hypothesis was accepted at the same level.

3.7.3 Comparison between groups 1 and 2 with respect to categorical variables

The Mann-Whitney U-test was used to compare groups 1 and 2 with respect to each categorical variable.

The null hypothesis stated that there was no improvement between groups 1 and 2 with respect to the variable of comparison at the $\alpha = 0.05$ level of significance.
The alternative hypothesis stated that there was an improvement between the treatments at the same level of significance.

Decision rule:

The null hypothesis was rejected at the α level of significance if $p < \alpha /2$ where p was the observed significance level or probability value. Otherwise, the null hypothesis was accepted at the same level.

3.7.4 Comparison between related samples within group 1 with respect to continuous variables

The two-sample paired t-test was used to compare results from related samples. In each test, the null-hypothesis stated that there was no significant improvement between the two related samples being compared, at the α = 0.05 level of significance. The alternative hypothesis stated that there was an improvement between the two groups.

Decision rule:

The null hypothesis was rejected at the α level of significance if $p < \alpha$ where p was the observed significance level or probability-value. Otherwise, the null hypothesis was accepted at the same level.

3.7.5 Comparison between related samples within group 1 with respect to categorical variables

Wilcoxon's signed rank test was used to compare results from related samples.
In each test, the null hypothesis stated that there was no improvement between the two related samples being compared, at the α level of significance.

The alternative hypothesis stated that there was an improvement.

Decision rule:

The null hypothesis was rejected at the α level of significance if $p < \alpha$ where p was the observed significance level or probability value. Otherwise, the null hypothesis was accepted at the same level.

3.7.6 Comparison between related samples within group 2 with respect to continuous variables

The two-sample paired t-test was used to compare results from related samples.

In each test, the null-hypothesis stated that there was no improvement between the two related samples being compared, at the α level of significance. The alternative hypothesis states that there was an improvement between the two groups.

Decision rule:

The null hypothesis was rejected at the α level of significance if $p< \alpha$ where p was the observed significance level or probability value. Otherwise, the null hypothesis was accepted at the same level.

3.7.7 Comparison between related samples within group 2 with respect to categorical variables

Wilcoxon's signed rank test was used to compare results from related samples.

In each test, the null hypothesis stated that there was no improvement between the two related samples being compared, at the α level of significance. The alternative hypothesis stated that there was an improvement.

Decision rule:

The null hypothesis was rejected at the a level of significance if $p < \alpha$ where p was the observed significance level or probability value. Otherwise, the null hypothesis was accepted at the same level.

3.7.8 <u>Comparison using barcharts</u>

Visual summaries of analytical findings were given by the use of barcharts to compare groups 1 and 2 with respect to continuous variables of the study only. Average readings were used to construct barcharts.

CHAPTER FOUR

4.0 THE RESULTS

4.1 INTRODUCTION

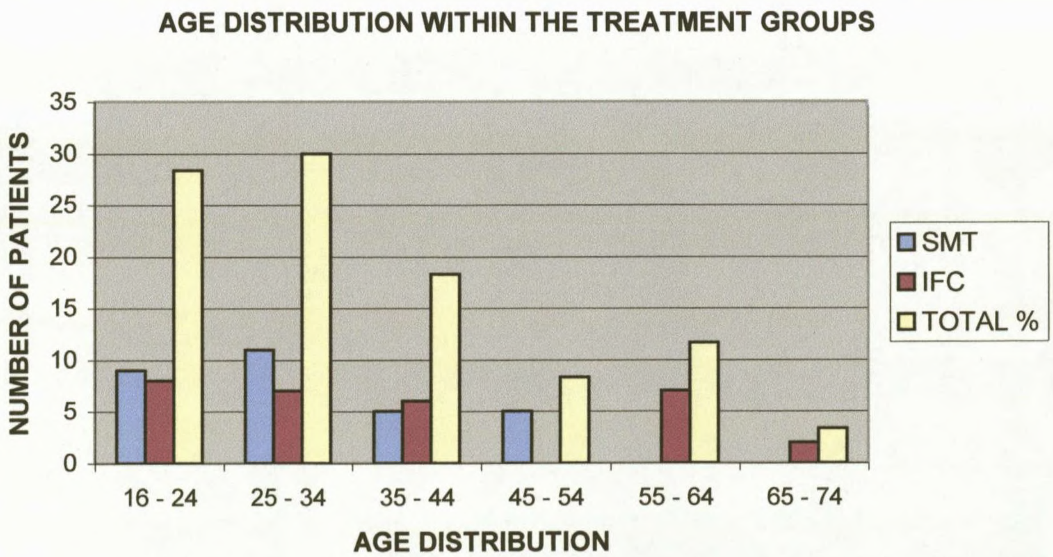
The statistical findings of this study are presented in this chapter.
The subjective and objective data of both SMT and IFC groups is discussed. The objective data was obtained from the algometer and thoracic goniometer range of motion readings and the subjective data was obtained from the questionnaires which were completed on the first, second and last treatment.

Intra and inter-treatment results were analyzed for both groups.

Demographic data consisting of age, race, gender, region distribution of thoracic spine fixations, occupations of patient's and distribution of type and direction of fixations present, were also highlighted.

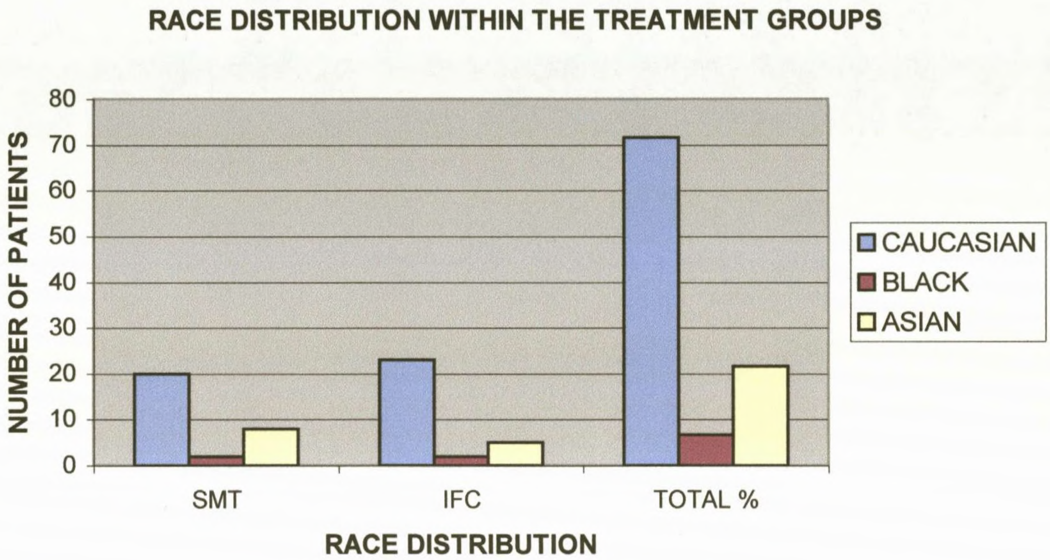
4.2 DEMOGRAPHIC DATA

FIGURE 4.1 <u>THE AGE DISTRIBUTION WITHIN THE SAMPLE GROUPS</u>



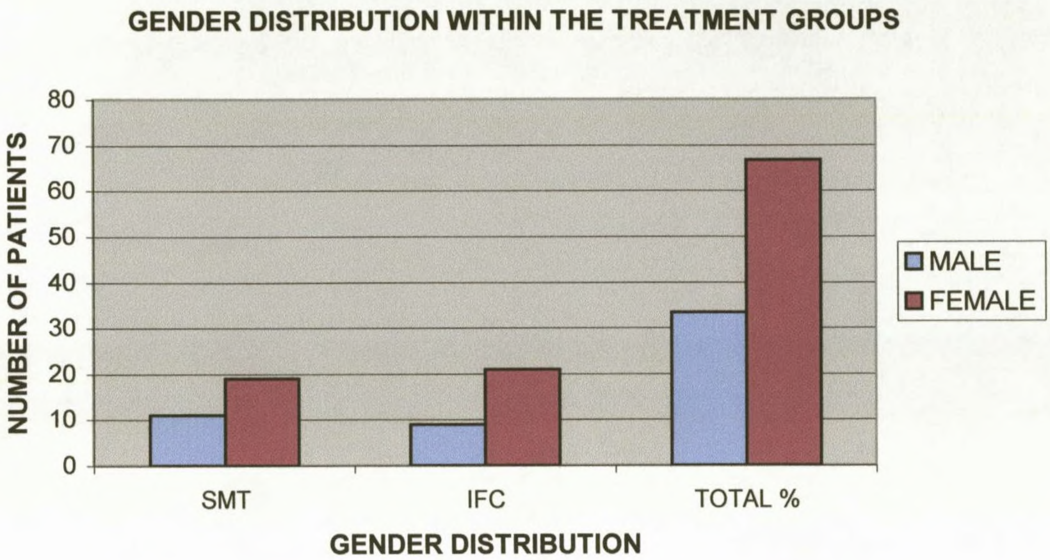
There is a dominance of patients within the 16 to 34 age group within the total sample group of 60. This is possibly due to the large number of students who took part in the study. The age group 45 to 54 was not present in the IFC group and patients in the age group of 55 to 64 and 65 to 74 were not present in the SMT group.

FIGURE 4.2 THE RACE DISTRIBUTION WITHIN THE SAMPLE GROUPS



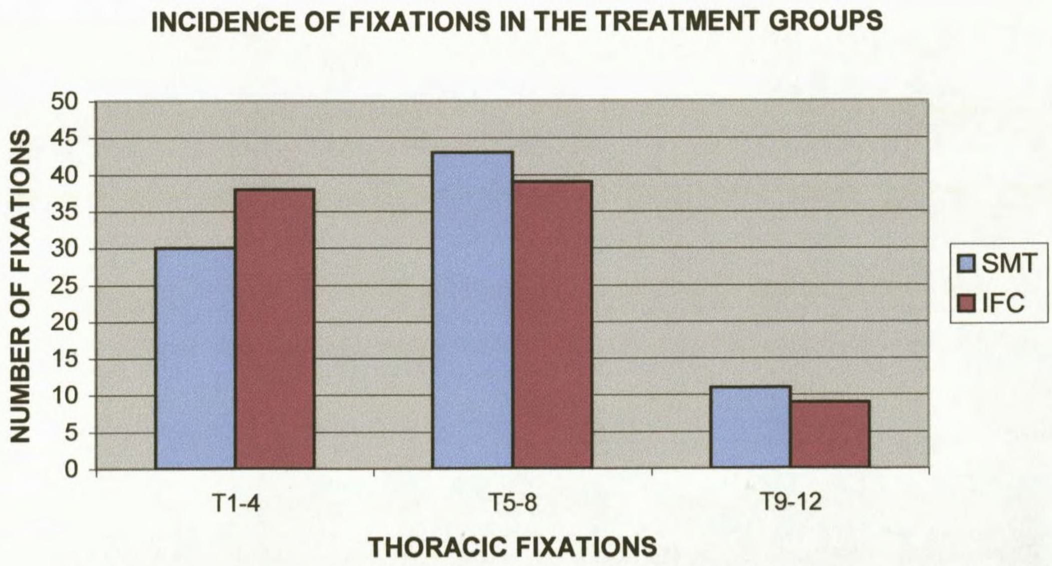
Caucasians made up the greater numbers in both treatment groups, followed by the Asians and then the Blacks. This could be due to the high prevalence of chiropractic students who took part in the study and who are mostly Caucasians.

FIGURE 4.3 THE GENDER DISTRIBUTION WITHIN THE SAMPLE GROUPS



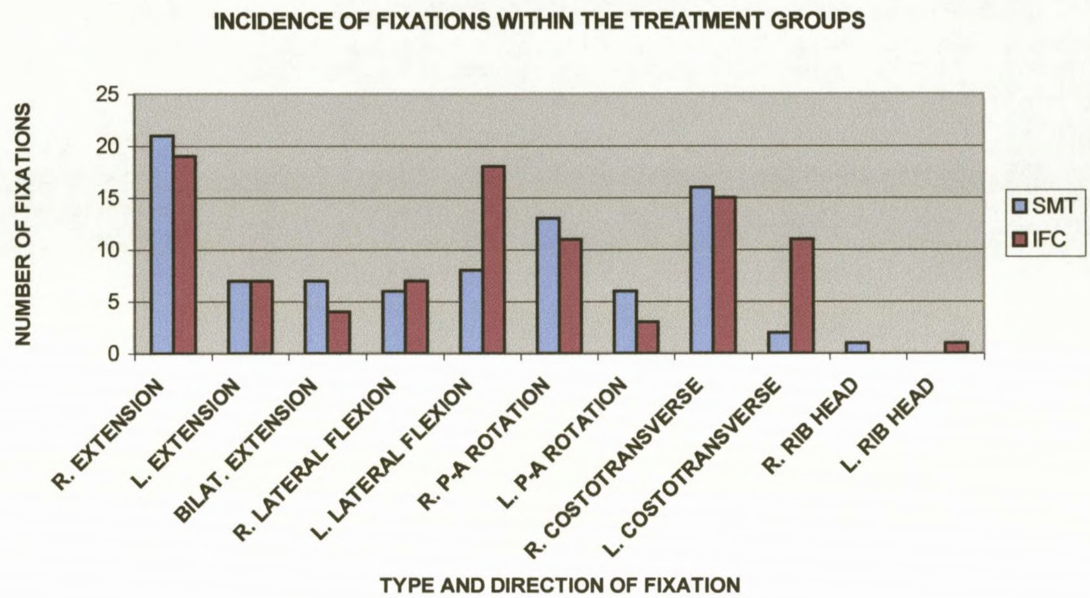
The female gender dominated both treatment groups. The incidence of mechanical thoracic back pain according to Mior and Diakow (1987:306) has a higher incidence among women especially health care takers such as chiropractors, dentists and nurses. Chiropractic students made up a large portion of both sample groups thus confirming Mior and Diakow's findings.

FIGURE 4.4 THE REGION DISTRIBUTION OF THE THORACIC SPINE FIXATIONS WITHIN THE SAMPLE GROUPS



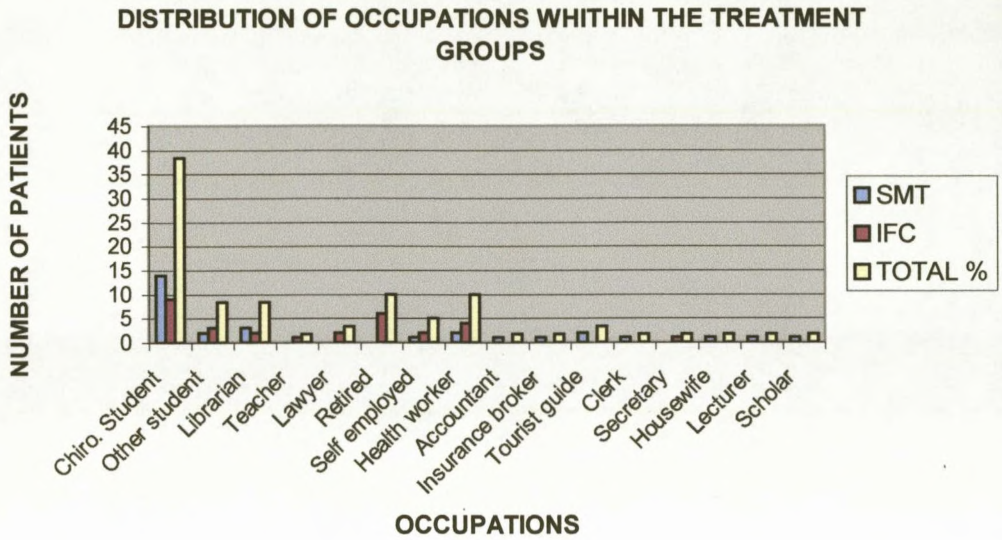
Fixations were mostly found between T1 and T8 in both sample groups. There appeared to be an even distribution amongst the two treatment groups.

FIGURE 4.5 THE DISTRIBUTION OF TYPE AND DIRECTION OF FIXATIONS WITHIN THE SAMPLE GROUPS



Right extension followed by right costotransverse and left lateral flexion seemed to be the most common fixations in the sample groups. The first two directions were equally present in both sample groups but left lateral flexion was definitely more prominent in the interferential treatment group.

FIGURE 4.6 THE OCCUPATION DISTRIBUTION WITHIN THE SAMPLE GROUPS



Chiropractic students made up a large portion of the sample group as the study was conducted at the chiropractic day clinic Technikon Natal, making it very accessible for the chiropractic students to take part in the study.

The findings of Mior and Diakow, (1987:306) stated that the high incidence of thoracic back pain occurs in health care workers especially chiropractic practitioners. Taking this finding into account the researcher also utilized the opportunity of performing the study on the easily accessible chiropractic students.

4.3 THE ANALYZED DATA

During this and subsequent chapters, the SMT group is referred to as group one and the IFC group is referred to as group two.

The two-sample unpaired t-test was used for inter-group comparisons with respect to each continuous variable. The Mann-Whitney U-test was used for inter-group comparisons with respect to each categorical variable.

The two-sample paired t-test was used for intra-group comparisons with respect to each continuous variable and the Wilcoxon's signed rank test was used for intra-group comparisons with respect to each categorical variable.

Key for abbreviations in tables:

Group 1: receiving spinal manipulative therapy

Group 2: receiving interferential current therapy

NRS – 101: Numerical Pain Rating Scale – 101 Questionnaire

McGill: Short – Form McGill Pain Questionnaire

LF: lateral flexion

4.3.1 The inter-group analysis of continuous variables using the unpaired t- test

TABLE 4.1 COMPARISONS OF THE CONTINUOUS VARIABLES BETWEEN GROUP I AND 2 USING THE UNPAIRED T-TEST

KEY:
1: FIRST TREATMENT
2: SECOND TREATMENT
3: FINAL TREATMENT

CONTINUOUS VARIABLES	MEANS GROUP 1	MEANS GROUP 2	P - VALUE
FLEXION 1	16.100	17.567	0.376
FLEXION 2	14.767	16.6	0.2
FLEXION 3	17.667	16.5	0.389
EXTENSION 1	8.133	9.7	0.172
EXTENSION 2	8.367	9.1	0.482
EXTENSION 3	10	8.6	0.217
LEFT LF 1	15.467	14.767	0.759
LEFT LF 2	16.133	13.667	0.282
LEFT LF 3	15.233	11.567	0.058
RIGHT LF 1	15.7	15.167	0.793
RIGHT LF 2	16.933	13.467	0.135
RIGHT LF 3	15.167	11.633	0.058
LEFT ROTATION 1	17.3	20.7	0.13
LEFT ROTATION 2	17.167	21.033	0.135
LEFT ROTATION 3	20.167	19.967	0.92

RIGHT ROTATION 1	17.567	20	0.292
RIGHT ROTATION 2	17	18.167	0.572
RIGHT ROTATION 3	19.467	20.733	0.596
ALGOMETER 1	4.27	4.3733	0.804
ALGOMETER 2	4.273	4.471	0.615
ALGOMETER 3	4.85	5.062	0.699
NRS 1	42.5	37.733	0.231
NRS 2	29.917	32.483	0.562
NRS 3	21.333	20.567	0.854

The null hypothesis is accepted for the inter-group analysis of the goniometer and algometer readings as well as the Numerical Pain Rating Scale – 101 Questionnaire. This indicates that at the $\alpha = 0.05$ level of significance there was no improvement between groups 1 and 2 when compared at visits one, two or three.

In a number of the above readings especially of the goniometer, it is evident that some patients appear to worsen after the first treatment and then improve again at the final treatment. This could be due to a "normal" chiropractic aggravation after a treatment (Kleynhans, 1980:359).

As Kleynhans, (1980:359) states: "Normal or adequate reactions are described as subjective discomforts that do not influence the working ability with spontaneous remission at least two days after manipulation".

The results which did worsen on the second visit, did improve by the final treatment which correlates with the literature's findings.

4.3.2 The inter-group analysis of categorical variables using the Mann-Whitney test

TABLE 4.2 COMPARISONS OF THE CATEGORICAL VARIABLES BETWEEN GROUP 1 AND 2 USING THE MANN-WHITNEY TEST

OSWESTRY 1	OSWESTRY 2	OSWESTRY 3	MCGILL 1	MCGILL 2	MCGILL 3
0.166	0.067	0.017	0.761	0.413	0.391

The null hypothesis is rejected for the inter-group analysis of the Oswestry Questionnaire. This indicates that at the $\alpha = 0.025$ level of significance, there was an improvement between groups 1 and 2 when compared at the final treatment.

The Oswestry Questionnaire is used primarily to measure the patient's functional disability. Statistical difference is present in the analysis of this questionnaire indicating that manipulation is better at restoring the normal joint movement as well as restoring and increasing the patient's functional ability then interferential current therapy was able to.

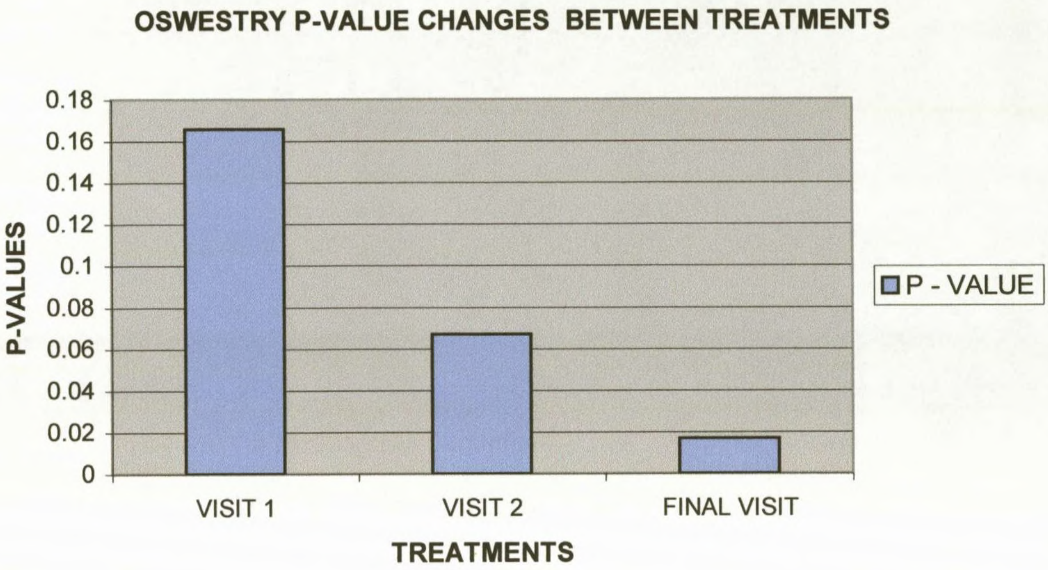
In contrast, the null hypothesis is accepted for the Short Form McGill Pain Questionnaire, indicating that there was no statistical improvement between groups 1 and group 2 when compared at visits 1, 2 and 3.

Manipulation did not indicate to be more effective in decreasing the pain felt by the patient then interferential current therapy.

This could be due to possibly not enough treatments given to the patients, thus not eliminating the problem and pain altogether.

Manipulation alone, without any other modality such a soft tissue therapy, cryotherapy or stretching may have aggravated some of the dysfunctional joints, adding to the inflammation and tenderness of the zygopophyseal joints thus not reducing the patients thoracic pain as effectively as it could.

FIGURE 4.7 INTER-GROUP COMPARISON OF OSWESTRY QUESTIONNAIRE P-VALUES BETWEEN TREATMENTS



This figure illustrates the improvement of the Oswestry Questionnaire in the final visit. When this questionnaire is statistically compared between the treatment groups, manipulation proved to be the most effective in improving the patient's function and disability.

4.3.3 The intra-group analysis within group 1 of continuous variables using the Paired t-test

TABLE 4.3 COMPARISONS OF THE CONTINUOUS VARIABLES WITHIN GROUP 1 USING THE PAIRED T-TEST

	MEAN	SIGNIFICANCE (2 TAILED)
PAIR 1 - FLEXION 1	16.1	PAIR 1 - 0.263
FLEXION 2	14.767	
PAIR 2 - FLEXION 2	14.767	PAIR 2 - .004
FLEXION 3	17.667	
PAIR 3 - FLEXION 1	16.1	PAIR 3 - .241
FLEXION 3	17.667	
PAIR 4 - EXTENSION 1	8.133	PAIR 4 - .805
EXTENSION 2	8.367	

PAIR 5 -	EXTENSION 2	8.367	PAIR 5 - .013
	EXTENSION 3	10	
PAIR 6 -	EXTENSION 1	8.133	PAIR 6 - .025
	EXTENSION 3	10	
PAIR 7 -	LEFT LF 1	15.467	PAIR 7 - .601
	LEFT LF 2	16.133	
PAIR 8 -	LEFT LF 2	16.133	PAIR 8 - .265
	LEFT LF 3	15.233	
PAIR 9 -	LEFT LF 1	15.467	PAIR 9 - .814
	LEFT LF 3	15.233	
PAIR 10 -	RIGHT LF 1	15.7	PAIR 10 - .268
	RIGHT LF 2	16.933	
PAIR 11 -	RIGHT LF 2	16.933	PAIR 11 - .037
	RIGHT LF 3	15.167	
PAIR 12 -	RIGHT LF 1	15.7	PAIR 12 - .576
	RIGHT LF 3	15.167	
PAIR 13 -	LEFT ROT 1	17.3	PAIR 13 - .930
	LEFT ROT 2	17.167	
PAIR 14 -	LEFT ROT 2	17.167	PAIR 14 - .010
	LEFT ROT 3	20.167	
PAIR 15 -	LEFT ROT 1	17.3	PAIR 15 - .037
	LEFT ROT 3	20.167	
PAIR 16 -	RIGHT ROT 1	17.567	PAIR 16 - .605
	RIGHT ROT 2	17	
PAIR 17 -	RIGHT ROT 2	17	PAIR 17 - .041
	RIGHT ROT 3	19.467	
PAIR 18 -	RIGHT ROT 1	17.567	PAIR 18 - .106
	RIGHT ROT 3	19.467	
PAIR 19 -	ALGOMETER 1	4.27	PAIR 19 - .981
	ALGOMETER 2	4.273	
PAIR 20 -	ALGOMETER 2	4.273	PAIR 20 - .006
	ALGOMETER 3	4.85	
PAIR 21 -	ALGOMETER 1	4.27	PAIR 21 - .031
	ALGOMETER 3	4.85	

PAIR 22 - NRS 1	42.5	PAIR 22 - .000
NRS 2	29.917	
PAIR 23 - NRS 2	29.917	PAIR 23 - .001
NRS 3	21.333	
PAIR 24 - NRS 1	42.5	PAIR 24 - .000
NRS 3	21.333	

The null hypothesis is rejected for the intra-group analysis of the goniometer readings. This indicates that at the $\alpha = 0.05$ level of significance there was an improvement within group 1 for flexion when compared at visits two and three. There was also an improvement for extension when compared at visits two and three and visits one and three.
Right lateral flexion also improved between visits two and three.
Left rotation improved between visits two and three and one and three.
Right rotation improved between visits two and three.

The null hypothesis was rejected for the intra-group analysis of the algometer readings. This indicates that at the $\alpha = 0.05$ level of significance there was an improvement within group 1 when compared at visits two and three and again between visits one and three.

The null hypothesis was rejected for the intra-group analysis of the NRS-101 Questionnaire readings. This indicates that at the $\alpha = 0.05$ level of significance there was an improvement within group 1 when compared at visits one and two, two and three and one and three.

4.3.4 The intra-group analysis within group 1 of categorical variables using the Wilcoxon's Signed Rank test

TABLE 4.4 COMPARISON OF THE CATEGORICAL VARIABLES WITHIN GROUP 1 USING THE WILCOXON'S SIGNED RANK TEST

	MEANS	MEANS	P - VALUE
OSWESTRY 1 VS 2	12.82	8.71	0
OSWESTRY 2 VS 3	8.71	5.38	0.002

OSWESTRY 3 VS 1	5.38	12.82	0
MCGILL 1 VS 2	10.07	4.83	0
MCGILL 2 VS 3	4.83	3.23	0.002
MCGILL 3 VS 1	3.23	10.07	0

The null hypothesis was rejected for the intra-group analysis of the Oswestry and the Short – Form McGill Pain Questionnaire. This indicates that at the $\alpha = 0.05$ level of significance there was an improvement within group 1 when compared at visits one, two and three.

4.3.5 The intra-group analysis within group 2 of continuous variables using the Paired t-test

TABLE 4.5 COMPARISONS OF THE CONTINUOUS VARIABLES WITHIN GROUP 2 USING THE PAIRED T-TEST

		MEAN	SIGNIFICANCE (2 TAILED)
PAIR 1 -	FLEXION 1	17.567	PAIR 1 -.286
	FLEXION 2	16.6	
PAIR 2 -	FLEXION 2	16.6	PAIR 2 - .902
	FLEXION 3	16.5	
PAIR 3 -	FLEXION 1	17.567	PAIR 3 - .233
	FLEXION 3	16.5	
PAIR 4 -	EXTENSION 1	9.7	PAIR 4 - .465
	EXTENSION 2	9.1	
PAIR 5 -	EXTENSION 2	9.1	PAIR 5 - .362
	EXTENSION 3	8.6	
PAIR 6 -	EXTENSION 1	9.7	PAIR 6 - .257
	EXTENSION 3	8.6	
PAIR 7 -	LEFT LF 1	14.767	PAIR 7 - .325
	LEFT LF 2	13.667	
PAIR 8 -	LEFT LF 2	13.667	PAIR 8 - .067
	LEFT LF 3	11.567	

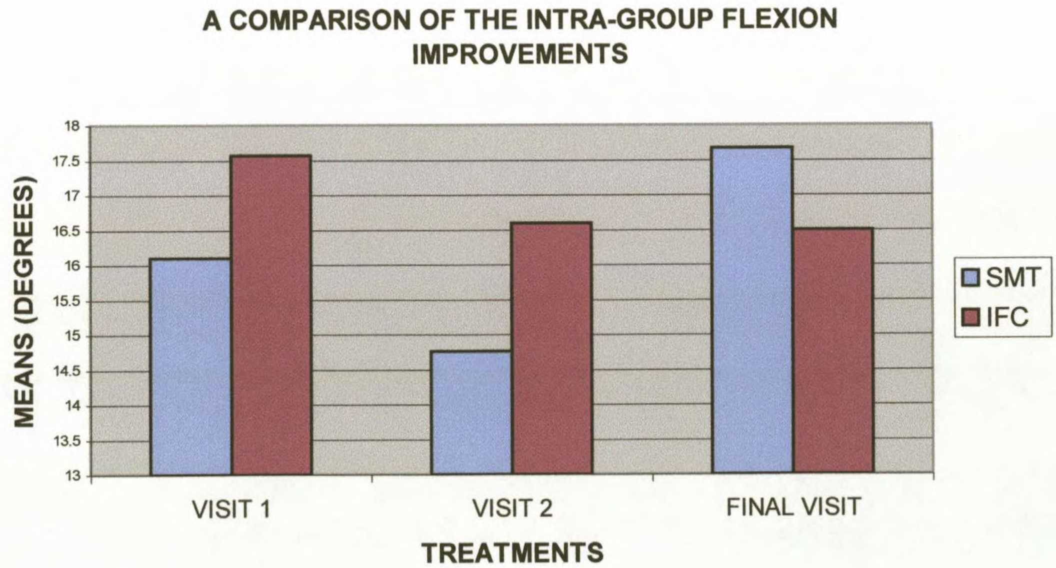
PAIR 9 - LEFT LF 1	14.767	PAIR 9 - .006
LEFT LF 3	11.567	
PAIR 10 - RIGHT LF 1	15.167	PAIR 10 - .061
RIGHTLF 2	13.467	
PAIR 11 - RIGHT LF 2	13.467	PAIR 11 - .060
RIGHT LF 3	11.633	
PAIR 12 - RIGHT LF 1	15.167	PAIR 12 - .003
RIGHT LF 3	11.633	
PAIR 13 - LEFT ROT 1	20.7	PAIR 13 - .872
LEFT ROT 2	21.033	
PAIR 14 - LEFT ROT 2	21.033	PAIR 14 - .582
LEFT ROT 3	19.967	
PAIR 15 - LEFT ROT 1	20.7	PAIR 15 - .684
LEFT ROT 3	19.967	
PAIR 16 - RIGHT ROT 1	20	PAIR 16 - .123
RIGHT ROT 2	18.167	
PAIR 17 - RIGHT ROT 2	18.167	PAIR 17 - .033
RIGHT ROT 3	20.733	
PAIR 18 - RIGHT ROT 1	20	PAIR 18 - .657
RIGHT ROT 3	20.733	
PAIR 19 - ALGOMETER 1	4.3733	PAIR 19 - .611
ALGOMETER 2	4.471	
PAIR 20 - ALGOMETER 2	4.471	PAIR 20 - .016
ALGOMETER 3	5.062	
PAIR 21 -ALGOMETER 1	4.3733	PAIR 21 - .007
ALGOMETER 3	5.062	
PAIR 22 - NRS 1	37.733	PAIR 22 - .009
NRS 2	32.483	
PAIR 23 - NRS 2	32.483	PAIR 23 - .000
NRS 3	20.567	
PAIR 24 - NRS 1	37.733	PAIR 24 - .000
NRS 3	20.567	

The null hypothesis was rejected for the intra-group analysis of the goniometer readings. This indicates that at the $\alpha = 0.05$ level of significance there was an improvement within group 2 when compared at visits one and three for left lateral flexion as well as right lateral flexion between visits one and three. Right rotation also shows an improvement when compared at visits two and three.

The null hypothesis was rejected for the intra-group analysis of the algometer readings. An improvement is evident for the algometer readings when compared at visits one and two, two and three and between one and three.

The null hypothesis is rejected for the intra-group analysis of the NRS-101 readings as all the readings between visits one and two, two and three and one and three all show an improvement at an $\alpha = 0.05$ level of significance.

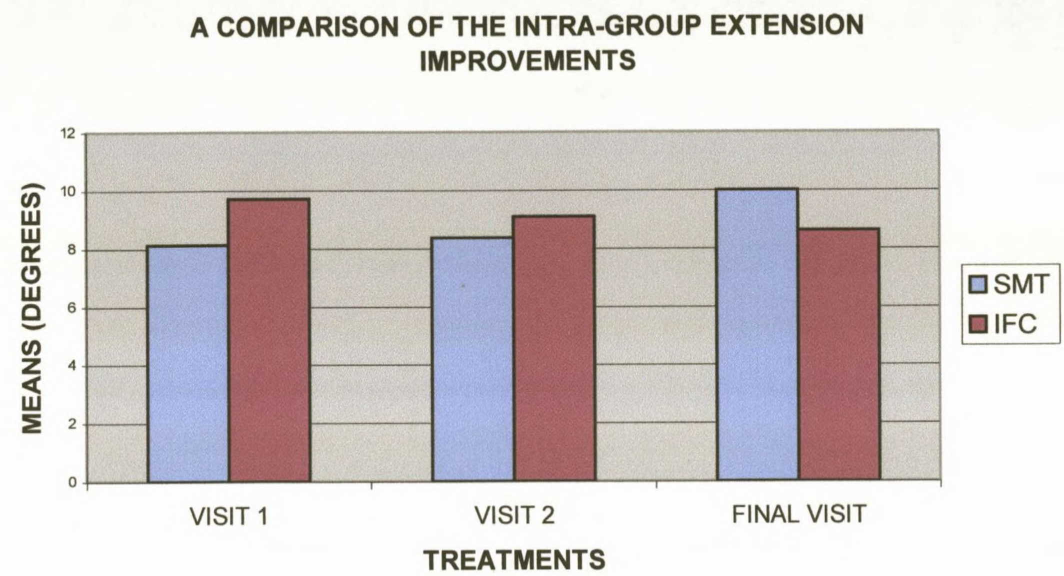
FIGURE 4.8 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF FLEXION



Comparison within the manipulation group showed improvement between the second and final treatment. The graph shows a decline between the first and the second visit. This could be due to a normal post manipulation aggravation, which can last up to two days. The most common aggravations include local or referred pain from the area of the manipulation (Kleynhans, 1980:359 and Leboeuf – Yde et al. 1997:511-514).

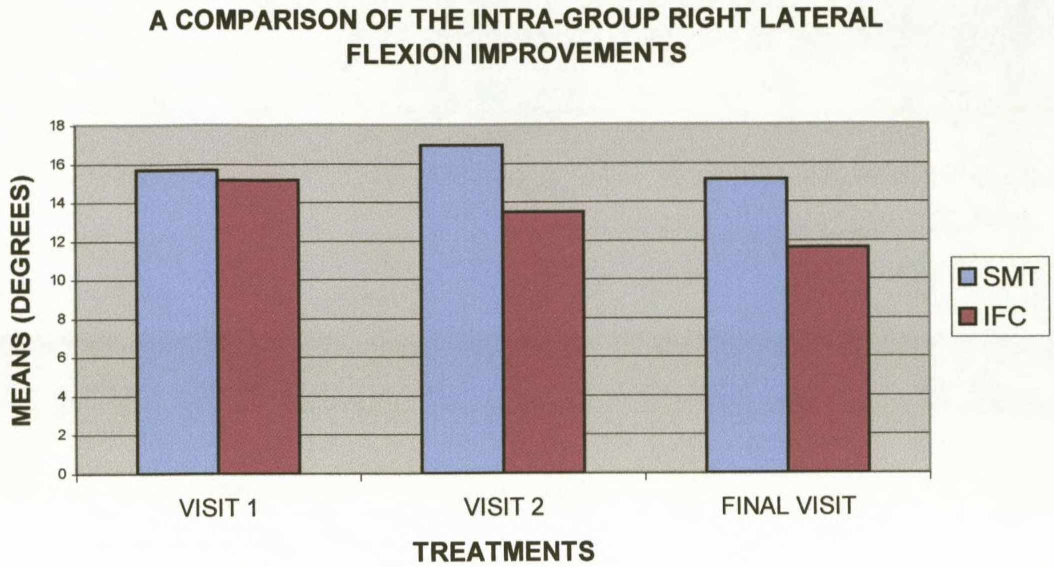
Interferential current therapy did not show statistical improvement for flexion within it's group.

FIGURE 4.9 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF EXTENSION



Statistical analysis showed manipulation to increase extension's range of motion between the first and final treatments as well as between the second and final visit. Therefore within this treatment group after each visit there was statistical improvement in extension.

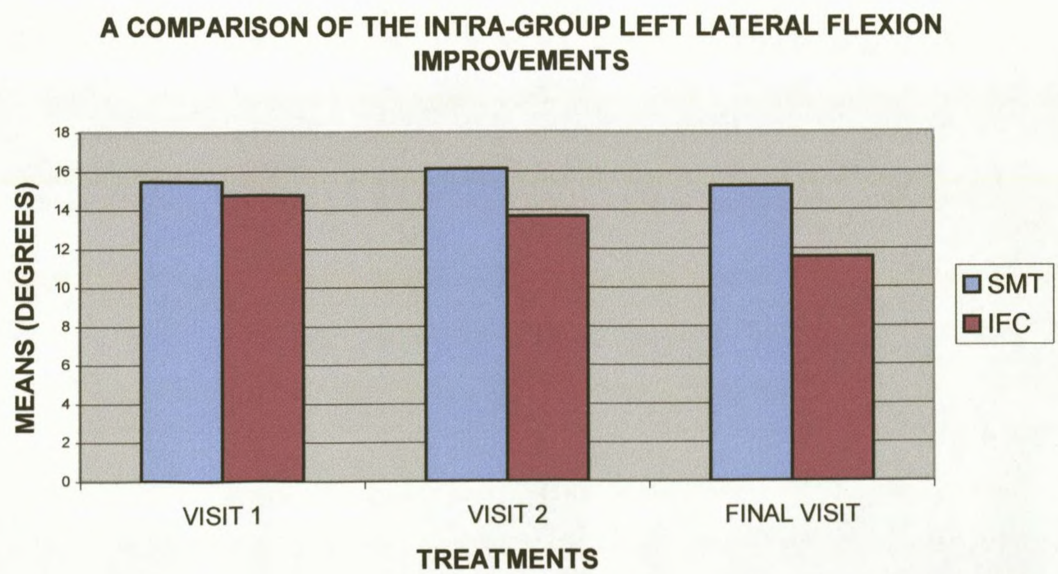
FIGURE 4.10 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF RIGHT LATERAL FLEXION



Within the manipulation group there was improvement noted between the second and final treatment.

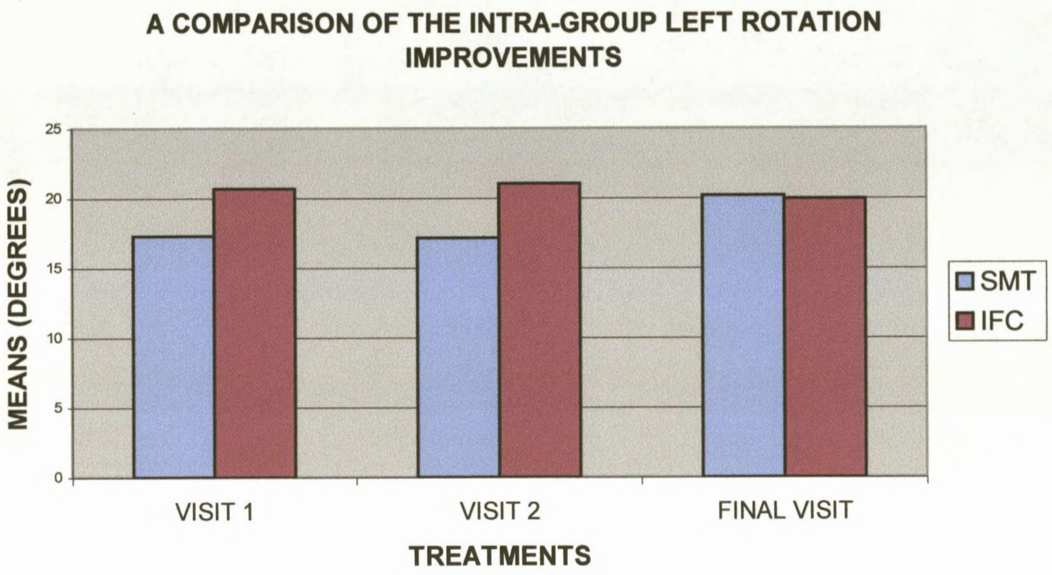
Statistical analysis also showed interferential current therapy to improve right lateral flexion measurements between the first and final treatment.

FIGURE 4.11 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF LEFT LATERAL FLEXION



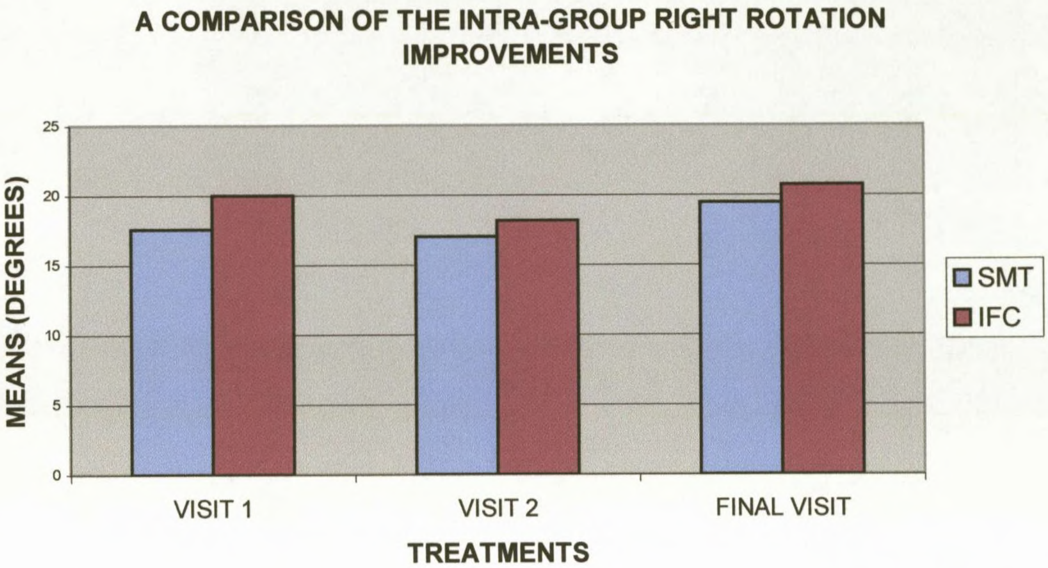
Interferential current therapy improved left lateral flexion between the first and final treatment when compared within it's own group.
Manipulation did not show an improvement in this range of motion.

FIGURE 4.12 <u>COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF LEFT ROTATION</u>



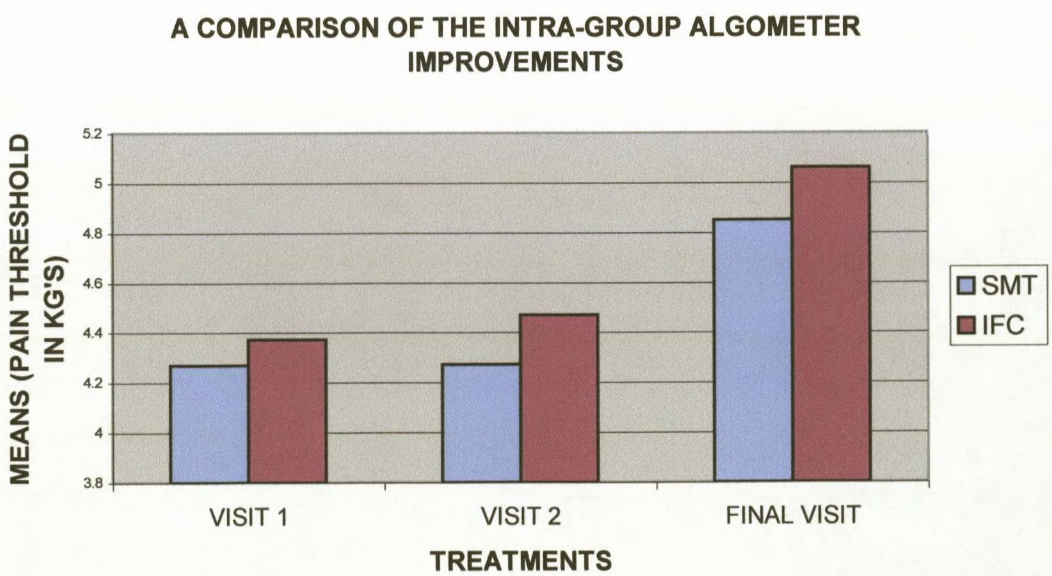
Within the manipulation group, left rotation showed improvement between the second and final treatment as well as the first and final treatments.
Interferential therapy showed no improvement in this range of motion.

FIGURE 4.13 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF RIGHT ROTATION



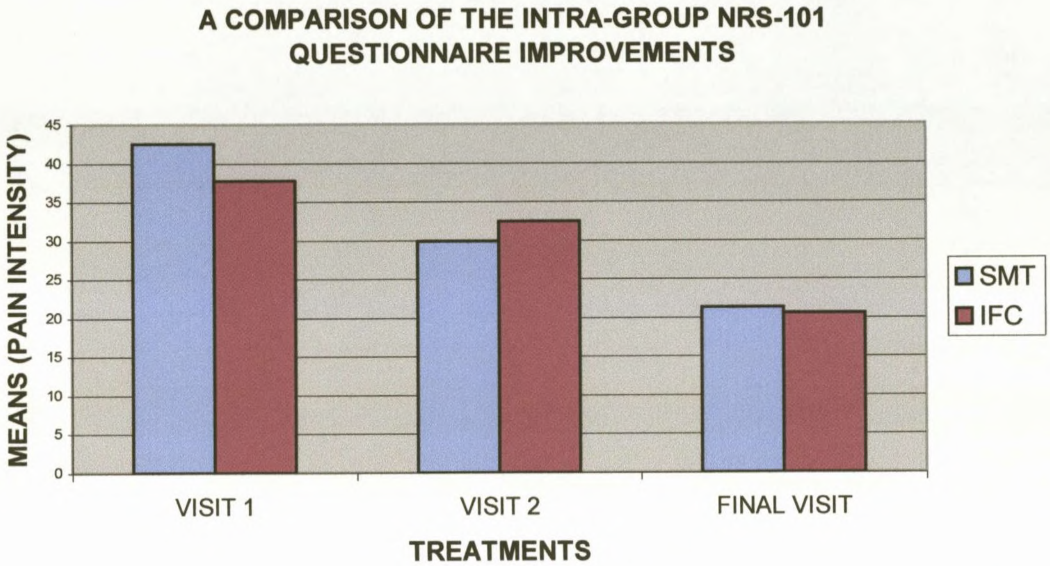
Statistical analysis showed interferential current therapy and manipulation to improve right rotation between their respective second and final treatments.

FIGURE 4.14 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF THE ALGOMETER ANALYSIS



Statistical analysis showed interferential current therapy and manipulation to improve in the algometer readings between the first and final treatment as well as the second and final treatments.

FIGURE 4.15 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF THE NRS-101 QUESTIONNAIRE



Both groups showed statistical improvement within their own sample group using the NRS-101 questionnaire. This indicates that both therapies are effective in decreasing the intensity of mechanical thoracic back pain.

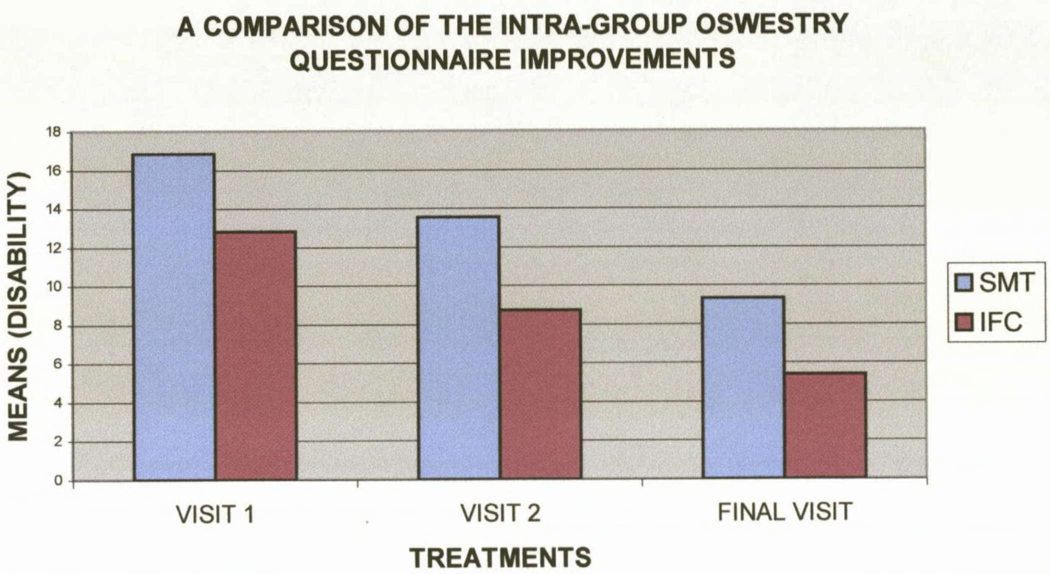
4.3.6 The intra-group analysis within group 2 of categorical variables using the Wilcoxon's Signed Rank test

TABLE 4.6 COMPARISONS OF THE CATEGORICAL VARIABLES WITHIN GROUP 2 USING THE WILCOXON'S SIGNED RANK TEST

	MEANS	MEANS	P - VALUE
OSWESTRY 1 VS 2	16.83	13.53	0.003
OSWESTRY 2 VS 3	13.53	9.33	0.006
OSWESTRY 3 VS 1	9.33	16.83	0
MCGILL 1 VS 2	10.5	6.83	0.002
MCGILL 2 VS 3	6.83	4.33	0.013
MCGILL 3 VS 1	4.33	10.5	0

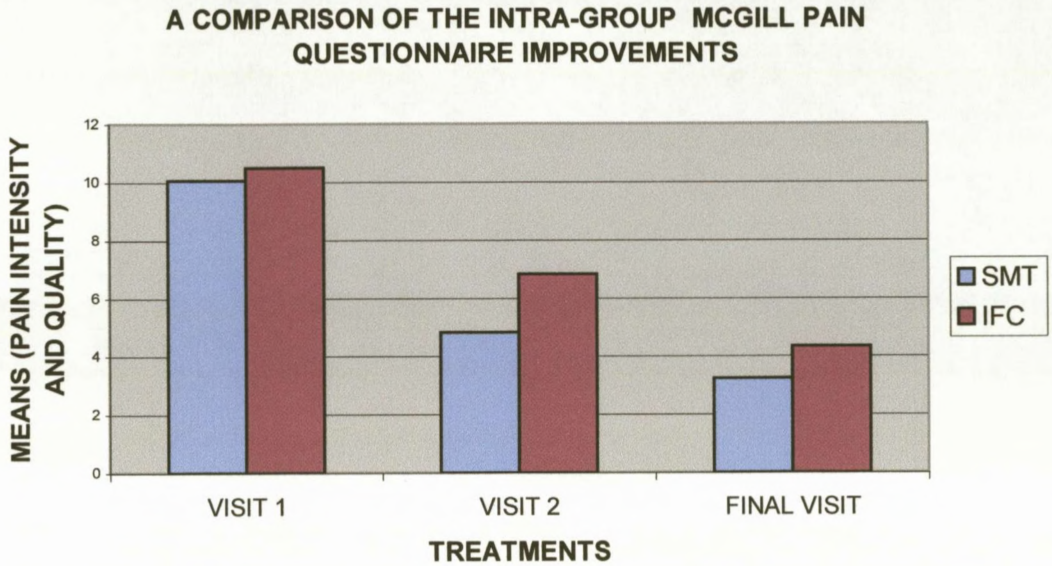
The null hypothesis was rejected for the intra-group analysis of the Oswestry and the Short – Form McGill Pain Questionnaire. This indicates that at the $\alpha = 0.05$ level of significance there was an improvement within group 2 when compared at visits one, two and three.

FIGURE 4.16 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF THE OSWESTRY QUESTIONNAIRE



Both manipulation and interferential current therapy showed statistical improvement within their treatment groups with the Oswestry Questionnaire.

FIGURE 4.17 COMPARISON OF THE INTRA-GROUP STATISTICAL IMPROVEMENTS OF THE MCGILL PAIN QUESTIONNAIRE



Both groups showed statistical improvement within their own sample group using the McGill Pain questionnaire. This indicates that both therapies are effective in decreasing the quantity and quality of mechanical thoracic back pain.

CHAPTER FIVE

5.0 DISCUSSION OF RESULTS

5.1 INTRODUCTION

This chapter will discuss the results obtained from the subjective and objective data presented in chapter four.

In the evaluation of the inter-group data the assessment from measurements of the first treatment gives an indication of any baseline differences in subjective and objective findings between the two groups, in terms of their original signs and symptoms.
The inter-group comparison at the final treatment indicates which treatment protocol is more effective.

The analysis of the subjective and objective intra-group results between the first, second and final treatment represents the effectiveness of each treatment regime.

5.2 INTER-GROUP COMPARISONS

5.2.1 Subjective measurements

Despite the improvements within each treatment group, the only statistical difference noted between the treatment groups in the subjective measurement analysis was in the Oswestry Back Pain Disability questionnaire, which showed a significant change in the final visit (figure 4.7).
As mentioned earlier in the study the Oswestry Back Pain Disability Questionnaire measures the daily limitations of a patient's performance compared with that of a fit person (Fairbank et al. 1980:271).

The statistical difference noted between the treatments was that manipulation was more effective in restoring the patient's function and disability by the end of the clinical trial than interferential current therapy was able to (figure 4.7).

The other two subjective measurements, which are the McGill Pain questionnaire and the NRS 101, are both involved in measuring the patient's perception of the intensity of their pain and the quality of their pain.
The statistical analysis showed no statistical significance between the two therapies using these measuring tools although clinical improvements were evident in both groups. This indicates that spinal manipulative therapy did not prove to be more effective then interferential current therapy in reducing the patient's intensity and quality of pain.

5.2.2 Objective measurements

The algometer and Brom II goniometer readings showed no statistical difference between the two groups.
Both the algometer and the Brom II are objective type measurements allowing the researcher to obtain a non-biased clinical representation of changes that may have occurred in a patient after the therapies. The results indicate that spinal manipulative therapy was not more effective in increasing the patient's range of motion and decreasing local pain intensity than interferential current therapy.

5.3 INTRA-GROUP COMPARISONS

In both intra-group analyses, significant improvements were seen in manipulation and interferential treatment groups.

5.3.1 Objective measurements

In group one, where manipulation was the treatment administered, the goniometer readings showed, flexion to improve between the second and final

treatment (figure 4.8) as well as extension, which also improved between the second and the final as well as the first and final treatments (figure 4.9).
Right lateral flexion (figure 4.10) and right rotation improved between the second and final visit (figure 4.13). Left rotation improved between the second and final visits as well as the first two treatments (figure 4.12).
The only range of motion, which did not show improvement, was left lateral flexion (figure 4.11) otherwise all ranges of motion increased after spinal manipulative therapy.
One of the possible reasons that manipulation did not show an improvement in left lateral flexion is because, looking at figure 4.5 which displays the distribution of the type and direction of the fixations, the interferential current therapy group had approximately eighteen patients with this type of fixation versus the approximate seven in the manipulation group. The interferential current therapy group had a greater incidence of this type and direction of fixation, therefore having a greater opportunity to have some effect on it.
Most of the other common types of fixations had a fairly even distribution between the two treatment groups (figure 4.5).

The sample group that received interferential current therapy showed improvements in right lateral flexion (figure 4.10) as well as left lateral flexion between the first and final visits (figure 4.11).
Right rotation improved between the second and final treatment (figure 4.13).

Both groups showed improvement in their lateral flexion and rotation motions.
In the manipulation and interferential group, right lateral flexion together with right rotation improved.
This could be due to the fact that rotation and lateral flexion are a coupled motion in the thoracic spine. Thus if a fixation was found and adjusted in the lateral flexion direction it will undoubtedly affect the rotation component and visa versa (White and Panjabi, 1990:103 and Willems et al. 1996:312). This coupled motion effect would make lateral flexion and rotation collectively, the most common fixation found and treated in the sixty member sample group.
The higher incidence of the two types of fixations could explain the common

trend of improvement seen in these two ranges of motion in both treatment groups.

It is evident though that when looking at the intra-group results, that manipulation increased the thoracic range of motion in more directions than interferential current therapy and that improvement was already taking place after the first treatment. The improvement continued in the second treatment but most ranges of motion improved by the final treatment. This could be due to manipulation resolving the fixation and joint dysfunction, increasing range of motion and subsequently reducing the thoracic pain. The results seem to indicate that restoring the mechanical play in a dysfunctional joint with manipulation brings about efficient motion, decreases the surrounding muscle spasm and thus decreases pain (Mennell, 1990:7).

Inferential current may not have affected as many ranges of motion as manipulative therapy did because it does not directly work at restoring the joints loss of motion.

Instead, as Hogenkamp et al. (1987:21) stated, "an interferential application positioned near or on the vertebral column effectively treats local pain, hypertonia of the erector trunci muscles and aids in restoring disturbances in the neurovegetative balance".

The analgesic effect of interferential therapy brought on by closing the pain gait as well as activating the descending pain suppression system and increasing the local circulation to help remove chemicals from the area that are stimulating nociceptors (Goats, 1990:89, De Domenico, 1982:16 and Forster and Palastanga, 1985:109) helped decrease the surrounding muscle spasm. By reducing the reflex muscle spasm, which aids in maintaining the joint dysfunction, interferential therapy did show improvement in some range of motions but not as many as spinal manipulative therapy seemed to do. Spinal manipulative therapy also proved to be a faster acting therapy in restoring joint movements as increases are evident after only the first treatment.

The algometer readings for both the spinal manipulative and interferential current therapy groups showed improvements between the first and final as well as the second and final treatments (figure 4.14).

These statistical changes indicated that both therapies were as affective in minimizing the local thoracic spinal pain as each other. Both therapies clinically and objectively reduced the overlying joint tenderness at the selected levels of treatment and it was achieved using different methods.

Spinal manipulation directly affected and restored the motion of the joint, which reduced local articular inflammation allowing the reflex muscle spasm to decrease and thus reduced local pain.

Interferential current therapy's analgesic affect was transmitted to the surrounding muscles of the dysfunctional joint, reducing the muscle spasm, inflammation and pain. Once the reflex muscle spasm was reduced, a few of the dysfunctional joints were able to return to normal motion, bringing about an increase in their range of motion.

Both methods proved to equally decrease local pain giving practitioners a choice of treatment modalities, especially if one is faced with contra-indications to one of the therapies. The modalities could even be used in conjunction with each other to enhance the therapeutic effect.

5.3.2 Subjective measurements

The subjective measurements for the spinal manipulative therapy all showed improvement. The NRS-101, McGill Pain Questionnaire and the Oswestry Disability Index showed improvement between all three visits (figures 4.15, 4.17, and 4.16).

All three questionnaires also showed statistical improvement within the interferential current therapy group (figures 4.15, 4.17, and 4.16).

In both groups the subjective measurements all showed improvement from the first and second, second and third and between the first and final treatments. The subjective results show a slightly greater improvement then the objective findings. This could be seen as both therapies clinically having a greater effect despite the lack of correlating objective findings.

One must also consider the lack of patient understanding in correctly completing the subjective questionnaires, thus bringing about error and inaccuracies in the subjective data.
Patients may also have answered their questionnaires to please the researcher thus recording greater improvements in their condition then there actually was.

5.4 STUDY LIMITATIONS

From the statistical analysis of this study there is no statistically significant differences between spinal manipulative therapy and interferential current therapy in the treatment of mechanical thoracic spine pain.
Clinical results though showed both therapies to be valuable in the treatment of mechanical thoracic back pain

Having stated the above, the following factors must be considered for future studies of this nature.

5.4.1 Cross-over study design

An enhancement of this study would be to introduce a cross-over aspect to the treatment protocol which would allow for a more effective analysis of the therapies.
As the statistical analysis of the study showed that both treatment protocols are as effective as one another in the treatment of mechanical thoracic back pain, a cross -over designed study would allow the patient and researcher an opportunity to more effectively compare the therapies and thus also provide more data. The added data would allow for a more in depth statistical analysis of the two therapies possibly making it easier to determine which is the most effective treatment.

5.4.2 Follow-up review

Although this study attempted to determine whether manipulation versus interferential current therapy was more effective in the treatments of mechanical thoracic back pain, it was a bit short sighted in not including a one month follow up review. This would have aided in determining the long-term effects of the two therapies. It would also have contributed more of an answer to the original question of which therapy ultimately was more superior in alleviating mechanical thoracic back pain, once more time had lapsed and the possible aggravation of the treatments themselves had settled down.

5.4.3 Study size and power

A weakness of this study is the sample size being small (30 per group), resulting in the sample group not being representative of the population (of people suffering from the effects of mechanical thoracic back pain).
Koes et al. (1995:230) listed criteria for the methodological assessment of a clinical trial for back and neck manipulations. Out of the four subsections on their list, the section addressing the study population counted for 30 out of the possible 100 points. The authors attached a value of 12 points to any clinical trial with a sample size of > 100 subjects. This indicates the strength that a larger study population lends to a study.

There is also a close connection between sample size and the power of statistical tests. A smaller sample size allows for the greater likelihood of a type II error occurring (i.e. accepting a false null hypothesis). This results from the low power of the study size to detect small but clinically relevant treatment differences (Koes et al. 1995:233).

5.4.4 Homogeneity

In a randomized clinical trial, the goal is that the study groups should be similar in patient characteristics. A higher degree of comparability between the groups allows for more valid trial conclusions (Haldeman, 1992:418).

As this study had a randomized allocation of subjects into the relevant groups, it makes it difficult to have sample groups with comparable baseline characteristics.
However the demographic studies do show a heavier distribution of chiropractic students compared to the rest of the sample group patient characteristics. Weather this fact added to the homogeneity of the study or to its detriment must be considered in future studies. Possibly in studies to follow the sample group should concentrate solely on chiropractic students and practitioners or limit the numbers to an equal proportion to the rest of the subject vocational characteristics.

In this study, both subacute and chronic mechanical thoracic pain syndromes were treated. In future studies one stage of the condition should be treated so as to uniform the sample group and the condition being treated.

The demographic studies showed that the two groups were similar in age distribution up to the age of 44 and then complete non-uniform distribution up to age 74. An age limitation needs to be placed in future studies.
Females made up slightly more then half the population as well as the Caucasians in the race distribution of the population.
The thoracic fixation level distribution and the type and direction of the fixations were equally distributed through out the sample groups.
A number of characteristics can be uniformed and improved on to limit the study to so many different influencing factors and thus enhance it's strength.

5.4.5 Blinding

In order to add to the strength of this study an element of blinding should be used to reduce the researcher's bias.
An effective and relatively easy blinding technique that could be added to the study is to allow one consistent neutral member to elicit the objective measurements from the patients. The neutral member is not to know which therapy the patient is administered in order to maintain an objective and unbiased data gathering procedure.

Another way to decrease researcher bias is again to utilize a neutral member to motion palpate for fixations in the patient's thoracic spine. He can be brought in from the very beginning of the study to obtain an even more objective baseline as far as which fixations the researcher will be treating and measuring. He can then re-motion the patients again without knowing which treatment regime the patient received, at each visit to standardize the researchers findings.
As mentioned earlier in the literature according to Haas et al. (1995:124), the research he conducted concluded that there is definite moderate responsiveness of thoracic – end play restriction to spinal manipulation and that end play and it's change by manipulation is definitely detectable by manual palpation by chiropractors.

These procedures were not included in this study due to time constraints placed on the study itself and the lack of the constant availability of one consistent neutral member at the clinic at all times.

5.4.6 Accuracy of measuring tools

The objective measurements obtained from the BROM goniometer could not have been accurate to the nearest degree as the instrument is marked in increments of two degrees and thus one had to rely on the judgment of the person recording the measurements. Subtle movements of the apparatus and the possibility of the error of parallax occurring may also have limited the accuracy of measurements taken from the goniometer although all precautions were taken to avoid such errors.

Despite the study indicating in chapter three that the objective and subjective measurement tools are valid methods of capturing changes within the test subjects true changes of dysfunctional joints undergoing manipulation could have been incompletely measured.
The BROM goniometer is designed to measure the range of motion of the lumbar spine and not the thoracic spine. The design of a thoracic spine goniometer would have to be more sensitive to pick up the smaller

movements of the thoracic spine versus the more mobile and larger lumbar spine movements.

Using the algometer also allows for the possibility of patients indicating a false higher level of pain threshold due to the patients delay in verbalizing whether tenderness was felt or not as well as having the need to try please the researcher.

Electronic measuring devises for both the algometer and goniometer would be more sensitive in picking up the smaller differences and changes then the human eye thus reducing observer bias.

A weakness in all studies utilizing questionnaires is the lack of patient understanding in correctly completing the subjective questionnaires, thus bringing about error and inaccuracies in the subjective data.
Patients may also have answered their questionnaires to please the researcher thus recording greater improvements in their condition then there actually was. This could explain the significant improvement in all the subjective forms of measurements within both treatment groups.

CHAPTER 6

6.0 RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

The findings of this study are not conclusive in determining the most efficient therapy for mechanical thoracic back pain, although it has proved that both manipulation and interferential current treatments are effective therapies in their own right.

Future studies must include a cross -over designed study allowing the patient and researcher to more effectively compare the two therapies making it easier to determine which is the most effective treatment.
A follow – up evaluation after a certain time must also be considered in order to evaluate the long term effects of these treatment protocols.

The sample group should be larger to allow the statistical tools to show their strength and ability in picking up trends in results and detecting subtle data changes thus making the results more valid and powerful.

Mechanical thoracic back pain has certainly been shown to play a part in contributing to the back pain statistics, presenting itself in varied groups of people in different professions, age groups and races.
This study included too many different types of variables and did not place enough limitations on certain characteristics, thus definitely making it a wide based building block for more uniformed and limited studies.
Future studies may possibly try concentrating on certain vocational characteristics such as the health providers, age groups between sixteen and forty four as well as the female gender.
Chronicity of the mechanical thoracic back pain must also be limited to acute, sub acute or chronic type cases.

As technology advances more sensitive instrumentation must be introduced in the measuring of thoracic spine movements as well as the effects of manipulation. Measuring devises with more accurate readings and greater detection of small but significant differences need to be investigated and utilized in order to determine the effects of different therapies.

Blinding techniques need to be utilized in order to reduce the researchers bias. A neutral member must be considered in the processes of motion palpation and fixation finding as well as the gathering of objective data from the patients.
A neutral member would also aid in the fact that successful and effective motion palpation and manipulation requires a level of skill and experience. For this reason it would be of benefit in future studies that the researcher or the neutral member possibly delivering the motion palpation and manipulation have at least five years experience.

6.2 CONCLUSIONS

This study consisted of 60 patients divided randomly and equally into two groups forming the manipulative and interferential current therapy groups.
All the patients underwent an extensive medical history, physical and orthopedic examination which allowed for the diagnosis of mechanical thoracic back pain.

Both group of patients came in for a minimum of three treatments and up to a maximum of six treatments. The treatments were given two to three times a week, varying the clinical trial time between two to three weeks depending on each patient's subjective and objective responses.
The first group of patients received spinal manipulative therapy to the thoracic spine and the second sample group received interferential current therapy.

Inter-group statistical analysis of the Oswestry Questionnaire indicated that the use of manipulation is more effective in improving the patient's function and disability then inferential current therapy.

Unfortunately the inter-group analysis of the other subjective and objective data did not show manipulation to be more effective in the other measuring criteria.

The intra-group analysis of each therapy though indicated that both manipulation and interferential current treatments are very effective in their own right.
Both therapies showed a marked improvement in the patient's perception of their intensity and quality of pain. The more objective clinical data indicated that manipulation definitely proved to have beneficial effects in the increase of most thoracic range of motions except for left lateral flexion and that could be due to the decreased incidence of that fixation in the manipulative group versus the interferential group.
The algometer readings were also significantly improved in both groups.

Despite the improvements noted within each treatment group, very little differences were seen between the therapies, which makes it difficult to distinguish the more superior therapy for mechanical thoracic back pain.
The long-term efficacy of manipulative therapy and inferential therapy was also not taken into account in this study. This may be achieved in future studies by including a follow-up consultation after a specific and pre-determined time period has elapsed.

Overall it appears that significant benefit can be derived from the use of manipulative and interferential current therapy in the treatment of mechanical thoracic back pain, however further studies are needed to determine the most efficient. This study can therefore be used in the future as a foundation to build and extend further research on.

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Addendum A

Short-form McGill Pain Questionnaire (SF-MPQ)

Ronald Melzack (1984)

Date:________ File no:________________________Visit no:_____

Patient name:____

	NONE 0	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 B

NUMERICAL RATING SCALE – 101 QUESTIONNAIRE

DATE:………………. FILE NO.:……………. VISIT NO.:…………………

PATIENT NAME:……………………………………………………………………………

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at it's worst**. 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.

……………………………………

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at it's 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.

……………………………………

Addendum C

OSWESTRY BACK DISABILITY INDEX

Patient Name:____________________ File No:________ Date:__________

This questionnaire has been designed to give the doctor information as to how your back pain has affected your ability to manage everyday life. Please answer every section and mark in each section only ONE box as it applies to you. We realize that you may consider that two of the statements in any one section could relate to you, but please just mark the box which most closely describes your problem.

Section 1 - Pain Intensity ☐ I have no pain at the moment. ☐ The pain is very mild at the moment. ☐ The pain is moderate at the moment. ☐ The pain is fairly severe at the moment. ☐ The pain is severe at the moment. ☐ The pain is the worst imaginable at the moment.	**Section 6 - Standing** ☐ I can stand as long as I want without extra pain. ☐ I can stand as long as I want, but it gives extra pain. ☐ Pain prevents me from standing for more than 1 hour. ☐ Pain prevents me from standing for more than ½ hour. ☐ Pain prevents me from standing for more than 10 minutes. ☐ Pain prevents me from standing at all.
Section 2 – Personal Care (Washing, Dressing ...) ☐ I can look after myself normally without causing extra pain. ☐ I can look after myself normally but it causes extra pain. ☐ It is painful to look alter myself and I am slow and careful. ☐ I need some help but manage most of my personal care. ☐ I do not get dressed, I wash with difficulty and stay in bed.	**Section 7 – Sex life** ☐ My sex life is normal and causes no extra pain. ☐ My sex life is normal but causes extra pain. ☐ My sex life is nearly normal but it is very painful. ☐ My sex life is severely restricted. ☐ My sex life is absent because of pain. ☐ Pain prevents any sex life at all.
Section 3 - Lifting ☐ I can lift heavy weights without extra pain. ☐ I can lift heavy weights but it gives extra pain. ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example on a table. ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned. ☐ I can lift only very light weights. ☐ I cannot lift or carry anything at all.	**Section 8 – Social life** ☐ My social life is normal and gives no extra pain. ☐ My social life is normal but increases the degree of pain. ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests, for example dancing. ☐ Pain has restricted my social life and I do not go out as often. ☐ Pain has restricted my social life to my home. ☐ I have no social life because of pain.
Section 4 – Walking ☐ Pain does not prevent me waking any distance. ☐ Pain prevents me walking more than 1 mile (2.2km). ☐ Pain prevents me walking more than ½ mile (1.1km). ☐ Pain prevents me walking more than 1/4 mile (0.5km). ☐ I can only walk using a stick or crutches. ☐ I am in bed most of the time and have to crawl to the toilet.	**Section 9 – Sleeping** ☐ I have no trouble sleeping. ☐ I can sleep well only by using pills. ☐ Even when I take pills I have less than 6 hours sleep. ☐ Even when I take pills I have less than 4 hours sleep. ☐ Even when I take pills I have less than 2 hours sleep. ☐ Pain prevents me from sleeping at all.
Section 5 – Sitting ☐ I can sit in any chair as long as I like. ☐ I can only sit in my favourite chair as long as I like. ☐ Pain prevents me sitting for more than 1 hour. ☐ Pain prevents me from sitting for more than ½ hour. ☐ Pain prevents me from sitting for more than 10 minutes. ☐ Pain prevents me from sitting at all.	**Section 10 – Travelling** ☐ I can travel anywhere without extra pain. ☐ I can travel anywhere but it gives extra pain. ☐ Pain is bad but I manage trips over 2 hours. ☐ Pain restricts me to trips less than 1 hour. ☐ Pain restricts me to trips under 30 minutes. ☐ Pain prevents me from travelling, except to the doctor and / or hospital.

Adapted from Fairbanks (1980)

Addendum D

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
- Accidents/Injuries
- Surgery
- Hospitalizations

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
- Tobacco
- Alcohol
- Social Drugs

7. Immediate Family Medical History

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

8. Psychosocial history:

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

9. Review of Systems

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

Addendum E

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: - Dorsalis pedis:

- Radio-femoral delay:
- Carotid:
- Radial:
- 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:
- 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 (51-52):
- 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:

Pupillary light reflexes = Direct:
= Consensual:

Fundoscopy findings:

IIII 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 - Comeal 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 & Gag reflex:

X 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:

- 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 F

REGIONAL EXAMINATION - THORACIC SPINE

Patient: File #: Date:

Intern: Signature:

Clinician: Signature

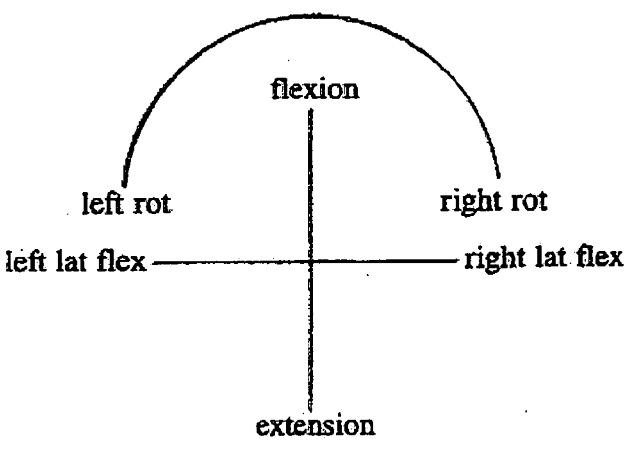
STANDING

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
Extension
L/R Rotation
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 EXAMINTION:

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

Basic LOWER LIMB neuro:

Myotomes:

Dermatomes:

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 G INFORMED CONSENT FORM

Please do not sign unless all your questions have been answered adequately by the researcher. Any queries to be addressed to Dr A Jones – (031) 903 4467.
(To be completed in duplicate by patient/subject*) *Delete whichever is not applicable.

TITLE OF RESEARCH PROJECT

____

____

NAME OF SUPERVISOR

____

NAME OF RESEARCH STUDENT

____

Date:__________

PLEASE CIRCLE THE APPROPRIATE ANSWER

1. Have you read the research information sheet? YES/NO
2. Have you had an opportunity to ask questions regarding this study? YES/NO
3. Have you received satisfactory answers to your questions? YES/NO
4. Have you had an opportunity to discuss this study? YES/NO
5. Have you received enough information about this study? YES/NO

6. Who have you spoken to? ______________________________

7. Do you understand the implications of your involvement in this study? YES/NO
8. Do you understand that you are free to withdraw from this study YES/NO
   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 NECESSARY INFORMATION BEFORE GIVING CONSENT.

PATIENT/SUBJECT*	Name______________ (in block letters)	Signature_____________
PARENT/GUARDIAN*	Name______________ (in block letters)	Signature_____________
WITNESS	Name______________ (in block letters)	Signature_____________
RESEARCH STUDENT	Name______________ (in block letters)	Signature_____________

Addendum H ***LETTER TO PATIENT***

Dear patient,

Thank you for participating in this research project, your contribution will provide clinical data for research and chiropractic practises.

This project is attempting to ascertain the effectiveness of manipulation in comparison to interferential current treatment in mechanical thoracic back pain. You will be randomly allocated into one of two treatment groups.

You have been selected, as you meet the specific criteria of the research and have shown no obvious contra-indications to the treatments. All treatments will be free of charge for the duration of the research.
You will be required to attend a minimum of three treatments and a maximum of six treatments over a two to three week period.
All treatments will take place at the Chiropractic Day Clinic, Technikon Natal and will be supervised by a qualified Chiropractic doctor.

While you are part of this research project you may not receive any other form of treatment including medication for your thoracic back pain, as this will exclude you from the research.

If you have any further questions please do not hesitate to ask me.
Your co-operation is greatly appreciated.

Yours sincerely

Natalie Tsolakis (sixth year intern)

Addendum I GONIOMETER READINGS FORM

PATIENT NAME: FILE #:

GONIOMETER READINGS

DATE OF FIRST VISIT: ....

FLEXION .... degrees

EXTENSION .... degrees

LEFT LATERAL FLEXION .... degrees

RIGHT LATERAL FLEXION .... degrees

LEFT ROTATION .... degrees

RIGHT ROTATION: .... degrees

DATE OF SECOND VISIT: ....

FLEXION .... degrees

EXTENSION .... degrees

LEFT LATERAL FLEXION .... degrees

RIGHT LATERAL FLEXION .... degrees

LEFT ROTATION .... degrees

RIGHT ROTATION: .... degrees

DATE OF LAST VISIT: ....

FLEXION .... degrees

EXTENSION .... degrees

LEFT LATERAL FLEXION .... degrees

RIGHT LATERAL FLEXION .... degrees

LEFT ROTATION .... degrees

RIGHT ROTATION: .... degrees

Addendum J **ALGOMETER READINGS FORM**

PATIENT NAME: **FILE #:**

ALGOMETER READINGS:

DATE OF FIRST VISIT: **.......................................**

LOCATION: ....

READING: kg/cm2

DATE OF SECOND VISIT: **.......................................**

LOCATION: ....

READING: kg/cm2

DATE OF LAST VISIT: **.......................................**

LOCATION: ....

READING: kg/cm2