THE EFFECTIVENESS OF SPINAL MANIPULATION VERSUS SPINAL MANIPULATION IN CONJUNCTION WITH CORE STABILISATION EXERCISES IN THE TREATMENT OF MECHANICAL LOW BACK PAIN.

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I *Nicholas Langley Boden* do declare that this dissertation is representative of my own work.

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DEDICATION

I dedicate this to my family for their undying support for me during my studies.
This is the fruit of their hard work

In loving memory of
'Joycie' and 'Jeanie'

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ABSTRACT

Low back pain is estimated to effect 60-90% of the world's population sometime during their lives while 20-30% of people suffer from low back pain at any given time (Cassidy and Burton, 1992:3). Locally, epidemiological studies into low back pain have revealed incidence rates of 57.6% amongst black South Africans (Van der Meulen, 1997) and between 70 and 80% amongst Indians and Coloureds (Docrat, 1999).

The use of spinal manipulation with the emphasis on restoring joint mobility, has been proven to be one of the most effective and cost effective approaches in the management low back pain of a mechanical origin (Di Fabio, 1992). McMorland (2000), showed in a study of 199 patients, that spinal manipulation resulted in an average of 52.5% and 52.9% reduction in low back pain and disability respectively.

Panjabi (1992:I) has postulated a theory of a 'neutral zone' around which the passive lumbar spine operates. He describes the neutral zone as a region of intervertebral motion around the neutral posture where little resistance is offered by the passive spinal column. It is, according to Panjabi (1992:I), possible for this neutral zone to increase with injury to the spinal column or with weakness of stabilising muscles, which could result in low back pain. The trunk muscles therefore have to be able to co-contract isometrically to control the neutral zone and protect the spinal tissue from excessive motion (Richardson et al.1990). The transversus abdominis muscle and multifidus muscle have been identified as playing an important role in the complex synergistic interaction of the trunk (Norris, 1995). The above concept involving muscles attempting to maintain a neutral zone is commonly referred to as 'core stabilisation' (Norris, 1995).

Research into the role of core stabilisation of the lumbar spine involving patients with lower back pain has confirmed the insufficient muscular stabilisation of the lumbar spine by the Transversus abdominis muscle (Hodges and Richardson 1996).

Current approaches to low back pain are largely passive in nature, involving mobilisation, traction, manipulation, heat and electrotherapy (Evans and Oldreive, 2000). This passive approach to low back pain has been criticised (Wadell, 1987).

This study therefore investigated the effectiveness of spinal manipulation versus spinal manipulation in conjunction with core stabilisation exercises in the treatment of mechanical low back pain.

This randomised, comparative clinical trial consisted of sixty voluntary subjects each suffering from mechanical low back pain. There were two groups of thirty, who were treated five times, over a three-week period. Group A received manipulation and core stabilisation exercises, while Group B received manipulation alone.

Outcome measures included subjective responses via the Revised Oswestry Low Back Disability Questionnaire and the Pain Sensitivity Scale. Objective Data was gained from the Orthopedic Rating Scale, Algometer and prone endurance measurements of the transversus abdominis muscle. Data was collected prior to the initial treatment, before the third and after the fifth.

Statistically, both groups showed improvements both objectively and subjectively with regards their low back pain. Intra-Group analysis revealed a statistically significant increase in transversus abdominis endurance in Group A. Inter-group analysis however showed a slight difference in favour of the manipulation group

in terms of subjective findings, but no significant difference was found between the treatment protocols in terms of the objective findings.

This study found that retraining core stability did have an effect on the endurance of the Transversus abdominis muscle. It was however not sufficient to conclude that a combined core stabilisation and manipulation program was more effective than manipulation alone.

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Definition of terms

Adjustment

A manual maneuver specific in direction, point of contact, amplitude and velocity to partly or wholly correct a subluxation (fixation) (Redwood, 1997:333).

Biomechanics

The application of mechanical principles to living structures. (Redwood, 1997:334).

Chiropractic

Chiropractic is that discipline within the healing arts especially concerned with the etiology, pathogenesis, diagnostics, therapeutics and prophylaxis of functional disturbances, pathomechanical states, pain syndromes and other neurophysiologic effects related to the statics and dynamics of the neuromusculoskeletal system, particularly those related to the spine and the pelvis (Schaefer and Faye, 1990).

Clinical Instability

A significant decrease in the capacity of the stabilising system of the spine to maintain the intervertebral neutral zones within the physiological limits so that there is no neurological dysfunction, no major deformity and no incapacitating pain (Panjabi:II, 1992:394).

Core stabilisation

The rehabilitation and retraining of the so-called core stabilisers of the lumbar spine (transversus abdominis and multifidus), to provide increased stability around the neutral zone.

Contra-indication

The counterbalancing of a defect in structure or function (Redwood, 1997:335).

Durban Institute of Technology

The tertiary institute formed on the 1 April 2002 by the merging of Natal Technikon and M.L Sultan technikons (own).

Incidence

A rate which refers to the number of persons with new back pain occurring over a given period among a known number of persons who were previously without back pain (Giles and Singer, 1997:18).

Joint fixation (restriction)

The temporary immobilisation of a joint in a position that it may normally occupy during any phase of movement (Redwood, 1997:338).

Manipulation

A passive manual maneuver during which a joint is quickly brought beyond its restricted physiologic range of movement and beyond its elastic barrier, without exceeding the boundaries of anatomic integrity (Redwood, 1997:339).

Mechanoreceptor

A receptor that is excited by mechanical pressures or distortions, as those responding to sound, touch and muscular contractions (Redwood, 1997:341.)

Nociceptor

A receptor preferentially sensitive to a noxious stimulus or to a stimulus that would become noxious if prolonged (Redwood, 1997:341).

Neutral zone

That part of physiological intervertebral motion, measured from the neutral position, within which the spinal motion is produced with a minimum of internal resistance (Panjabi II, 1992:391)

Palpation

Manual examination of a body part (Redwood, 1997:342).

Prevalence

The number of persons who have experienced back pain ever, even if they are not affected at present (Giles and Singer, 1997:18).

Subluxation

An alteration of alignment, movement, integrity and or physiologic function of a motion segment, while the joint surfaces remain in contact; the resulting neurophysiological disturbance may be local or widespread (Redwood, 1997:343).

ABBREVIATIONS

RODQ- Revised Oswestry low back Disability Questionnaire

ORS-Orthopedic Rating Scale

PSS- Pain Sensitivity Scale

Alg.- Algometer

SIS- Sacroiliac syndrome

LFS- Lumbar facet syndrome

Sd.- Standard deviation

Se. -Standard error

SMT- Spinal manipulative therapy

P-value-level of significance

TLF- Thoracolumbar fascia

IAP- Intra-abdominal pressure

CHAPTER ONE

1.1 Introduction

Low back pain is estimated to effect 60-90% of the world's population sometime during their lives, while 20-30% of people suffer from low back pain at any given time (Cassidy and Burton, 1992:3). In South Africa, epidemiological studies into low back pain have revealed incidence rates of 57.6% amongst black South Africans (Van der Meulen, 1997) and between 70and 80% amongst Indians and Coloureds (Docrat, 1999).

Kirkaldy-Willis (1992:129), discovered that along with Myofascial Pain Syndrome, Posterior Facet syndrome and Sacroiliac Joint syndrome accounted for 50% of cases of low back pain seen at the Royal University Hospital in Saskatoon over a 10 year period.

Panjabi (1992:1) outlined the role of dysfunction of the active subsystem of the spine (muscles and tendons) in the control of the Neutral zone of the spine. Further research into this active subsystem implicated dysfunction of two deep local muscles known as Core Stabilisers in the incidence of low back pain. Transversus abdominis was found to have reduced endurance in low back pain patients (Evans and Oldreive, 2000), while wasting and inhibition of the other core stabiliser and co-contractor, Multfidus has also been found (Hides et al. 1994).

Manipulation is a common form of treatment for mechanical Low Back Pain, while Chiropractic has been shown to be a successful form of treatment of recurrent or long lasting mechanical low back pain (Lars-Christian et al. 2001). Patients receiving Chiropractic care (manipulation) for such pain have been shown to show "improvement" early in the course of treatment (Lars-Christian et al. 2001). In another study, McMorland (2000), showed that spinal manipulation resulted in an average of 52.5% and 52.9% reduction in low back pain and disability respectively (n=199).

The Primary approach to the treatment of low back pain is that of pain relief (Frost and Klaber-Moffat, 1992). This may involve the use of modalities in addition to spinal manipulative therapy. These forms of treatment, although beneficial to the patient's pain and disability, have recently been criticised because of their largely passive nature (Evans and Oldrieve, 2000).

An active modality for the retraining and development of the Core Stabilisers has been developed in Australia. The Stabilizer is a pressure biofeedback device developed by the Chatanooga Company in association with a group of Physiotherapists who helped develop the Core Stability theories (Chatanooga, 2002).

This randomised clinical trial was therefore designed to determine the benefits of combining spinal manipulation with retraining of the core stabilisers in the short-term treatment of acute on chronic mechanical low back pain.

1.2 THE PROBLEM AND IT'S SETTING

1.2.1 THE PROBLEM STATEMENT

The purpose of this investigation was to evaluate the relative effectiveness of spinal manipulation versus spinal manipulation in conjunction with core stabilisation exercises in the treatment of mechanical low back pain.

1.2.2 THE OBJECTIVES:

1.2.2.1 Objective One

The first objective was to evaluate the relative effectiveness of spinal manipulation versus spinal manipulation in conjunction with core stabilisation exercises, in terms of subjective clinical findings, in the treatment of mechanical low back pain.

1.2.2.2 Objective Two

The second objective was to evaluate the relative effectiveness of spinal manipulation versus spinal manipulation in conjunction with core stabilisation exercises, in terms of objective clinical findings, in the treatment of mechanical low back pain.

1.2.2.3 Objective Three

The third objective was to integrate the results of objective one and two in order to determine whether either of the two treatments was more effective in terms of subjective and objective clinical findings.

Chapter Two

2. REVIEW OF THE RELATED LITERATURE

2.1 Introduction

In order to establish a greater understanding of low back pain, it is important to outline the relevant anatomy, biomechanics and pathogenesis of the structures related to this condition and the treatment approaches involved. It is also vital to outline the basic concepts, theories and principles surrounding core stabilisation.

2.2 Incidence and prevalence of low back pain

Low back pain is estimated to effect 60-90% of the world's population sometime during their lives while 20-30% of people suffer from low back pain at any given time (Cassidy and Burton 1992:3). Locally, epidemiological studies into low back pain have revealed incidence rates of 57.6% amongst black South Africans (Van der Meulen 1997) and between 70 and 80% amongst Indians and Coloureds (Docrat 1999).

Reviews of clinical management and health care shows that approximately 60% of the population will report LBP some time during their lives. 70% of these sufferers will experience these episodes at least three or more times in their lives and 20% will continue experiencing some degree of pain throughout their lives (Waddel, 1995).

Schaefer and Faye (1990:195) suggest that the three most common diagnoses associated with low back pain are lumbar facet syndrome, sacroiliac joint syndrome and lumbar radicular syndrome, which may be discogenic or biomechanical in origin. Urli and Till (1995) found in a sample of a nursing population (n=30) in South Africa that 33.3% of the sample population were diagnosed with Sacroiliac syndrome.

Research into the role of core stabilisation of the lumbar spine and pelvis, involving patients with lower back pain has revealed insufficient muscular stabilisation of the lumbar spine by the transversus abdominis muscle (Hodges and Richardson, 1996).

Further research has also revealed wasting of the lumbar multifidus (co-contractor of transversus abdominis) in patients with low back pain (Hides et al. 1994). Related research revealed that the recovery of multifidus in low back pain patients is not automatic after resolution of the first episode of low back pain (Hides et al. 1996).

The importance of core stability in mechanical low back pain has been illustrated in a study into the endurance of the core stabilisers in a golfing population (n=20). This study showed a reduced endurance, specifically of transversus abdominis, in golfers with a history of low back pain (Evans and Oldreive, 2000).

2.3 RELEVANT BIOMECHANICS AND ANATOMY

2.3.1 Biomechanics of the Lumbar Spine and Pelvis

2.3.1.1 Introduction:

Panjabi's 1992 papers on the stabilising system of the spine puts forward a theory of three separate but intimately linked systems that are part of and play major role's in the providing of stability in the low back.

2.3.1.2 Spinal Stability

Before establishing an understanding of spinal *stability*, it is important to understand what spinal *instability* is. The basic concept of spinal instability is that abnormally large intervertebral motions cause either compression and/or stretching of the inflamed neural elements or abnormal deformations of ligaments, joint capsules, annular fibres and end plates which are known to have a significant density of nociceptors (Panjabi, 1992:II). In both above situations, these large movements are likely to cause pain.

2.3.1.3 Functions of the spinal system

The basic functions of the spinal system are threefold:

a. To allow movements between body parts

b. To carry loads

c. To protect the spinal cord and nerve roots (White and Panjabi, 1990).

2.3.1.4 Components of the spinal stabilising system

Panjabi (1992: I) outlines the three subsystems that play a role directly and/or indirectly in the stability of the spinal system:

a. The passive musculoskeletal subsystem:

   This includes vertebrae, facet joints, intervertebral discs, spinal ligaments and joint capsules, as well as the passive properties of the muscles.

b. The active musculoskeletal subsystem

   This system includes the muscles and tendons surrounding the spinal column.

c. The neural and feedback subsystem

   This includes the various force and motion transducers, located in ligaments, tendons and muscles and the neural control centre (brain).

2.3.1.5 Normal functioning of the spinal stabilising system

The Neutral Zone

The neutral zone is described as "that part of the range of physiological intervertebral motion, measured from the neutral position, within which the spinal motion is produced with a minimal internal resistance" (Panjabi, 1992:II). Clinical stability concentrates on reducing the size of the neutral zone by ensuring proper functioning of the components of

spinal stability. This is important as an increase in the neutral zone size indicates clinical instability.

This function is a highly complex one, and involves a constant monitoring and interaction of these subsystems to provide spinal stability in response to constantly changing stability demands, including the effect of changes in posture and dynamic and static loading of the spine.

Studies indicate that without a stabilising system, the spinal cord buckles under relatively small loads. *In vitro* spinal studies indicate that spinal columns become biomechanically unstable at of loads of 90N or 9kg at the L5-sacrum junction (Crisco out of Panjabi, 1992: I). Normal loads provided by body mass of the in vivo spine range from 140-210kg in the standing position, hence the importance of a normally functioning spinal stabilizing system.

The Passive (ligamentous subsystem).

The components of this system do not provide significant stability to the spine in the vicinity of the neutral position. It is towards the end of the ranges of motion that the ligaments develop reactive forces that resist spinal motion. The passive components probably function as transducers for measuring vertebral positions and motions (Panjabi, 1992:I).

The Active (musculo-tendonus) subsystem.

The muscles and tendons of the active subsystem are the means through which the spinal system generates forces and provides the required stability to the spine. The force transducers built into the tendons of the muscles measure the magnitude of force generated in each muscle. Therefore this aspect of the tendons is part of the neural control subsystem (Panjabi, 1992:I).

The Neural Control subsystem.

The neural subsystem receives information form the various transducers, determines specific requirements for spinal stability and causes the active subsystem to achieve the stability goal. Individual muscle tension is measured and adjusted until the required stability is achieved. The requirements for the spinal stability and therefore the individual muscle tensions, are dependent on dynamic posture, that is, variation of lever arms and inertial loads of different masses and external loads (Panjabi, 1992: I).

2.3.1.6 Clinical Instability

Clinical Instability is defined as a significant decrease in capacity of the stabilising system of the spine to maintain the intervertebral neutral zones within the physiological limits so that there is no neurological dysfunction, no major deformity and no incapacitating pain (Panjabi, 1992:II).

Neutral zone size

An increase in the neutral zone size is an indicator of clinical instability. Neutral zone size is a function of passive (spinal column) and active (spinal muscle) components of the spinal stabilising system. Dysfunction within any of the three subsystems discussed above can lead to an increase in size of the neutral zone (Panjabi, 1992: 2).

Dysfunction in the three subsystems

1. Passive subsystem dysfunction

   The dysfunction of the passive subsystem may be caused by mechanical injury, such as over-stretching of ligaments, development of tears and fissures in the annulus, development of micro-fractures in the end-plates and extrusion of the disc material into the vertebral bodies (Panjabi, 1992: I).

2. Active subsystem dysfunction

   The active musculoskeletal subsystem may develop deterioration of its ability to receive and/or carry out the neural commands, to provide accurate feedback of muscle tension information to the neural control unit or to produce co-ordinated and adequate muscle

tensions; such deformation may result from disuse, degeneration, disease or injury (Panjabi, 1992: I).

3. Neural subsystem dysfunction

   To achieve the required stability at every instance of time, the neural subsystem has the enormously complex task of continuously and simultaneously monitoring and adjusting the forces in each of the muscles surrounding the spinal column. Errors in the firing of muscles may cause dysfunction in this subsystem. Too small or too large muscle forces and/or too early or too late firing of muscles can effect this subsystem. In addition to damaging the active subsystem, muscle force errors might lead to overload of a passive structure (eg. Disc) (Panjabi, 1992: I). Figure 1 below, explains the concept of Spinal stability and the forces involved.

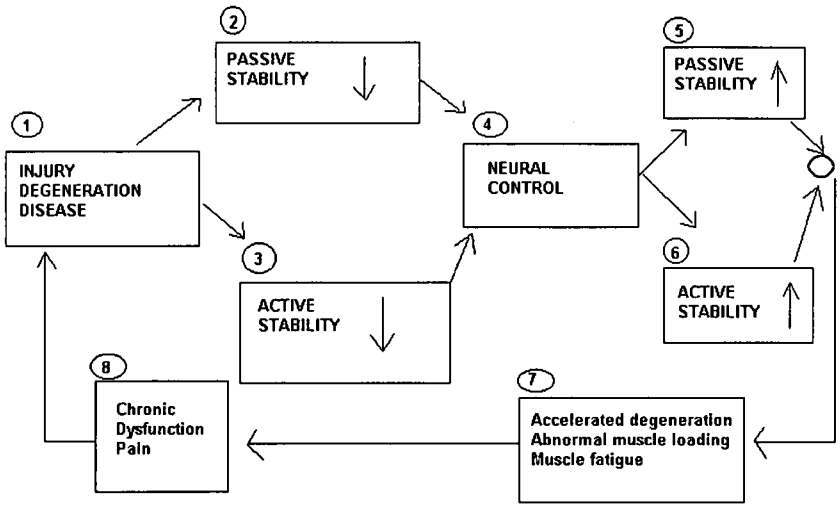

Figure 1: Functioning of the Spinal Stability system (Panjabi 1992: I)

2.3.2 Anatomy of the major components of the Stabilising system

2.3.2.1. Lumbar zygapophysal joints (lumbar facet joints)

Anatomy

The lumbar zygapophyseal joint is a typical synovial joint and is formed by the articulation between the inferior articular process of the superior vertebral body, and the superior articular process of the vertebral body below (Kirkaldy-Willis, 1992:7). The lumbar zygapophyseal joints are biplanar, with the major posterior parts approximated to the sagittal plane (Giles, 1997). These diarthrodial joints are surrounded by a capsule posterolaterally and the ligamentum flavum anteromedially. The articular capsule, ligamentum flavum and synovial joint folds are lined by a synovial membrane.

Function

The function of the zygapophysial joints is to guide and restrain movement between vertebrae and to protect the discs from shear forces, excessive flexion and axial rotation. Giles (1997).

Innervation

Innervation of the lumbar facet joints comes from the medial branches of the dorsal rami of the spinal nerves. Each articular branch supplies the nearby joint and it may send branches to the sub-adjacent joint as well (Moore: 1992).

Gattermann (1995:21) describes three types of sensory receptors within the facet joints:

1. Type I: Sensitive static and dynamic mechanoreceptors which are continuously firing due to continual joint motion.
2. Type II: less sensitive mechanoreceptors which fire only on joint motion
3. Type III: slow-conducting mechanoreceptors.

2.3.1.3 The Sacroiliac joints.

Introduction

Recent research has implicated the Sacroiliac joint in the Stabilisation theory (Richardson et.al 2002). In addition the Sacroiliac joint forms an integral part of the bony support offered by the vertebral column. Bernard and Kirkaldy-Willis (1987) performed a study in which it was reported that the sacroiliac joint was the primary source of back pain in 22,5 % of 1293 patients presenting with back pain. In a small sample (N=30) of the nursing population in South Africa, 33.3% of nurses with low back pain were diagnosed with sacroiliac syndrome (using the Kirkaldy-Willis model of classification), 6.6% with myofascial syndrome and 60% with a combination of both syndromes (Urli and Till, 1995).

Anatomy

The sacroiliac joint is formed by the articulation between the sacrum and the ilium. The joint is a synovial joint within which the iliac surface is composed of thin fibro-cartilage and the articular surface of the sacrum is composed of hyaline cartilage (Kirkaldy-Willis 1992:71).

This atypical synovial joint is stabilised by various structures

1. Powerful interosseus ligaments.
2. A strong articular capsule.
3. Posterior sacroiliac ligaments.
4. The iliolumbar ligament- attached to the fifth lumbar vertebra.
5. The sacrotuberous ligament-attached to the ischial tuberosity.
6. The sacrospinous ligament (Giles, 1997).

Functions

The strong weight bearing synovial joints differ from other synovial joints in that they possess very little mobility. This provides stability and is related to their responsibility for transmitting most of the weight of the body to the hip bones. The irregular articular

surfaces of the ilium and sacrum means that the joint surfaces fit securely together and are not easily dislocated. The movement of the sacroiliac joints is limited to a slight gliding and rotatory movement. When a considerable force is applied (eg. jumping), the force is transmitted via the vertebral column to the sacral base, which rotates anteriorly. The force is then transmitted to each ilium and lower limb (Moore, 1992: 251).

Innervation of the Sacroiliac joint.

The articular branches of these joints are dervied form the superior gluteal nerves, the sacral plexus, and the dorsal rami of the S1 and S2 nerves (Moore,1992: 251).

The posterior aspect of the sacroiliac joint is innervated by both posterior rami of L5-S2 spinal nerves and the anterior aspect is innervated by both posterior branches from the L3-S2 nerve roots and the superior gluteal nerve L5-S2.

2.3.1.3 Anatomy of Core Stabilisation

Introduction

Bergmark (1989) categorised the trunk muscles into local and global muscle systems based on their biomechanical roles. These two subsystems have been termed Global and Local muscles.

Global Muscles

Global muscles are the larger, torque producing muscles. In terms of the abdominal synergy, the global muscles have been described as the muscles linking the thoracic cage to the pelvis (Bergmark, 1989). Their role is to provide general trunk stabilisation and to balance external loads, thereby minimising the resulting forces on the spine (Richardson, 1995). Examples of these muscle are the erector spinae and quadratus lumborum muscles (Stanford, 2002).

Physiology of global muscles

Global muscles or 'movement synergists' like rectus abdominis have predominantly type II fibres. Type II fibres are suited for rapid powerful contractions (Norris, 1995).

Local Muscles

Local muscles have their origin and insertion on the lumbar vertebrae and control the lateral stiffness and intervertebral relationship of the spinal segments and the posture of the lumbar spine (Bergmark ,1989). The multifidus and transversus abdominis are considered to be local muscles of the lumbar spine (Evans and Oldreive, 2000).

Physiology of Local muscles

Local muscles or 'stability synergists' like transversus abdominis have been shown to demonstrate the properties of Type I fibres (Norris, 1995). Type I fibres are considered to be slow, fatigue resistant fibres that can contract for prolonged periods at a low force level (Evans and Oldreive, 2000).

Anatomy of the Transversus abdominis

The transversus abdominis muscle, the deepest abdominal muscle, arises from the lateral third of the inguinal ligament, the inner lip of the iliac crest inferiorly, the thoracolumbar fascia posteriorly and the inner surfaces of the costal cartilages of the lower six ribs superiorly. Its fibres run transversely around the abdominal wall to end in an aponuerotic sheath that attaches to the same muscle of the opposite side via the linea alba (Palastanga et al. 1994).

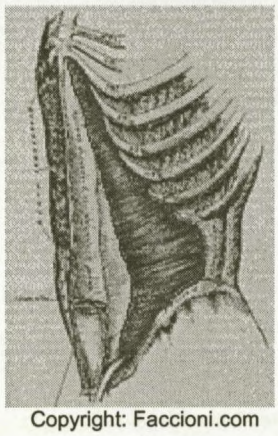

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Figure 2: Transversus Abdominus

Physiology of Transversus Abdominis muscle

Due to its anatomical attachment, the TrA is classed as a postural type muscle as well as a stability synergist (Norris, 1995). TrA's richness in slow twitch type I fibres means that it is a tonically contracted muscle that has a certain level of muscle tone, continuously present and active to help stabilise joints and maintain posture (Evans and Oldreive, 2000.)

Transversus abdominis recruits its type I slow-twitch fibres at a low level of voluntary contraction (VC) which ensures that the muscle fibres are efficient and meet virtually all their needs via aerobic pathways (Evans and Oldreive, 2000). It has been argued that a relatively low level of muscle force, approximately 25% maximum voluntary contraction (MVC), are needed to develop the increased muscle stiffness required for spinal stability (Richardson and Jull, 1995).

The Function of Transversus abdominis

Various studies involving techniques such as fine wire electromyography of the transversus abdominis muscle in response to various limb movements and perturbations of the trunk have revealed evidence of the core stabilising role of transversus abdominis.

These roles include:

1. Transversus Abdominis is controlled independently of the other trunk muscles, therefore allowing it to be isolated functionally from other abdominal muscles (Richardson, 1995).

2. The TrA is involved in the preparation of the body for the disturbance produced by the movement of lower the limbs. Patients suffering from chronic low back pain, show a delayed contraction of TrA, which may indicate dysfunction in the neuromuscular control of the local stabilising system, resulting in poor lumbar stabilisation (Richardson 1995).
3. Transversus abdominis is the only abdominal muscle active during various phasic movements, highlighting its role as an active stabiliser of the spine (Richardson, 1995).
4. TrA is active prior to both upper and lower limb movements in subjects with no history of LBP (Hodges and Richardson, 1999).
5. TrA is the only abdominal muscle that has an aponeurotic attachment to the middle layer of the thoracolumbar fascia (TLF) (Bogduk, 1997). TrA helps control intersegmental motion via production of lateral tension in the TLF (Evans and Oldrieve, 2000). This effect seems to have a more localised effect on the lower lumbar levels (Tesh, 1997).
6. TrA is involved in increasing stiffness of the spine in a general manner by increasing the IAP and/or by increasing tension in the TLF (Evans and Oldreive, 2000). In low back pain sufferers, a decrease in endurance of TrA has been shown (Evans and Oldreive, 2000), which may result in a decrease in lumbar stability.
7. The transversely orientated muscle fibres of transversus abdominis significantly decrease the laxity of the sacroiliac joints (Richardson et al. 2002). A stronger, more controlled pattern of TrA contraction may limit excessive movement of the SIJ and therefore decrease the incident of painful joint syndromes.
8. The contraction of transversus abdominis, independently of the other abdominal muscles, affects the laxity of the sacroiliac joints to a larger extent than a bracing action using all of the lateral abdominal muscles (Richardson et al. 2002).

Anatomy of the lumbar multifidus muscle

The multifidus muscle covers the laminae of S4 to C2 vertebrae. Its fibres pass superomedially form the vertebral arches to the spinous processes, spanning one to three vertebrae. Acting unilaterally, the multifidus extends the trunk and stabilise the vertebral column (Moore, 1992: 355).

Physiology of the Multifidus muscle

Multifidus, like the TrA muscle is also considered to be a local rather than a global muscle in the lumbar spine. The multifidus muscle is also made up of slow twitch tonic-type I muscle fibres, which suits its role as a stabiliser (Hides et al. 1996).

Functions of the Multifidus Muscle

Recent *in vitro* biomechanical studies have shown that the lumbar multifidus muscle is an important component of lumbar segmental stability (Hides et al.1996).

1. It is able to provide segmental stiffness and control motion in the neutral zone (Wilke et al. 1995).
2. Multifidus, when compared to other muscles in close proximity to L4-L5, contributed two thirds of the increased stiffness imparted by the contraction of the muscles (Wilke et al. 1995).
3. Acting unilaterally, the multifidus extends the trunk and stabilises the vertebral column (Moor,e 1992: 355).

Dysfunction of Multifidus

Various studies have revealed a correlation between low back pain and dysfunction of the multifidus muscle:

1. Hides et al. (1994) used real-time ultrasound imaging to illustrate evidence of lumbar multifidus muscle wasting ipsilateral to symptoms in patients with acute/subacute low back pain. The wasting was not generalised, and it has been suggested that it is as a result of painful inhibition.
2. Multifidus muscle recovery was found not to be automatic after resolution of acute, first-episode low back pain. In addition it was suggested that a resultant lack of localised muscle support may be one reason for the high recurrence rate of low back pain following the initial episode (Hides et al. 1996).

2.4 Core stabilisation

2.4.1 Co-contraction between Transversus Abdominis and Multifidus

These two core stabilisers have been found to be related through a co-contraction pattern (Richardson and Jull, 1995). Recruiting muscles in co-contraction is considered to provide support and joint stabilisation even when contractions occur at low levels of MVC (Richardson and Jull, 1995).

2.4.2 Specific core stabilisation exercises

Exercise involving co-contraction of the deep abdominal and back muscles is in line with stabilisation. Furthermore a simultaneous isometric co-contraction of transversus abdominis and multifidus, while maintaining the spine in a static neutral position, should help re-educate the stabilising role of these muscles (Richardson and Jull, 1995).

The exercise program should therefore include activating an isometric co-contraction of these muscles and training the patient to hold a low-level tonic contraction. In addition isolating the local muscles from the larger global muscles is vital to ensure that the correct muscles are being reactivated (Richardson and Jull, 1995).

2.4.3 Body position and level of resistance

The local muscles function to control segmental stiffness independent of the global muscle system, which is responsible for balancing the external loads. There is no need for high loaded exercise and it is logical to reduce external loading during rehabilitation of the local system. This is achieved by using exercise positions such as four point kneeling or prone lying where body weight is supported and no additional external resistance is applied. The advantage of these positions is that they also reduce the chance of pain and reflex inhibition which could be increased if high load exercises were given early in rehabilitation (Richardson and Jull, 1995).

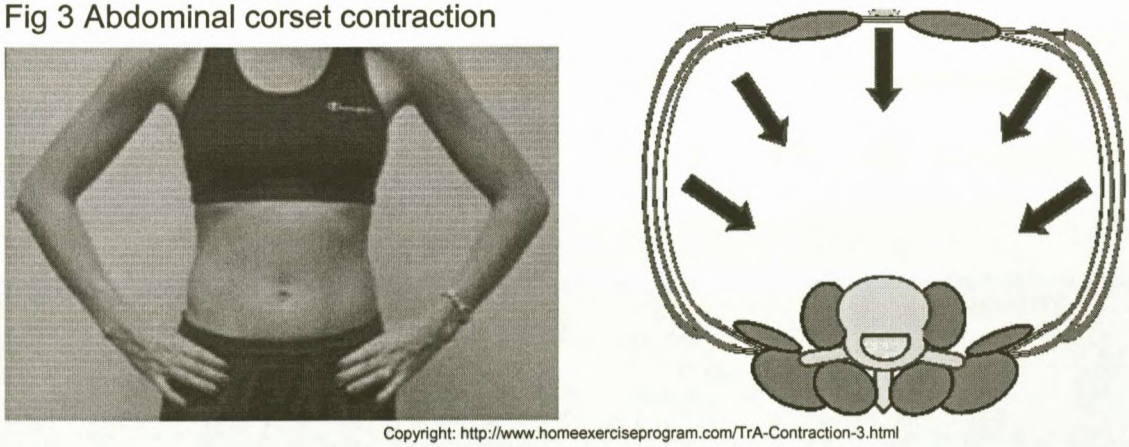
2.4.4 Number of repetitions and holding ability

A localised and specific isometric setting exercise was developed to improve the stability role of the local muscles. This isometric co-contraction of the TrA and Multifidus involves retraining a specific motor skill. In order to gain maximum benefit, the exercise needs to be repeated as many times as possible throughout the day (Richardson and Jull, 1995).

2.4.5 Methods of progression

Progression of this new type of exercise can be taken through several stages. At first, it involves increasing the holding time of the isometric co-contraction as well as the number of repetitions. This setting exercise can be progressed from low loads with minimal body weight to more functional body positions with gradually increasing external loads. In addition, advances need to be made from performing the exercise with a static neutral position to other static positions at more extremes of range. Finally, patients should be able to hold a co-contraction of the deep muscles during dynamic functional movements of the trunk (Richardson and Jull, 1995).

Fig 3 Abdominal corset contraction



Copyright: http://www.homeexerciseprogram.com/TrA-Contraction-3.html

2.4.6 Effects of the core stabilisation exercises

The purpose of the exercise is to isolate the correct muscle action in all exercise positions and develop holding ability. The working hypothesis for the importance of isolating the muscle action relates to motor control issues (Richardson and Jull,1995).

2.4.7 Efficacy of the core stabilisation program

Evidence between core stabilisation and the increase in segmental stability and pain relief has been shown in various studies.

1. A investigation into the effect of this type of exercise in patients suffering from chronic low back pain with radiological diagnosis of spondylolysis and spondololysthesis (n=42), showed that this type of exercise resulted in a significant reduction in pain intensity and an increase in functional mobility when compared to the control group.
2. A single case study by Stanford (2002) into the effectiveness of specific lumbar stabilisation exercises showed a marked relief in all impairments including range of motion and report of pain following five treatments.
3. A randomised clinical trial into the effectiveness of core stabilising exercises involving the transversus abdominis and multifidus muscles showed that after 1 year, recurrence in the treatment group was 30% compared to 85% in the non-treatment group ($p<0.001$) and 35% in the treatment group compared to 75% in the non-treatment group after a 3-year follow up (Hides et al. 2001).

2.5 Lumbar facet (posterior) syndrome

Symptom presentation:

Pain is often localised and unilateral. Pain may be referred to the groin, greater trochanter and to the posterior thigh as far as the knee (Kirkaldy-willis, 1992: 106).

Associated clinical signs:

Tenderness to pressure on one side and at one level, and hypertonic muscles at the site of the lesion (Kirkaldy-willis, 1992: 106).

Hyperextension movements of the back increase the pain, whereas flexion reduces it. Activities that may increase the pain include sleeping on the abdomen, sitting in an upright position, and lifting a load in front of the body at or above the waistline. When symptoms are acute, sneezing and coughing may accentuate the pain (Gatterman, 1995: 162).

According to Giles et al. (1997: 89), the effect of joint dysfunction on associated soft tissue structures, with possible venous stasis, nerve ischaemia, and soft tissue entrapment has been postulated as a potential mechanism for causing back pain of a mechanical nature.

Giles further explains that various soft tissue structures could theoretically be involved in LBP of mechanical origin. They are:

- Large intra-articular synovial folds of the zygapophyseal joints.
- The fibrous tissue within the joint capsules becomes attached by adhesions, to the adjacent hyaline cartilage.
- The distorted and tractioned blood vessels within the intervertebral foramen.
- The neural structures that become attached by adhesions to densely fibrotic intra-articular synovial folds.
- Stenosis of the intervertebral foramen due to hypertrophy of the ligamentum flavum with or without adjacent posterolateral intervertebral disc herniation.

2.6 Sacroiliac syndrome

Symptoms

Pain over the posterior aspect of the sacroiliac joint that varies in its degree of severity; referred pain in the groin, over the greater trochanter, down the back of the thigh to the knee, and occasionally down the lateral or posterior calf to the ankle, foot and toes (Kirkaldy-Willis, 1992: 124).

Associated clinical signs

Tenderness over the posterior superior iliac spine in the region of the sacroiliac joint. Movement of the joint is also restricted. According to Urli and Till (1995) 33.3% of a South African nursing population were diagnosed with sacroiliac syndrome.

2.7 The Effects of spinal manipulative therapy (SMT).

Chiropractic manipulation is described by Gatterman (1990:410) as "..a passive manual manoeuvre in which specifically directed manual forces are applied to vertebral and extra-vertebral articulations of the body, with the object of restoring mobility to restricted areas."

The possible effects of spinal manipulation according to Calliet (1981: 129-130) are as follows:

- A facet joint is immobilised by an acute synovial reaction and adherence of joint surfaces of the facet takes place. A passive movement, which involves the mobilisation of the spinal motion segment back and forth through its passive range of motion, separates these surfaces.
- The mechano-receptors of the joint are desensitised by the abrupt movement of the joint (manipulation), and reflex protective muscle spasm is eliminated allowing the joint to move again.
- The manipulation allows entrapped menisci to exit the facet joint in which it became entrapped.
- The capsule of the facet joint becomes lodged between two adjacent articular surfaces and the manipulative process allows this capsule to be freed.
- The spindle systems of adjacent muscles are reflexly stimulated by the dynamic thrust of the manipulation and reciprocally relax the extrafusal muscle fibres.
- The mal-aligned spinal segments are aligned to conform to the centre of gravity.

Panzer and Gatterman (1995:464) state that the treatment of choice for sacroiliac subluxation is specific manipulative therapy directed at the sacroiliac articulation. A review article by Hendler et al. (1995:169) stated that "manipulation provides dramatic relief" in cases of sacroiliac syndrome.

McMorland (2000), showed in a study of 199 patients, that spinal manipulation resulted in an average of 52.5% and 52.9% reduction in low back pain and disability.

The literature therefore indicates that manipulation for lumbar facet joint syndrome and/or sacroiliac joint syndrome is an effective treatment for this condition.

2.8 Conclusion

As can be seen from the above, there is a large body of evidence that highlights the importance of all three subsystems involved in overall spinal stability. At the same time it has been shown that in the presence of low back pain, one or more components of the spinal stabilising is affected. The dynamic inter-relationship of the three subsystems means that a change in one component has an affect on other components of the stabilising system.

Therapeutic approaches to low back pain have been criticised for their largely passive approaches (Panjabi, 1992:2). The need to incorporate an active approach to low back pain by involving the patient is some form of exercise regime has been shown to be a successful one (Konrad et al. 2001).

The successful results achieved by retraining core stability, and the success of Chiropractic manipulation in the treatment of low back pain, warrants an investigation into the effect of combining these two approaches.

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 INTRODUCTION

This chapter deals with the methods employed in the data collection, as well as the statistical methods used for the interpretation of the data.

3.2 THE DATA

The data used in this study is divided into two types:

a. Primary data

b. Secondary data

3.2.1 The Primary Data

The primary data was obtained directly from the patients and consisted of:

- Information gathered from the case history (Appendix A), physical examination (Appendix B) and regional lumbar spine and pelvis examination (Appendix C).
- The patient's pain sensitivity as obtained through the use of an algometer.
- Specific diagnosis and evaluation of the syndromes involved, namely Lumbar facet and Sacroiliac syndrome, by use of an Orthopedic rating scale (Appendix D).
- Endurance testing of the Transversus Abdominis muscle using the Stabilizer Biofeedback Device (Chatanooga, Australia) (Appendix D).
- The patient's perception of their disability obtained through use of the Revised Oswestry Low Back Disability Index (Appendix E) (Hsieh et al. 1992).
- The patient's pain sensitivity as perceived by the pain sensitivity scale (Hsieh et al. 1992) (Appendix E).

3.2.2 The Secondary Data

The secondary data was obtained from a search of related literature. This included relevant journal articles, published reports and textbooks containing information pertaining to the study being conducted.

3.3 CRITERIA GOVERNING ADMISSIBILITY OF DATA

The only subjective data admitted came from the Pain Sensitivity Scale and Revised Oswestry Low Back Disability Index (Appendix E) which was used to establish the patient's subjective response during the study. Objective feedback from the patient was obtained through the use of an algometer (Appendix D), the orthopedic rating scale (Appendix D) and Stabilizer readings of Transversus Abdominis endurance (Appendix D). All these findings were completed and documented under the supervision of the researcher.

3.4 RESEARCH METHODOLOGY AND MATERIALS USED

3.4.1 Patients

The objective of this investigation was to evaluate the relative effectiveness of Spinal Manipulative therapy (SMT) compared to Spinal Manipulative Therapy combined with Core Stabilisation in the management of mechanical low back pain (LBP).

A sample size of 60 patients was used in this study. These patients presented to the Durban Institute of Technology Chiropractic Day Clinic with mechanical low back pain. The patients were randomly divided into two groups of 30, Group A the SMT and Core Stabilisation group and Group B, the SMT group.

Patients were recruited from sports clubs and by advertising in the following areas: The Durban Central Fire Department, St Aidan's Mission Hospital and the Durban Institute of Technology. Advertisements were also distributed through a distribution network. Respondent's were screened telephonically and subsequently scheduled for an initial consultation if they met the criteria explained below.

3.4.2 Inclusion and Exclusion Criteria for patients:

The inclusion criteria for the study were:

- Patients had to be between the ages of 18 and 65 years.
- Patients suffering from mechanical low back pain incorporating Lumbar Facet Syndrome and/or Sacroiliac syndrome (Kirkaldy Willis, 1992:291).

The exclusion criteria for the study were:

- Contraindications to spinal manipulation including osteomyelitis, TB of the spine, infectious arthritis, disc prolapse, hemangioma, vertebral malignancy and advanced spondylolisthesis (Triano, 1992:352).
- Contraindication to abdominal muscle strengthening: Glaucoma, pregnancy, hypertension, osteoporosis, spinal tumors, inflammatory diseases and impaired circulation (Harms-Ringhdal, 1993:243).
- Patients currently receiving treatment for mechanical low back pain.
- Subjects on anti-inflammatory drugs.
- Patients with extreme discomfort on contracting the abdominal muscles.
- Illiterate patients.
- Patients undertaking any specific abdominal or lower back exercise during the study, above and beyond normal exercise routines (e.g. running).

3.5 Ethical considerations.

- The rights and welfare of the subject were protected
- Informed consent was obtained (Appendix G).
- The subject was not coerced into participating in the study.
- Information was given to subjects in an understandable language where possible.
- The research involved no more than minimal risk.
- Confidentiality was maintained

- Participation was voluntary and did not involve financial benefit.
- The subject was free to withdraw from the study at any time.

Ethical standards are maintained through the Durban Institute of Technology ethics committee, which gives its approval to the study.

3.6 Intervention

At the initial consultation, all potential candidates for the study underwent a full case history (Appendix A), a physical examination (Appendix B) and a regional low back and pelvis examination (Appendix C). Patients were also provided with an Information Sheet (Appendix F) and informed consent (Appendix G) was obtained before inclusion into the study.

The most symptomatic joints were identified by motion palpation of the lumbar spine and sacroiliac joints (Schafer and Faye, 1990: 211-217). Motion palpation was used to identify segments in the lumbar spine and sacroiliac joints with restricted and/or abnormal motion (Schaefer and Faye, 1989: 211-216, 256-259). Motion palpation was also used to identify in which plane a manipulative technique should be given, allowing the patient to have the least amount of discomfort and to restore maximum joint play to their spine (Schaefer and Faye, 1989:211-216, 256-259).

Motion palpation was used in conjunction with the Orthopedic rating scale (ORS) in order to give an objective rating of the severity of the syndrome(s) as motion palpation does not give insight into the relative severity of the syndromes. The ORS also provides an additional objective measure of relative improvement in the syndrome(s).

Endurance of the Transversus Abdominis (TrA) muscle in patients from both groups was tested using the method prescribed by Oldrieve et al (2000). Patients were taught how to contract the Transversus abdominis in the four-point kneeling position. In this position, it was ensured that the patient's shoulders were directly over the hands and the hips over the knees. This position was used, as the forward shift of the abdominal contents provides a facilitatory stretch of the deep abdominals but provides an inhibitory effect for the superficial muscle, the rectus abdominis (Jull et al.1995). The examiner's hand was placed

under the lower abdomen and the following was asked of the patient, "As you breathe out, gently draw your lower abdomen off my hand and maintain this position while breathing normally."

Both groups' TrA endurance was tested in the prone position (appendix H). With the Stabiliser placed centrally over the abdomen, with the umbilicus in the centre of the inflatable sleeve, the Stabiliser was pumped up to a pressure of 70mmHg. The patient was then instructed to cause a drop in pressure of between 6 and 10mmHg. A variation of 2mmHg was allowed for the normal breathing pattern, but if this was exceeded i.e the pressure increased over 66mmHg, the patient was assumed to have reached their endurance level. A stopwatch was used to time the number of 10-second contractions that the patient could hold. 20 seconds rest was allowed between each contraction.

Substitution patterns including inhalation, dominant obliques and lifting of the pelvis off the testing surface was continuously monitored to ensure proper contraction of Transversus abdominis (Richardson and Jull, 1995). The same stopwatch was used throughout the study to ensure consistency.

This testing was done at consultations 1,3 and 5 to assess changes in endurance. It was assumed that an increased ability to hold more contractions implied an increase in both endurance and control of this muscle. To ensure that the patient performed a bona fide contraction, the examiner's fingers continuously felt for a contraction of TrA at a site slightly medial to either ASIS.

Patients in both groups received SMT in accordance to the treatment protocol of Kirkaldy-Wills (1988:249). This involved receiving 4 treatments over a two-week period with a follow up treatment one week (5-7 days) later.

Patients in Group A also received retraining of the TrA muscle over all four consultations. These patients were taught re-training of this muscle in the supine and supine loading position as prescribed by the manufacturers, Chatanooga. The sleeve was placed beneath the lumbar spine with the bottom of the sleeve in line with the PSIS's. It was then pumped up to 40mmhg. The patient was required to perform a TrA contraction, but was not allowed

to cause an increase in pressure. This ensured that an isolated contraction of TrA was maintained. The number of 10-second contractions in this position was noted, in a similar manner to the one described above. After this the patient was allowed 2 minutes rest and were then taught retraining of TrA with leg loading, in a similar manner to the one described above. The examiner's fingers were again placed just medial to the ASIS as an additional monitoring tool to ensure contraction of the TrA.

To ensure that patient's kept focused on using the TrA in normal daily life outside of the clinic environment, patients were urged to perform the abdominal sling exercise on non-treatment days, as described by Jull et al. (1995). They were urged to keep a record of the number of ten second contractions performed three times a day, and were given an 'exercise diary' to keep a record of these exercises (Appendix I). The exercise diary however had no statistical influence on the study. Aside from this motivation, the patient was encouraged to attempt to incorporate these stabilising exercises into his/her normal day to day activities as the benefits of such stabilising exercises would only be felt if the patient 'bought' into the concept of stabilisation.

Patients in Group B had their TrA endurance tested at treatments 1,3 and 5, but received no retraining program or home exercise program. They received SMT only.

3.6.1. Measurements

The severity of the patient's low back pain in both groups was assessed at treatments 1,3 and 5. Both objective and subjective measurements were assessed before each of the above consultations.

A record of these readings was kept in a reading sheet (Appendix E).

3.6.1.1 Objective Measurements

The force dial algometer was used to assess tenderness of the affected joint(s). This instrument measures the number of kilograms the patient can withstand before

complaining of pain. The measurements were taken by placing the rubber tip over the symptomatic facet and/or sacroiliac joint and a measurement in kilograms per square centimetre (kg/cm^2). The algometer's ability to measure pressure sensitivity and to identify aberrant tender areas provides a means of quantifying treatment, so as to identify patient improvement (Fischer, 1986.)

Further objective measurements were obtained through the use of an Orthopedic rating scale (Appendix D). The orthopedic tests incorporated in this scale were used to establish a rating for the facet and/or sacroiliac syndrome.

These tests included:

Lumbar facet tests:

Lumbar facet joint challenge (2 points)

This test is performed with the patient lying prone. 'Springing' the spinous process discerns the status of the facet joints. The examiner places one thumb on the spinous process above and one on the spinous process below. The force is applied horizontally in opposite direction (Gatterman, 1990:84).

Kemp's test (4 points)

This involves a combination of lateral flexion and extension over the facet joints while the patient is in a seated position (Giles 1997:346). The examiner reaches around the patients shoulder's from behind and laterally bends, rotates and extends the patient to the right and then the left while applying an axial force. Pain in the lumbar region indicates a positive test (Gatterman, 1990:141).

Prone hyperextension test (2 points)

This involves lying the patient prone and helping them move into hyperextension of the lumbar spine. An increase in pain in the lumbar sign is considered as positive (Gatterman, 1990:162).

Sacroiliac tests

Patrick Faber (2 Points)

Mcgee (1997:473), describes this test with the patient lying supine. The examiner places the patients test leg so that the foot of the test leg is above the knee of the opposite straight leg. The examiner then pushes the test leg into abduction while stabilising the opposite hemi-pelvis with the other hand. A true positive test is indicated by a decrease in abduction as well as pain in the sacroiliac joint, therefor indicating a sacroiliac dysfunction. False positives include possible hip joint and/or adductor pathologies.

Gaenslen's test (2 points)

This test is described by Mcgee (1997:446) with the patient lying supine. The test hip extends beyond the edge of the table. The patient draws both legs up to the chest and then lowers the test leg off the edge of the table in to extension, with help from the examiner. The examiner places a shearing pressure in the opposite direction. The other leg is tested similarly. A positive test is indicated by pain in the sacroiliac joint(s).

Erichson's test (2 points)

Also known as Yeoman's test, it is described by Schaefer and Faye (1990:271). The patient lies prone. One hand applies pressure to the affected SI joint, while the other hand lifts the ipsilateral leg into hyperextension, with the knee flexed at 90 degrees. Pain in the SI joint indicates a positive test.

Posterior Shear Test (4 points).

This test is described by Laslett and Williams (1994), in the supine position. The hip is flexed and adducted while the examiner applies a force by pushing posteriorly along the line of the femur. Increase in pain over the SI joint indicates a positive test.

The Orthopedic rating scale for either facet or SI syndrome was scored out of a maximum of ten points. Only patients with a score of 6 out of ten or higher or a combined score of 12 out of 20 or higher where considered diagnostically acceptable and included into the study. This assessment was carried out in both groups at the first, third and fifth appointments. A change in score indicated a change in the patient's condition. The Orthopedic rating scale

was statistically analysed as a percentage of mechanical low back pain for each patient. This allowed for all 60 subjects to be analysed. Additional analysis was carried out on specific syndromes and the combination of syndromes. This was dependent on how many patients were selected for each syndrome or combination of syndromes. If the sample size was too small, the appropriate statistical tests could not be run.

As randomised reliability of the ORS has not yet been ascertained, the ORS was correlated with the Oswetry questionnaire in order to establish concurrent reliability Login (2001).

3.6.1.2 Subjective measurements

3.6.1.2.1 The Revised Oswestry Low back pain Disability Questionnaire (incorporating the Pain Sensitivity Scale).

The Revised Oswestry Low back pain Disability Questionnaire (RODQ) has been validated by the chiropractic research studies of Hsieh et al. (1992: 4-9) and Haas et al. (1995:79-87).

The RODQ has ten sections of six statements, including pain intensity, personal care, lifting, walking, sitting, standing, sleeping. Social life, travelling and changing degree of pain (pain sensitivity scale).

For each section of six statements the total score was 5. The first statement was scored as 0 and the last as 5. The total scored out of 50 total possible points multiplied by 100 to form a percentage (Fairbank and Pynsent, 2000: 2944).

3.7 Treatment of the Objectives

The purpose of this study was to investigate the relative effectiveness of spinal manipulative therapy combine with core stabilisation compared with spinal manipulative

therapy alone in the treatment of mechanical low back pain.

3.7.1 The First Objective

The first objective was to determine the relative effectiveness of spinal manipulative therapy combine with core stabilisation compared with spinal manipulative therapy alone in the treatment of mechanical low back pain in terms of subjective clinical findings.

3.7.2 The Second objective

The second objective was to determine the relative effectiveness of spinal manipulative therapy combine with core stabilisation compared with spinal manipulative therapy alone in the treatment of mechanical low back pain in terms of objective clinical findings.

3.8 Statistical Analysis

3.8.1 Treatment of Data

3.8.1.1. Subjective data

The subjective data were treated as follows:

- Questionnaires that the patients completed were screened to ensure that they had been completed correctly.
- Raw data from the questionnaires were converted into percentages and recorded separately for each group.
- The data were analysed using a 5% significance level.

3.8.1.2 Objective data

The objective data were treated as follows:

- The algometer readings were recorded separately for each group
- The Stabiliser readings were recorded separately for each group
- The results of the orthopedic tests were recorded separately for each group.

- The data were analysed using a 5% significance level.

3.9 STATISTICAL PROCEDURE

The Durban Institute of Technology research statistician was consulted concerning the manner in which the research study was analysed. The data were analysed using the computer statistical package SPSS Version 9.0.

Both parametric and non-parametric tests were used in order to analyse the data obtained. Parametric tests were used to analyse algometer readings, Stabiliser readings, Orthopedic Rating Scale (Percentage analysis), the results of the Pain Sensitivity Scale and the Revised Oswestry Low back disability questionnaire readings. Statistical tests included unpaired T-tests, for inter-group comparisons and Friedman's T-test for intra-group comparison.

3.9.1 Procedure 1: Unpaired T-test (inter-group)

Unpaired T-test (two-sample analysis) was used at the 5% level of significance. It was used to determine whether there was any significant difference between the two groups at the time of the first, third and final consultations. This parametric test was used, as the sample size was greater than or equal to 30 ($n \geq 30$).

The null hypothesis (H_0) stated there was no difference between the two groups. The alternative hypothesis (Hi) stated that there was a difference between the two groups (Fisher and Van Belle, 1993: 315-319).

Therefore the null hypothesis is either accepted or rejected depending on the p-value.

H_0 : There is no difference between the two groups.
H_i : There is a difference between the two groups.

$\alpha = 0.05$

Decision rule:

If $p < \alpha$, reject H_0.

If $p \geq \alpha$, accept H_0.

Where p is the reported p-value.

3.9.2 Procedure 2: The Friedman's T-Test for K-related samples (intra-group)

The Friedman's T-Test is a non-parametric test that compares three or more related groups (Instat,2001). If the p-value is small one can conclude that at least one of the treatments differs from the rest, it is therefore necessary to look at post tests to determine which groups differ from other groups (Instat, 2001). The Friedman's test was used to between the groups to determine if there was any significant difference according to the RODQ, PSS, ORS, algometer readings and Stabiliser readings between the first, third and fifth (follow up) visits.

Hypothesis testing:

The null hypothesis H_0 stated that there was no difference between consultations with regards to the variable of interest. The alternative hypothesis H_1 stated that there was a difference (improvement) between consultations with regards to the variable of interest.

- H_0: The two treatments yield identical results
- H_1: One treatment tends to yield larger results
- $\alpha = 0.05$ = level of significance of the test.

The decision rule:

For a one-tailed test:

-Reject H_0 at α level of significance of $p < \alpha = 0,05$

-Accept H_0 at α level of significance of $p \geq \alpha = 0.05$ where:

P= (reported p-value/2) if H_i is of form < and z is negative
H_i is of form > and z is positive

P= 1- (reported p-value/2) if H_i is of form < and z is positive
H_i is of form > and z is negative

If the null hypothesis H_0 is rejected for Friedman's T-test, then the multiple comparison procedure (Dunn's procedure), will have to be applied to determine which treatments are significantly different.

3.10 **Summary:**

Sixty patients suffering from mechanical low back pain, sacroiliac syndrome and/or lumbar facet syndrome were selected into the study. Thirty patients were randomly allocated into two groups of thirty each.

Those in group A received spinal manipulation and core stabilisation, while those in group B received spinal manipulation alone.

Chapter Four

The Results:

4.1 Introduction:

The first part of this chapter contains the demographic data of all the patients included in the study. The second part of this chapter contains the statistical analysis of the subjective and objective data obtained from the patients over the treatment period.

The patents in group A received spinal manipulative therapy and core stabilisation. The patients in Group B received spinal manipulative therapy alone.

4.2 Criteria governing the admissibility of data:

Information obtained from the case history, low back regional examination, Revised Oswestry Low back Disability Questionnaire (RODQ), Pain Sensitivity Scale (PSS), Orthopedic Rating Scale (ORS), the Stabiliser and algometer readings were used as data for this study. All the pain questionnaires were explained to the patients, who then completed them. The researcher took all the algometer and Stabiliser readings.

The null hypothesis H_0 stated that there was no difference between consultations with regards to the variable of interest. The alternative hypothesis H_1 stated that there was a difference between consultations with regards the variable of interest. The level of significance (α) was set at 0.05 (Fischer and Van Belle, 1993: 315-319).

The Dunn's procedure (Multiple comparison test)

Dunn's procedure was performed after Friedman's T-test if the null hypothesis was rejected. This was done to determine the significance of improvement of each treatment.

Dunn's procedure states:

Let *Rj* and *Rj'* be the *jth* and *j'th* consultation rank totals.

Let α be the experiment-wise error rate. $\alpha = 0.10$

(Experiment-wise error rate is usually higher than α and it depends on the number of groups (k)).

Decision rule:

$$| Rj\text{-}Rj' | \geq z \sqrt{\frac{bk(k+1)}{6}}$$

In the above formula:

b = the number of blocks

k = the number of consultations

z = value in the inverse normal distribution corresponding to {1 – [a/k(k-1)]}

In order to compute the consultation rank totals, the values in each block were ranked and then the sum of the ranks for each consultation was computed.

In this case $k = 3$, $\alpha = 0.10$, $z = 2.12$, $b = 30$.

4.3 **The sample size**

The sample size of the study was limited to 60 patients with thirty in each group. Sventy-five patients responded to the advertisements for treatment of mechanical low back pain. The patients were telephonically screened according to the study criteria. All 75 patients were then assessed at the Durban Institute of Technology Chiropractic day clinic, of whom 66 patients met the selection criteria and were accepted into the study. 6 patients were excluded due to non-compliance.

4.4 Inter-group analysis of the subjective measurements

4.4.1. **Analysis of the Subjective data**

Table 1: Comparison of the Revised Oswestry and pain sensitivity scores of the initial visit of groups one and two using the Unpaired T-Test.

	Group A SMT + Core stability First consultation			P-value	Group B SMT only First consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
RODQ 1	36.5333	15.5624	2.8413	0.089	29.4333	16.2516	2.9671
PSS 1	5.5833	1.8480	.3374	0.071	4.6333	2.1413	.3909

The null hypothesis is accepted for the RODQ and PSS questionnaires, indicating that no difference existed between group A and group B at the initial consultation. This indicates that each group was similarly matched regarding the severity of their LBP at the onset of the study.

Table 2: Comparison of the Revised Oswestry and pain sensitivity scores of the third visit of groups A and B using the Unpaired T-Test.

	Group A SMT + Core stability Third consultation			P-value	Group B SMT only Third consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
RODQ 3	22.2000	15.2619	2.7864	0.117	16.8333	10.3593	1.8913
PSS 3	3.6500	1.1718	3.136	0.173	3.0500	1.6523	.3017

The null hypothesis is accepted for the RODQ and PSS questionnaires, indicating that no difference existed between group A and group B at the third consultation.

Table 3: Analysis of the RODQ and PSS, of the final visits, of groups A and B, using the Unpaired T-test.

	Group A SMT + Core stability Final consultation			P-value	Group B SMT only Final consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
RODQ 5	14.6667	11.7130	2.1385	0.035	8.9000	8.6557	1.5803
PSS 5	2.1500	1.2398	.2264	0.008	1.3500	.9926	.1812

The null hypothesis is rejected for both the PSS and RODQ at the fifth consultation, therefore a statistically significant difference is noted between groups A and B. This indicates that Group B had a statistically better improvement than Group A at the final consultation.

4.5 Inter-group analysis of the objective data

Table 4: Comparison of the ORS (%) and algometer scores of the initial visit of groups A and B using the Unpaired T-Test.

	Group A SMT + Core stability First consultation			P-value	Group B SMT only First consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
ORS 1 (%)	8.4333	1.8134	.3311	0.613	8.1667	2.2296	.4071
ALG 1	5.9707	1.3954	.2548	0.831	5.8933	1.4054	.2566

The null hypothesis is accepted for the ORS and Algometer score, indicating that no difference existed between group A and group B at the initial consultation. This indicates that each group was similarly matched regarding the severity of their LBP at the onset of the study.

Table 5: Comparison of the ORS (%) and algometer scores of the third visit of groups A and B using the Unpaired T-Test.

	Group A SMT + Core stability Third consultation			P-value	Group B SMT only Third consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
ORS 3 (%)	7.5733	1.3799	.2519	0.870	7.5133	1.4529	.2653
ALG 3	7.1333	11.3949	2.0804	0.277	4.7667	2.8000	.5112

The null hypothesis is accepted for the ORS and Algometer score, indicating that no difference existed between group A and group B at the third consultation.

Table 6: Comparison of the ORS (%) and algometer scores of the third visit of groups A and B using the Unpaired T-Test.

	Group A SMT + Core stability Final consultation			P-value	Group B SMT only Final consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
ORS 5 (%)	8.7633	1.3090	.2390	0.375	8.4500	1.4019	.2560
ALG 5	1.3667	2.1088	.3850	0.861	1.4667	2.2854	.4173

The null hypothesis is accepted for the ORS and Algometer score, indicating that no difference existed between group A and group B at the final consultation.

4.6.1 **Analysis of the prone Transversus abdominis strength test**

Table 7: Comparison of the prone Stabiliser readings of the initial visits, of groups A and B using the Unpaired T-test.

	Group A SMT + Core stability First consultation			P-value	Group B SMT only First consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
Prone 1	3.7327	2.0543	.3751	0.438	3.3433	1.7986	.3284

The null hypothesis is accepted for the prone Stabiliser readings, indicating that no difference existed between group A and group B at the first consultation.

Table 8: Comparison of the prone Stabiliser readings of the third visits, of groups A and B using the Unpaired T-test.

	Group A SMT + Core stability Third consultation			P-value	Group B SMT only Third consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
Prone 3	5.4867	1.7988	.3284	0.400	17.8600	79.3685	14.4906

The null hypothesis is accepted for the prone Stabiliser readings, indicating that no difference existed between group A and group B at the third consultation.

Table 9: Comparison of the prone Stabiliser readings of the final visits, of groups A and B using the Unpaired T-test.

	Group A SMT + Core stability Final consultation			P-value	Group B SMT only Final consultation		
	Mean	S.D	S.E		Mean	S.D	S.E
Prone 5	6.1833	1.8421	.3363	0.423	17.9067	78.9840	14.4204

The null hypothesis is accepted for the prone Stabiliser readings, indicating that no difference existed between group A and group B at the third consultation.

4.7 Intra-group analysis of the subjective data for group A

4.7.1 Analysis of RODQ scores

Table 10: Analysis of RODQ scores Group A

Group A	Mean	S.D
RODQ1	36.5333	15.5624
RODQ3	22.2000	15.2619
RODQ5	14.6667	11.7130

Table 11: Rank scores of RODQ of Group A

Group A	Mean Rank	Rank scores	P.Value
RODQ1	2.87	86.1	0.000 (<0.001)
RODQ3	1.87	56.1	
RODQ5	1.27	38.1	

These two tables give an indication of the response to treatment within group A. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 12: Dunn's Procedure of RODQ Group A

Group A	Rank scores	Dunn's Procedure
RODQ1	86.1	$30 \geq 16.42$
RODQ3	56.1	$48 \geq 16.42$
RODQ5	38.1	$18 \geq 16.42$

- For j=1 and j'=3 , the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.
- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.
- For j = 3 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations three and five.

4.7.2 **Analysis of the Pain sensitivity scale scores for group A.**

Table 13: Analysis of PSS of Group A

Group A	Mean	S.D
PSS1	5.5833	1.8480
PSS3	3.6500	1.7178
PSS5	2.1500	1.2398

Table 14: Rank scores of PSS scores of Group A

Group A	Mean Rank	Rank scores	P.Value
PSS1	2.85	85.5	0.000 (<0.001)
PSS3	1.88	56.4	
PSS5	1.27	38.1	

These two tables give an indication of the response to treatment within group A. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 17: Rank scores of RODQ Group B

Group B	Mean Rank	Rank scores	P.Value
RODQ1	2.80	84	0.000 (<0.001)
RODQ3	2.03	60.9	
RODQ5	1.17	35.1	

These two tables give an indication of the response to treatment within group B. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 18: Dunn's procedure for RODQ scores for Group B

Group B	Rank scores	Dunn's Procedure
RODQ1	84	$23.1 \geq 16.42$
RODQ3	60.9	$48.9 \geq 16.42$
RODQ5	35.1	$25.8 \geq 16.42$

- For j=1 and j'=3, the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.

- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.

- For j = 3 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations three and five.

4.8.2 **Analysis of PSS scores for group B.**

Table 19: Analysis of PSS scores of Group B

Group B	Mean	S.D
PSS1	4.6333	2.1413
PSS3	3.0500	1.6523
PSS5	1.3500	0.9926

Table 20: Rank scores of PSS of Group B

Group B	Mean Rank	Rank scores	P.Value
PSS1	2.78	83.4	
PSS3	2.10	63	0.000 (<0.001)
PSS5	1.12	33.6	

These two tables give an indication of the response to treatment within group B. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 21: Dunn's procedure for PSS scores for Group B.

Group B	Rank scores	Dunn's Procedure
PSS1	83.4	20.4 ≥ 16.42
PSS3	63	49.8≥ 16.42
PSS5	33.6	29.4 ≥ 16.42

- For j=1 and j'=3, the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.

- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.

- For j = 3 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations three and five.

4.9 Intra-group analysis of objective measurements for Group A

4.9.1 Prone Stabiliser readings for Group A

Table 22: Prone readings for Group A

Group A	Mean	S.D
Prone1	3.7327	2.0543
Prone3	5.4867	1.7988
Prone5	6.1833	1.8421

Table 23: Ranks scores of prone readings Group A

Group A	Mean Rank	Rank scores	P.Value
Prone1	1.00	30	0.000 (<0.001)
Prone3	2.37	71.1	
Prone5	2.63	78.9	

These two tables give an indication of the response to treatment within group A. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 24: Dunn's procedure for Prone scores for Group A

Group A	Rank scores	Dunn's Procedure
Prone1	30	$41.1 \geq 16.42$
Prone3	71.1	$48.9 \geq 16.42$
Prone5	78.9	$7.8 \not\geq 16.42$

- For j=1 and j'=3, the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.

- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.

- For j = 3 and j' = 5, the above inequality is not true, hence the result is not significant, indicating no significant improvement in transversus abdominis strength between consultations three and five.

4.9.2 Algometer readings for Group A

Table 25: Algometer readings for Group A

Group A	Mean	S.D
ALG1	5.9707	1.3954
ALG3	7.5733	1.3799
ALG5	8.7633	1.3090

Table 26: Ranks scores for algometer readings for Group A

Group A	Mean Rank	Rank scores	P.Value
ALG1	1.05	31.5	0.000 (<0.001)
ALG3	2.00	60.0	
ALG5	2.95	88.5	

These two tables give an indication of the response to treatment within group A. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 27: Dunn's procedure for algometer scores for Group A

Group A	Rank scores	Dunn's Procedure
ALG1	31.5	$28.5 \geq 16.42$
ALG3	60.0	$57 \geq 16.42$
ALG5	88.5	$28.5 \geq 16.42$

- For j=1 and j'=3, the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.

- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.

- For j = 3 and j' = 5, the above inequality is true, hence the result is significant, indicating significant improvement between consultations three and five.

4.9.3 **ORS readings for Group A**

Table 28: ORS readings for Group A

Group A	Mean	S.D
ORS1	8.4333	1.8134
ORS3	7.1333	11.3949
ORS5	1.3667	2.1088

Table 29: Rank scores for ORS for Group A

Group A	Mean Rank	Rank scores	P.Value
ORS1	2.8	84	0.000 (<0.001)
ORS3	2.1	63	
ORS5	1.1	33	

These two tables give an indication of the response to treatment within group A. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 30: Dunn's procedure for ORS scores for Group A

Group A	Rank scores	Dunn's Procedure
ORS1	84	21 ≥ 16.42
ORS3	63	51 ≥ 16.42
ORS5	33	30 ≥ 16.42

- For j=1 and j'=3, the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.

- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.

- For j = 3 and j' = 5, the above inequality is true, hence the result is significant, indicating significant improvement between consultations three and five.

4.10 Intra-group analysis of objective data for group B

4.10.1 Algometer readings for Group B

Table 31: Algometer readings for Group B

Group B	Mean	S.D
ALG1	5.8933	1.4054
ALG3	7.5133	1.4529
ALG5	8.4500	1.4019

Table 32: Rank scores for Algometer readings Group B

Group B	Mean Rank	Rank scores	P.Value
ALG1	1.08	32.4	0.000 (<0.001)
ALG3	2.08	62.4	
ALG5	2.83	84.9	

These two tables give an indication of the response to treatment within group B. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 33: Dunn's procedure for algometer scores for Group B

Group B	Rank scores	Dunn's Procedure
ALG1	32.4	$30 \geq 16.42$
ALG3	62.4	$52.5 \geq 16.42$
ALG5	84.9	$22.5 \geq 16.42$

- For j=1 and j'=3, the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.

- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.

- For j = 3 and j' = 5, the above inequality is true, hence the result is significant, indicating significant improvement between consultations three and five.

4.10.2 Prone Stabiliser readings for Group B

Table 34: Prone stabiliser readings for Group B

Group B	Mean	S.D
Prone1	3.3433	1.7986
Prone3	17.8600	79.3685
Prone5	17.9067	78.9840

Table 35: Rank scores for prone stabiliser readings Group B

Group B	Mean Rank	Rank scores	P.Value
Prone1	1.75	52.5	
Prone3	2.08	62.4	0.0103 (>0.001)
Prone5	2.17	30.0	

These two tables give an indication of no significant response to treatment within group B. The null hypothesis is accepted and one can conclude at a 5% significance level, there was no significant improvement in transversus abdominus strength between consultations 1, 3 and 5.

4.10.3 ORS readings for Group B

Table 36: ORS readings for Group B

Group B	Mean	S.D
ORS1	8.1667	2.2296
ORS3	4.7667	2.8000
ORS5	1.4667	2.2854

Table 37: Rank scores for ORS readings for Group B

Group B	Mean Rank	Rank scores	P.Value
ORS1	2.77	83.1	0.000 (<0.001)
ORS3	2.08	62.4	
ORS5	1.15	34.5	

These two tables give an indication of the response to treatment within group B. The null hypothesis is rejected and one can conclude at a 5% significance level, there was an improvement between consultations 1, 3 and 5.

Table 38: Dunn's procedure for PSS scores for Group B

Group B	Rank scores	Dunn's Procedure
ORS1	83.1	$20.7 \geq 16.42$
ORS3	62.4	$48.6 \geq 16.42$
ORS5	34.5	$27.9 \geq 16.42$

- For j=1 and j'=3, the above inequality is true, hence the result is declared significant, which indicates improvement between consultation one and three.
- For j = 1 and j' = 5, the above inequality is true, hence the result is significant, indicating improvement between consultations one and five.
- For j = 3 and j' = 5, the above inequality is true, hence the result is significant, indicating significant improvement between consultations three and five.

4.11 Patients that were excluded from the study:

Table 39: Patients excluded from the study

Exclusion criteria	No. of patients	Percentage
Non-compliance	6	8%
Pregnant	1	1%
Contra-indication	3	4%
Didn't have ORS criteria.	5	7%

4.12 Descriptive Data

Demographical data included gender, age and racial distribution, as well as the number and side of facet and/or sacroiliac syndrome

4.12.1 Gender Distribution

Table 40: Gender distribution

Sex	Group A	Group B
Males (65%)	16	23
Females (35%)	14	7

The female to male ratio is 1 : 1.8

4.12.2 **Age distribution within the sample group of sixty:**

Table 41: Age Prevalence

Age	Group A	Group B
18-38	16	19
39-48	8	3
49-59	5	5
60-65	1	3

4.12.3 **Racial distribution within the sample size of sixty**

Table 42: Racial Distribution

Race	Group A	Group B
White	17	17
Black	2	1
Indian	8	9
Mixed race	3	3

4.12.4 **Side of sacroiliac syndrome**

Table 43: Side of SIS

Side	Group A	Group B
Right	19	11
Left	5	8

Table 44: Side of facet syndrome

Side	Group A	Group B
Left Lumbar	5	5
Right Lumbar	3	3

Figure 4.1

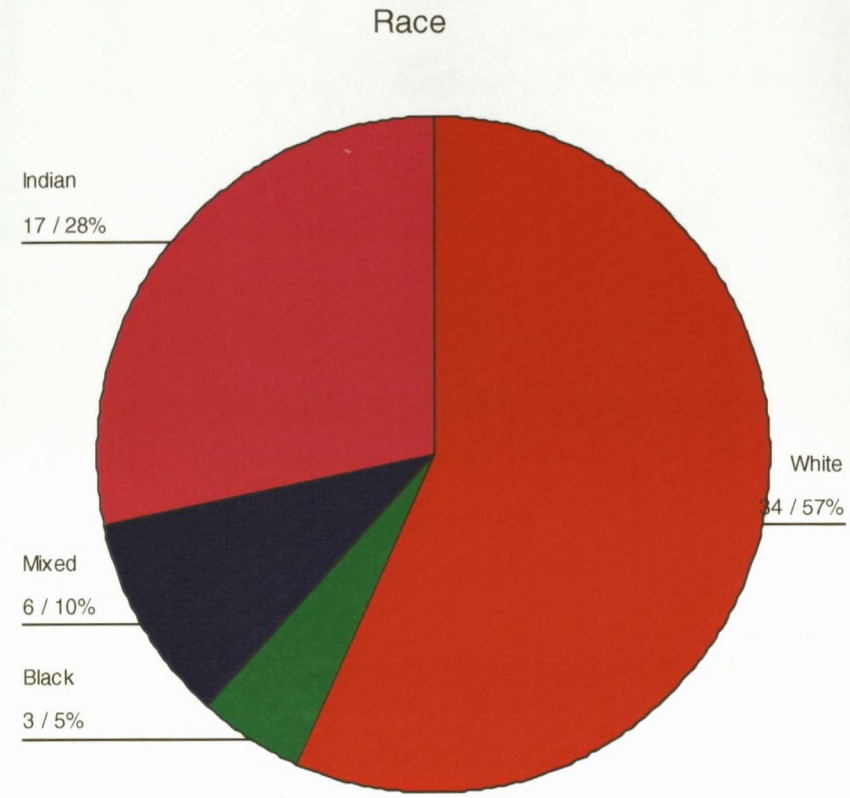


Figure 4.2

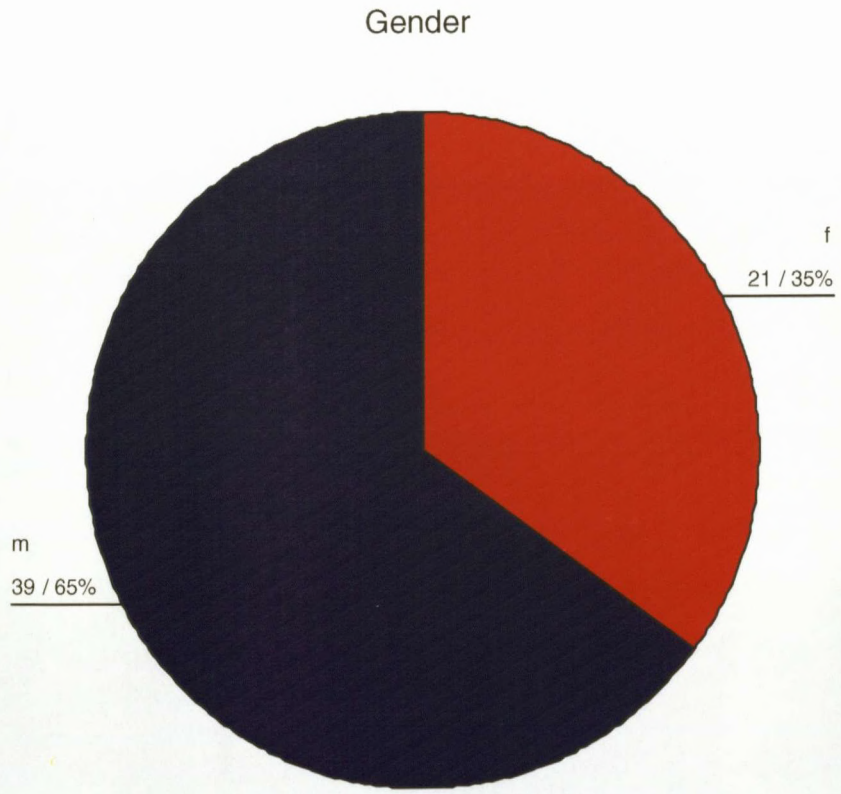


Figure 4.3

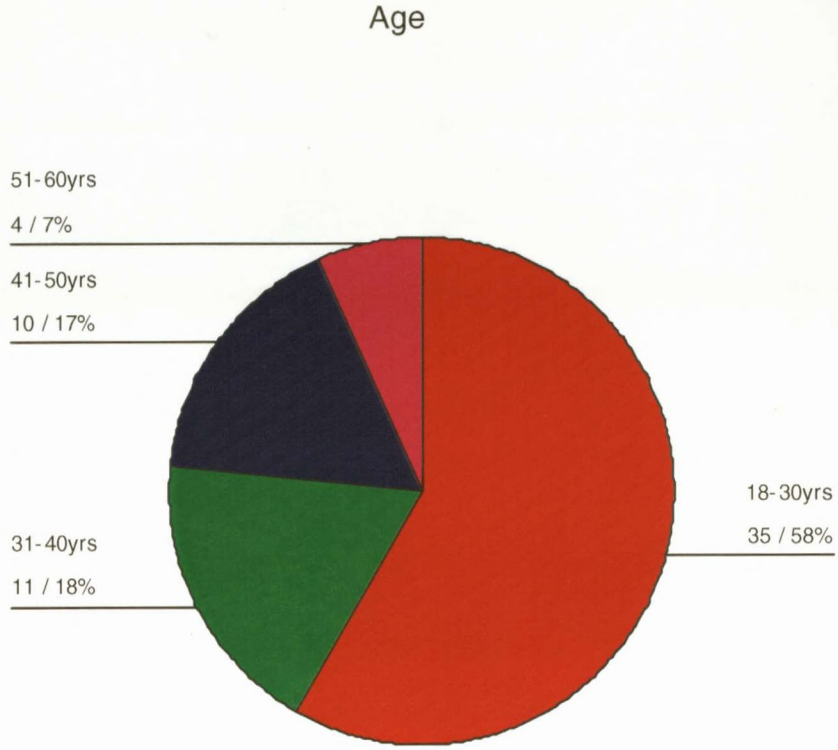


Figure 4.4 Side of fixation

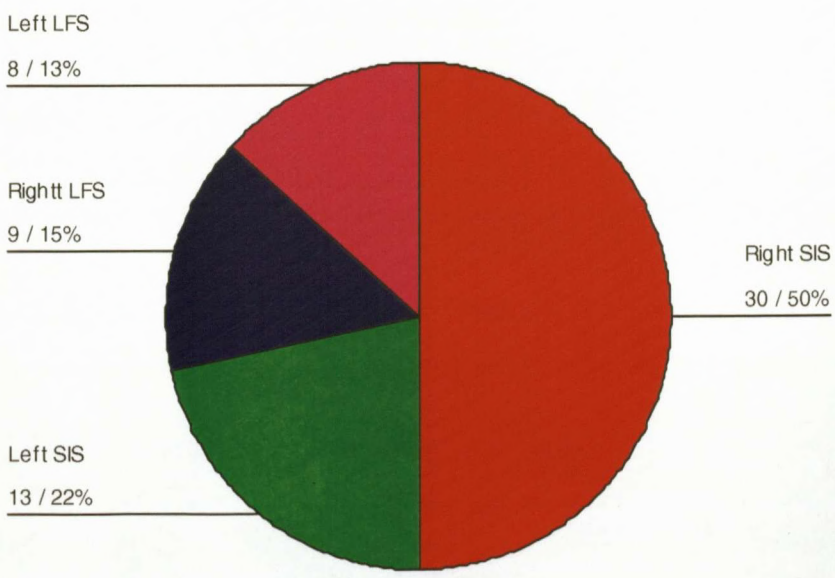


Figure 4.5 **Mean Algometer readings**

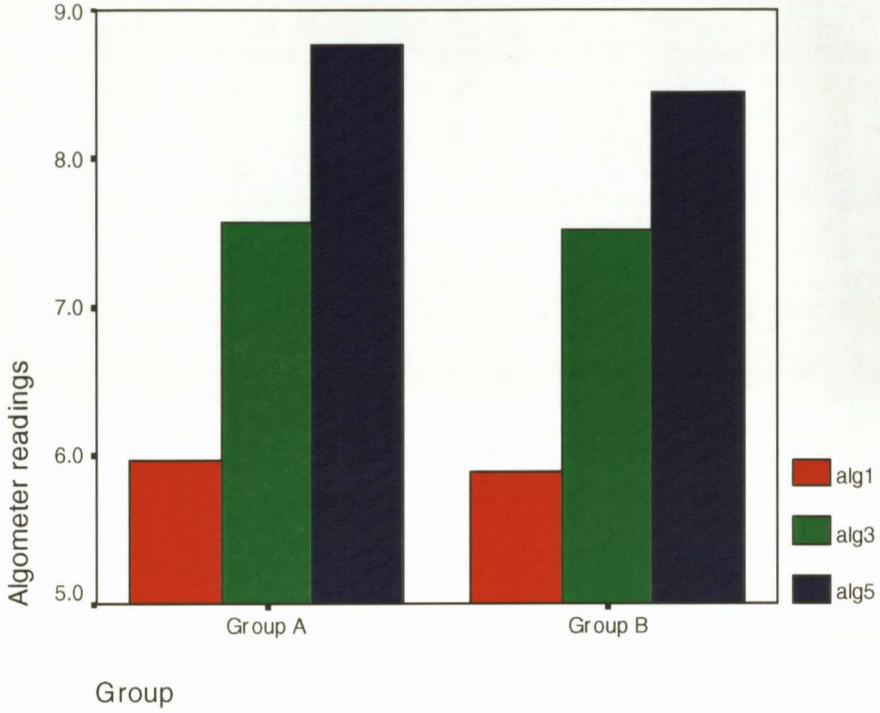


Figure 4.6: **Mean Pain Sensitivity Scale readings**

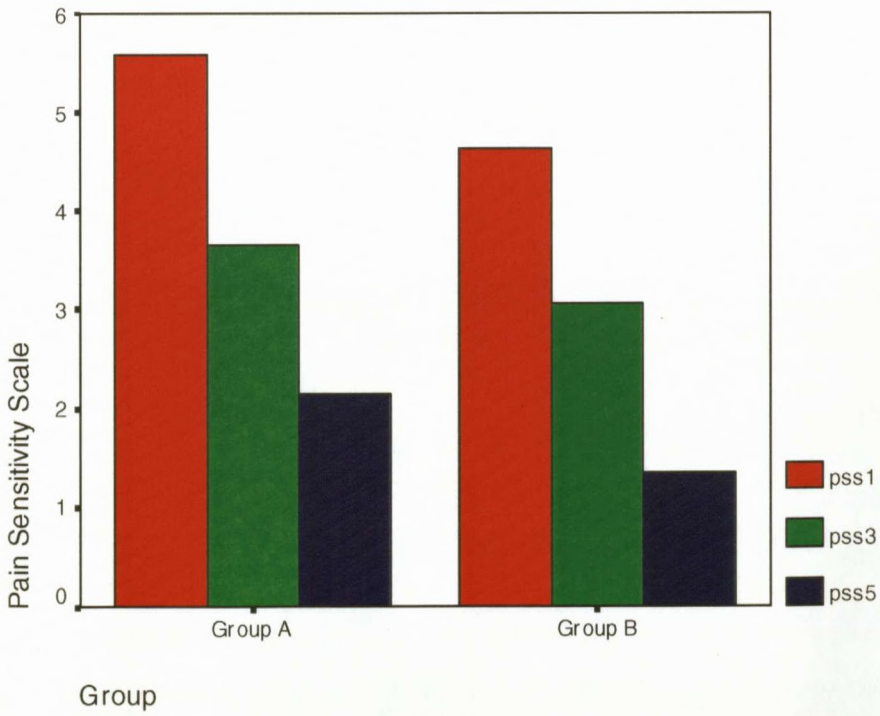


Figure 4.7 Mean ORS value (%)

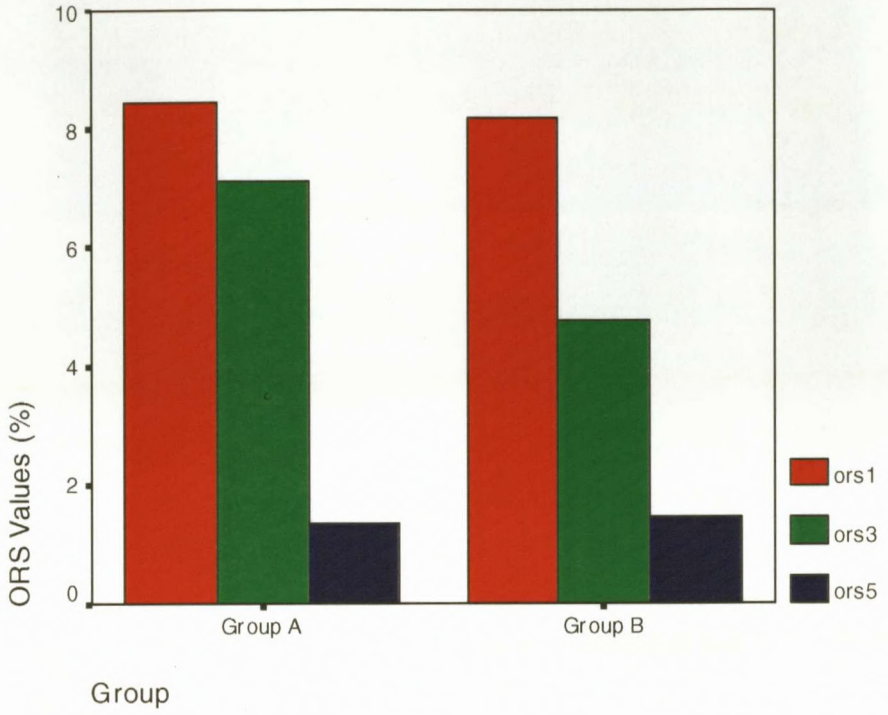


Figure 4.8 Mean Prone Stabiliser Readings

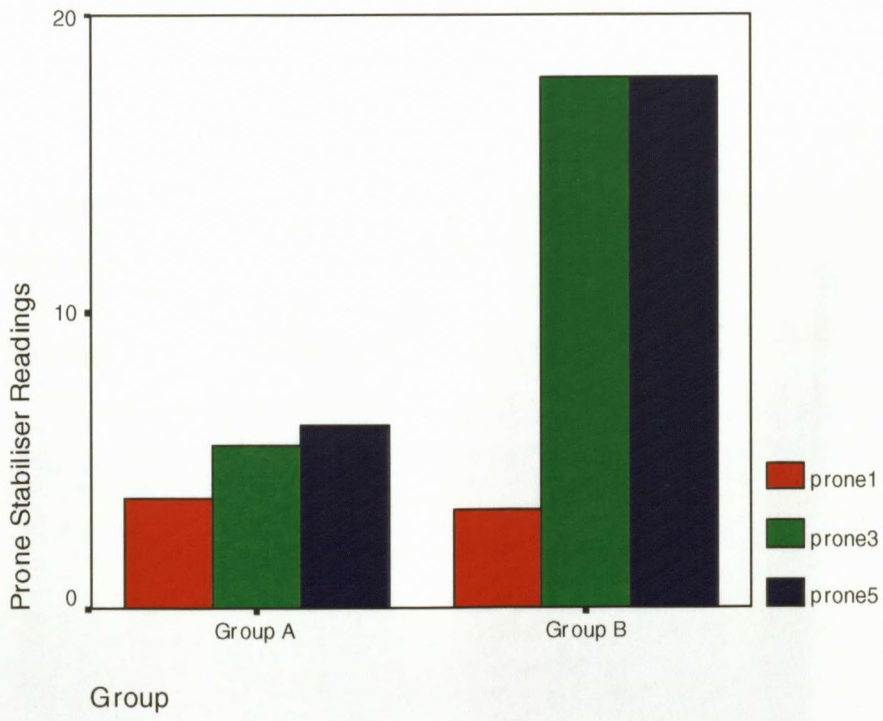


Figure 4.9 **Mean RODQ readings**

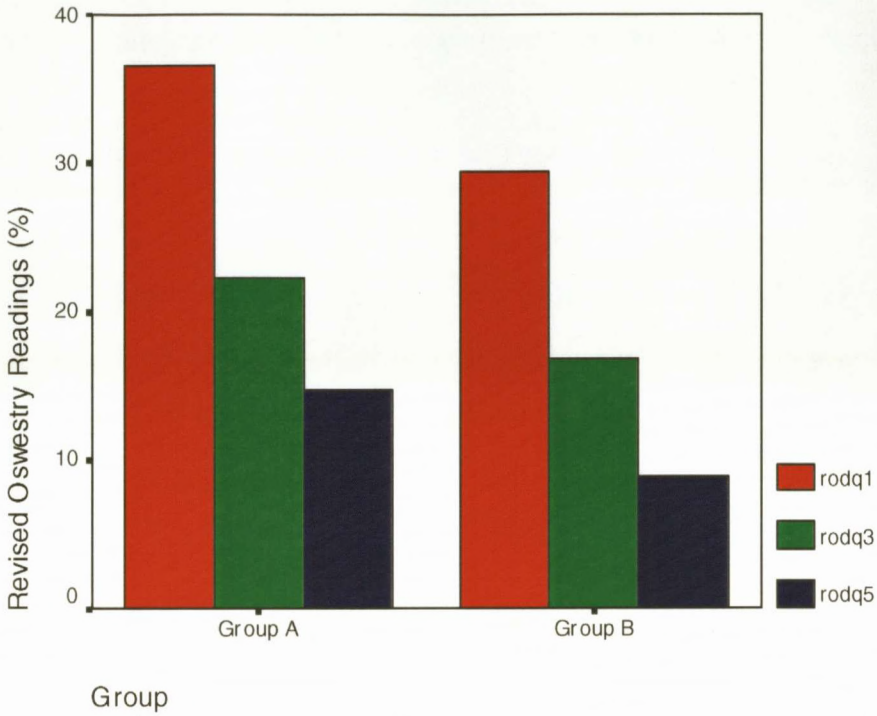


Figure 4.1

This figure shows the racial composition of the patients. White patients were the highest proportion of the study (57%), possibly due to the advertising method, the location of the Chiropractic clinic, and exposure to Chiropractic.

Figure 4.2

This figure shows gender distribution in the study. There seems to be a trend favouring a male predominance, possibly due to a larger male working population targeted by the advertising.

Figure 4.3

This figure shows age distribution in the study. The 18-30 age group has the greatest percentage of patients (58%). This could be due to the fact that these patients are more physically active.

Figure 4.4

This figure shows the proportion and side of syndromes. A right sacroiliac syndrome (50%) was the commonest syndrome. This may be related to right leg predominance in the general population.

Figure 4.5

This bar graph compares means of the algometer readings between groups A and B. Although the readings were similar at the initial consultation, Group A had a higher algometer reading at the final appointment (8,8).

Figure 4.6

This bar graph shows the mean ORS readings. Group A had a slightly higher reading at the first appointment but had a slightly lower reading at the final appointment than Group B, indicating a larger drop in percentage change in Group A.

Figure 4.7

This bar graph shows the mean prone Stabiliser readings. Group B showed a change between treatment one and three and no further change between the third and final treatment. Group A however showed a steady increase in TrA endurance across the whole treatment period.

Figure 4.8

This bar graph shows the mean RODQ readings. Group A had a higher initial reading than Group B but showed a greater change in score than Group B across the whole treatment.

Figure 4.9

This bar graph shows the mean pain sensitivity readings. Although Group A had a higher mean reading at the first consultation as well as at the final consultation, the drop in the mean was higher in Group A than Group B across the whole treatment time.

Chapter Five

5.1 Introduction

This chapter is concerned with the discussion of the objective and subjective data obtained from the first, third and final treatments.

The subjective data consisted of the Revised Oswestry Disability Questionnaire and the Pain sensitivity scale.

The objective data consisted of the Orthopedic Rating Scale, the prone Stabiliser readings and the Algometer readings.

The results are discussed in two main sections, namely: Intra-group results and Inter-group results.

5.2 Intra-group results

5.2.1 Subjective Data

5.2.1.1 The Revised Oswestry Disability Questionnaire

The RODQ scores were statistically analysed using Friedman's T-test.

Within Group A, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 ($p=0.000$). Tables 1 and 2 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

Within Group B, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 ($p=0.000$). Tables 3 and 4 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

These results indicate a reduction in the level of pain experienced by both groups over the treatment period.

5.2.1.2 The Pain Sensitivity Scale

The PSS scores were statistically analysed using Friedman's T-test.

Within Group A, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 (p=0.000). Tables 5 and 6 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

Within Group B, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 (p=0.000). Tables 7 and 8 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

These results indicate a reduction in the level of pain experienced by both groups over the treatment period.

5.2.2 Objective data

5.2.2.1 The Orthopedic Rating Scale

The ORS scores were statistically analysed using Friedman's T-test.

Within Group A, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 (p=0.000). Tables 9 and 10 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

Within Group B, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 (p=0.000). Tables 11 and 12 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

These results indicate a reduction in the level of pain experienced by both groups over the treatment period.

5.2.2.2 The prone Stabiliser readings for TrA endurance

The Stabiliser readings were statistically analysed using Friedman's T-test.

Within Group A, improvement in TrA endurance occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 (p=0.000). Tables 13 and 14 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5 and that there was no significant improvement in TrA endurance between treatment 3 and 5.

Within Group B no statistical improvement in TrA endurance occurred between any of the visits. Table 15 and 16 depict these results.

These results indicate that the Core stabiliser retraining within the treatment periods as well as the home exercise caused an increase in TrA endurance throughout the treatment period.

5.2.2.3 The Algometer readings.

The Algometer scores were statistically analysed using Friedman's T-test.

Within Group A, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 (p=0.000). Tables 17 and 18 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

Within Group B, improvements occurred between visits 1 and 3, 3 and 5 and hence 1 and 5 (p=0.000). Tables 19 and 20 depict these results. Dunn's procedure established that the greatest improvement occurred between treatments 1 and 5.

These results indicate a reduction in the level of pain experienced by both groups over the treatment period.

5.3 Inter Group Results

5.3.1 Subjective Data

5.3.1.1 The Revised Oswestry Disability Questionnaire

The RODQ scores were compared using the Unpaired T-test.

It was discovered that there was no significant difference at 1 and 3, but at the final consultation, group B showed a statistical significant difference in scores (p= 0.035), indicating that manipulation alone may have be more effective than manipulation and core stabilisation.

Similarly a study by Nadler et al. (2002), showed that Core strengthening had no significant effect in decreasing the incidence of low back pain in college athletes (n=625).

5.3.1.2 The pain sensitivity scale

The PSS scores were compared using the Unpaired T-test.

It was discovered that there was no significant difference at 1 and 3, but at the final consultation, group B showed a statistical significant difference in scores (p= 0.008), indicating that manipulation alone may have be more effective than manipulation and core stabilisation.

5.3.2 Objective data

5.3.2.1 Algometer readings

The Algometer scores were compared using the Unpaired T-test.

Although the results show no statistically significant difference between the two groups at any of the consultations, the Algometer readings in Group A were higher at all three consultations, indicating that the combined core stabilisation and manipulation group may shower a more sustained improvement than the manipulation group.

O'Sullivan et al. (1997) showed similar results in a study involving specific stabilising exercises in the treatment of Chronic low back pain with radiologic diagnosis of

spondylosis or spondylolisthesis. In this study the exercise group showed a statistically significant reduction in pain intensity and functional disability levels.

5.3.3.2 Orthopedic Rating Scale (percentage analysis)

The ORS scores were compared using the Unpaired T-test.

Although the results show no statistically significant difference between the two groups at any of the consultations, the ORS readings in Group A showed a more sustained and dramatic improvement over all three consultations, indicating that the combined core stabilisation and manipulation group may shower a more sustained improvement than the manipulation group.

5.3.3.3 The Prone Stabiliser tests for TrA endurance

The Prone Stabiliser tests were compared using the Unpaired T-test.

Although the results show no statistically significant difference between the two groups at any of the consultations, the Stabiliser readings in Group A showed a more sustained and dramatic improvement over all three consultations, indicating that the combined core stabilisation and manipulation group may shower a more sustained improvement than the manipulation group.

5.4 Comparison of the results

In terms of Intra-group analysis specific to the endurance of Transversus Abdominis, it was shown that Group A showed a statistically significant increase in endurance of the muscle when compared to group B. This is in line with other studies which showed a significant increase in ability to perform lumbar stabilisation exercises, after retraining ($p=0.01$) (Hagins et al. 1999).

The statistically significant results in favour of Group B in terms of subjective measurements may be due to the contribution of stiffness of the TrA muscle as these muscles may not have been used before.

Numerous studies exist which provide evidence of the effect of SMT on low back pain, McMorland et al. (2000); Koes et al. (1996). This study validates such findings, by showing a decrease in objective and subjective readings with manipulation alone.

5.5 Summary

This study found that retraining core stability did have an effect on the endurance of the Transversus abdominis muscle. It was not sufficient to conclude that a combined core stabilisation and manipulation program was more effective than manipulation alone.

Chapter Six

6.1 Recommendations

Homogeneity.

More closely defined parameters with regards to using matched pairs with respect to age, gender, race, occupation and extent of pain and disability would greatly enhance the strength of the study. It is therefore recommended that future studies include stratification to ensure homogeneity within the two groups. This would improve comparability of baseline patient characteristics.

Blinding

Observer bias could be eliminated by not allowing the examiner to know which group was being assessed, as well as by not allowing the examiner to view the previous treatments readings.

Sample Size

Larger Sample sizes increase the validity of any study and minimises the possibility of a Type II error, which is incorrectly accepting the null hypothesis.

Follow up consultations

No-long term follow up consultation was done which would help to address the cost-effectiveness and general efficacy of the treatment protocols utilised. Follow-up consultations are recommended at six month, 1 year and even 3 year periods (Hides et al. 2001). This is more pertinent in a study type like this one where muscle control and endurance are being assessed.

Diagnosis of Sacroiliac and Lumbar facet syndrome

Until strict, validated, diagnostic criteria are established for these two syndromes, the ability to diagnose them and treat them will continue to be questioned.

Use of the algometer

Unless the exact area of measurement is marked on the patient and the same area is assessed at each treatment, the validity of this tool remains questionable.

Study design

In this study, core stabilisation was the variable between the groups. A study into the effect of manipulation as the variable would indicate interesting results.

Use of Diagnostic Ultrasound

The use of diagnostic ultrasound imaging in the biofeedback retraining of TrA has been shown to be a useful tool (Hides et al. 1997). The use of this tool may provide a more 'objective' tool to retrain TrA strength and monitor changes in multifidus muscle size.

Stabiliser Pressure Biofeedback device

Although this tool has been established as a satisfactory tool in the measuring and retraining of TrA and multifidus (Cairns 2000), the effect of substitiution strategies as well as the involvement of Internal oblique is difficult to rule out.

6.2 Conclusion

The Clinical Standards Advisory Group recommended the pursuit and practise of 'active' rehabilitation programmes for simple low back pain. Feedback from patients in the core stabilisation group indicated a more positive disposition and attitude to their pain and disability (CSAG, 1994).

The short follow-up period involved in this study design prevents any conclusive comment on the effect of combining core stabilisation with manipulation, but the results do indicate that manipulation alone is an effective treatment protocol in the treatment of mechanical low back pain.

Therefore, further investigation, involving a better study design, a longer follow up period and better objective methods may yield different results.

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APPENDIX A

CASE HISTORY

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient:..... Date: .....

File # :..... Age : .....

Sex :..... Occupation:.....

Intern :.....Signature:.....

FOR CLINICIANS USE ONLY:

Initial visit

Clinician:..... Signature :.....

Case History:

Examination:

Previous: Current:

X-Ray Studies:

Previous: Current:

Clinical Path. lab:

Previous: Current:

Case Status:

PTT:.....

Signature:..... **Date:**.....

Conditional:

Reason for Conditional:.....

Signature: ..... **Date:** .....

All Conditions met in Visit No.:.....

To be signed into PTT:.....

Signature:..... **Date:** .....

Signed off:.....

Intern's Case History:

1. **Source of History:**

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

3. **Present Illness:**

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

4. **Other Complaints:**

5. **Past Medical History:**

- ▹ General Health Status
- ▹ Childhood Illnesses
- ▹ Adult Illnesses

8. **Psychosocial history:**

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

9. **Review of Systems:**

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

APPENDIX B

PHYSICAL EXAMINATION

TECHNIKON NATAL

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Patient:_____File#: _____Date:_____
Clinician:_____Signature:_____
Intern:_____Signature:_____

1. VITALS

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

2. GENERAL EXAMINATION

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

Urinalysis:

3. CARDIOVASCULAR EXAMINATION

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

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

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

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

Percussion: - borders of heart

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

4. RESPIRATORY EXAMINATION

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

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

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

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

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

5. ABDOMINAL EXAMINATION

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

Inspection
- Shape:
- Scars:
- Hernias:

Palpation
- Superficial:
- Deep = Organomegally:

- Masses (intra- or extramural)
- Aorta:

Percussion - Rebound tenderness:
- Ascites:
- Masses:

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

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

6. G.U.T EXAMINATION

External genitalia:
Hernias:
Masses:
Discharges:

7. NEUROLOGICAL EXAMINATION

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

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

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

Evidence of head trauma:

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

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

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

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

III Ocular Muscles:
Eye opening strength:

IV Inferior and Medial movement of eye:

V a. Sensory - Ophthalmic:
- Maxillary:
- Mandibular:

b. Motor - Masseter:
- Jaw lateral movement:

c. Reflexes - Corneal reflex
- Jaw jerk

VI Lateral movement of eyes

VII a. Motor - Raise eyebrows:
- Frown:
- Close eyes against resistance:
- Show teeth:
- Blow out cheeks:

b. Taste - Anterior two-thirds of tongue:

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

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

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

XII Inspection of tongue (deviation):

Motor System:

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

- 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:

APPENDIX C

REGIONAL EXAMINATION

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
REGIONAL EXAMINATION - *LUMBAR SPINE AND PELVIS.*

PATIENT: _____

FILE #: _____ DATE: _____

INTERN/RESIDENT: _____

SUPERVISING CLINICIAN: _____

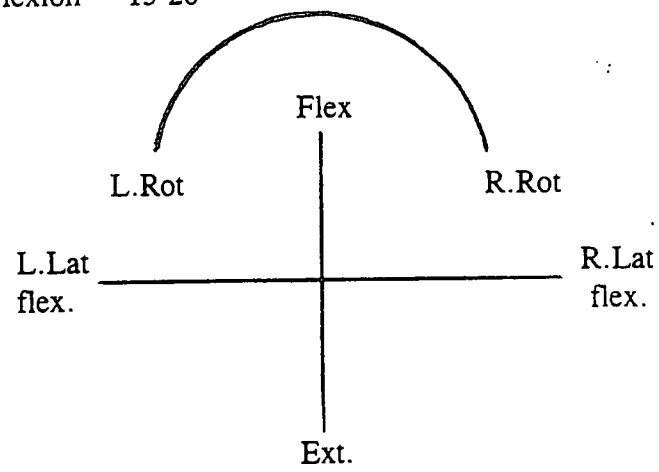
STANDING:

Posture
Minor's Sign
Skin
Scars
Discoloration
Muscle Tone
Bony & Soft Tissue Contours

Spinous Percussion
Schober's Test (6cm)
Treadmill
Body Type
Attitude

RANGE OF MOTION

Forward Flexion = 40-60°(15cm from floor)
Extension = 20-35°
L/R Rotation = 3-18°
L/R Lateral Flexion = 15-20°



SUPINE:

Skin
Hair
Nails
Palpate Abdomen/groin
Pulses (abdomen)

Observe abdomen
Fasciculations
Abdominal Reflexes

Pulses (extremities)
SLR
Bowstring
Plantar Reflex
Circumference (thigh, calf)
Leg Length:
- actual
- apparent

Sciatic Notch
Patrick FABERE
Gaenslen's Test
Gluteus Maximus Stretch
Hip Medial rotation
Psoas Test
Thomas' Test:
- hip joint
- Rectus Femoris

LATERAL RECUMBENT

S-I Compression
Ober's Test
Femoral Nerve stretch
Myotomes:
- QL
- Gluteus Medius

NON ORGANIC SIGNS

Pin Point Pain
Axial Compression
Trunk Rotation
Burn's Bench Test
Flip Test
Hoover's Test
Ankle Dorsiflexion Test.

GAIT

Rhythm
On toes (standing)
On Heels (standing)
Half squat on one leg

PRONE

Gluteal skyline
Skin rolling
Iliac crest compression
Facet joint challenge
S-I tenderness
Erichson's Test
Pheasant's Test
Myotome:
- Glut. Max

Active MF Trigger Pts:
- QL
- Glut. Med
- Glut. Min
- Glut. Max
- Piriformis
- Hamstrings
- TFL

NEUROLOGICAL EXAMINATION

DERMATOMES			MYOTOMES			REFLEXES		
	L	R		L	R		L	R
T12			Hip Flex			Pat.		
L1			Hip int rot			Achil		
L2			Hip ext rot			H/S		
L3			Hip abd					
L4			Hip add					
L5			Knee flex					
S1			Knee ext					
S2			Dorsiflex					
S3			Plantarflex					
			Eversion					
			Ext.hal.long					

Tripod
Kemp's Test

MOTION PALPATION and JOINT PLAY:

LEFT: Upper Thoracics:
Lumbar Spine:
Sacroiliac Joint:

RIGHT: Upper Thoracics:
Lumbar Spine:
Sacroiliac Joint:

Basic Exam: Hip
Case History:

ROM: Active:
Passive:
RIM:
Orthopaedic/Neuro/
Vascular:

Observ/Palpation:

Basic Exam: Thoracic Spine
Case History:

ROM: Motion Palp:
Active:
Passive:
Orthpaedic/Neuro/
Vascular:

Observ/Palpation:

APPENDIX D

DATA SHEET

Motion palpation and Orthopaedic rating scale

Name:_____ File Number:

	MOTION PALPATION				
	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Level					
Side					
Direction					

SACRO-ILIAC JOINT RATING					
	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Post Shear test (4)					
Gaenslen's test (2)					
Patrick Faber (2)					
Erichson's test (2)					
Total out of 10					

FACET JOINT RATING					
	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Kemp's test (4)					
Facet joint challenge (4)					
Prone hyperextension test (2)					
Total out of 10					

	Score for SI and Facet Joint syndrome				
Combined score out of 20					

Stabiliser Values					
	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Prone test					
Supine test					
Supine Loading test					

	Algometer Values				
	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Level					
Value					

APPENDIX E

REVISED OSWESTRY LOW BACK DISABILITY INDEX

AND

PAIN SENSITIVITY SCALE

Revised Oswestry
Low back pain and Disability Questionaire

atient 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 nswer every section and mark in each section only ONE box as it applies to you. We realize you may consider that two of the statements in any one ection relate to you, but please just mark the box which most closely describes your problem right now.

Section 1 - Pain Intensity

- ☐ The pain comes and goes and is very mild.
- ☐ The pain is mild and does not vary much.
- ☐ The pain comes and goes and is moderate.
- ☐ The pain is moderate and does not vary much.
- ☐ The pain comes and goes and is very severe.
- ☐ The pain is severe and does not vary much.

Section 2 - Personal Care

- ☐ I would not have to change my way of washing or dressing in order to avoid pain.
- ☐ I do not normally change my way of washing or dressing even though it causes some pain.
- ☐ Washing and dressing increase the pain but I manage not to change my way of doing it.
- ☐ Washing and dressing increase the pain and I find it necessary to change my way of doing it.
- ☐ Because of the pain I am unable to do some washing and dressing without help.
- ☐ Because of the pain I am unable to do any washing and dressing without help.

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.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I manage if they are conveniently positioned (e.g. 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 only lift very light weights at the most.

Section 4 - Walking

- ☐ I have no pain on walking.
- ☐ I have some pain on walking but it does not increase with distance.
- ☐ I cannot walk more than one mile without increasing pain.
- ☐ I cannot walk more than ½ mile without increasing pain.
- ☐ I cannot walk more than ¼ mile without increasing pain.
- ☐ I cannot walk at all without increasing pain.

Section 5 - Sitting

- ☐ I can sit in any chair as long as I like.
- ☐ I can only sit in my favorite chair as long as I like.
- ☐ Pain prevents me from sitting more than 1 hour.
- ☐ Pain prevents me from sitting for more than ½ hour.
- ☐ Pain prevents me from sitting for more than 10 minutes.
- ☐ I avoid sitting because it increases pain straight away.

Section 6 - Standing

- ☐ I can stand as long as I want without pain.
- ☐ I have some pain on standing but it does not increase with time.
- ☐ I cannot stand for longer than one hour without increasing pain.
- ☐ I cannot stand for longer than ½ hour without increasing pain.
- ☐ I cannot stand for longer than 10 minutes without increasing pain.
- ☐ I avoid standing because it increases the pain straight away.

Section 7 -Sleeping

- ☐ I get no pain in bed.
- ☐ I get pain in bed but it does not prevent me from sleeping well.
- ☐ Because of pain my normal night's sleep is reduced by less than ¼
- ☐ Because of pain my normal night's sleep is reduced by less than ½
- ☐ Because of pain my normal night's sleep is reduced by less than ¾
- ☐ Pain prevents me from.sleeping at all.

Section 8 - Social life

- ☐ My social life is normal and gives me no 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, e.g. dancing, etc
- ☐ Pain has restricted my social life and I do not go out very often.
- ☐ Pain has restricted my social life to my home.
- ☐ I have hardly any social life because of the pain.

Section 9 - Travelling

- ☐ I get no pain whilst travelling.
- ☐ I get some pain whilst travelling but none of my usual forms of travel make it any worse.
- ☐ I get extra pain whilst travelling but it does not compel me to seek alternative form of travel.
- ☐ I get extra pain whilst travelling which compels me to seek alternative forms of travel.
- ☐ Pain restricts all forms of travel.
- ☐ Pain prevents all forms of travel except that done lying down.

Section 10 - Changing degree of pain

- ☐ My pain is rapidly getting better.
- ☐ My pain fluctuates but overall is definitely getting better.
- ☐ My pain seems to be getting better but improvement is slow at present.
- ☐ My pain is neither getting better nor worse.
- ☐ My pain is gradually worsening.
- ☐ My pain is rapidly worsening.

Pain Severity Scale:

Rate your usual level of pain today by checking one box on the following scale

0	1	2	3	4	5	6	7	8	9	10

No pain **Excruciating pain**

Adapted from Hsieh et al 1992

APPENDIX F

LETTER OF INFORMATION

Dear Patient

Thank-you for agreeing to participate in this study.

As I am sure you are aware, low back pain is a very common condition that causes discomfort and pain to sufferers. Here at Technikon Natal Chiropractic Clinic, we are constantly investigating more effective forms of treatment of this debilitating condition.

My study hopes to show that improving the control and strength of the abdominal muscles along with the beneficial effects of a Chiropractic manipulation may further improve the effectiveness of management of low back pain.

There will be two groups, group A and group B. Group A will receive spinal manipulation combined with strengthening of the abdominal muscles which will take place in the clinic. You will however be shown a particular exercise that you will be required to perform at home between treatment days and which you must keep a record of. Group B will only receive spinal manipulation. Treatment periods will be four treatments over two weeks with a follow up treatment a week later.

Please read the notes below and feel free to ask for more clarity:

- You are under no obligation to participate in this study and may withdraw at any stage
- If you agree to enter the study please ensure that you attend all consultations.
- Your confidentiality rights will be firmly upheld and no information will be disseminated to the media.
- Risks of the study:
  - Please note that SMT can cause some stiffness but this is a rare side effect.
- Benefits of the study:
  - You should receive relief from your low back pain from the manipulation(s) you are given.
  - If you are in the abdominal group you will benefit from stronger deep abdominal muscles which should help to protect your back from re-injury.
- Important things to remember
  - Please do not make any major lifestyle or exercise changes, especially exercises involving the low back or abdominal muscles.
  - Please inform me of any pain or anti-inflammatory medication that you may take during the study.
- You will be debriefed after the study so that I can share the outcomes with you.

- Please remember to do your exercises as specified to you. You will find a pictorial explanation attached to this letter detailing how to perform the exercise correctly and how you know when the exercise is not being performed correctly. Please also fill in the exercise diary attached to the letter and keep it in a safe place.

If you have any questions at any stage of this study, please do not hesitate to ask me.

Yours truly,

Nicholas Boden
Chiropractic Intern

APPENDIX G

INFORMED CONSENT

INFORMED CONSENT FORM

(To be completed by patient/subject.)

Date:_____

Title of research dissertation:

The effectiveness of spinal manipulation versus spinal manipulation in conjunction with core stabilization exercises in the treatment of mechanical low back pain.

Supervisor: Dr. M.J Atkinson — Contact #: 204 2205
Research Student: Mr. Nicholas Boden — Contact#: 204 2205

Please circle the appropriate answer:

1. Have you read the 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?
   a. At any time
   b. Without giving a reason for your withdrawal
   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 these questions please obtain the necessary information before signing.

Please print in block letters:

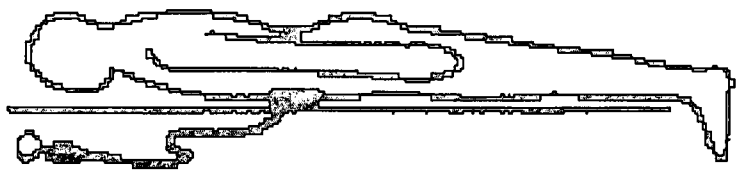
Patient/subject name: _____ Signature_____
Witness name:_____ Signature_____
Research student name: **Nicholas Boden** Signature_____

APPENDIX H

POSITIONS OF TESTING AND RETRAINING

The Prone Test for Transversus Abdominis and Internal Oblique.

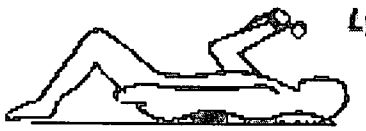
- Place three-chamber pressure cell under the abdomen and inflate to baseline of 70 mmHg.
- Draw abdominal wall up and in without moving the spine or pelvis.
- Pressure should decrease 6-10 mmHg.
- Hold 10 seconds, breathe normally.
- Perform 10 repetitions



Lying on abdomen

Training the Corset Action of Transverse Abdominis in Supine

- Place 3-chamber pressure cell under lumbar spine and inflate to a baseline of 40 mmHg (green band).
- Draw in the abdominal wall without moving the spine or pelvis.
- Pressure should remain at 40 mmHg; i.e., no movement of the spine.
- Hold for 10 seconds; breathe normally.
- Perform 10 repetitions.



Lying on back

Training the corset action of transversus abdominis with leg loading

- Place the three-chamber pressure cell behind the lumbar spine and inflate to baseline of 40 mmHg (green band).
- Draw in the abdominal wall without moving the spine or pelvis.
- Pressure should remain at 40 mmHg; i.e., no movement of the spine.
- Hold for 10 seconds; breathe normally.
- Repeat 10 times with each leg.

Lying (controlled leg movement)

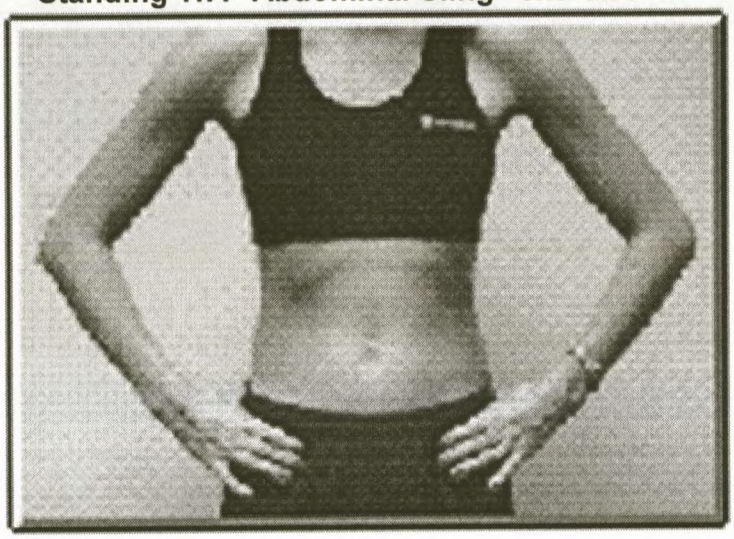
APPENIDX I

EXERCISE DIAGRAMS AND TABLE

Home Exercise Program

Maintain normal curves of the thoracic and lumbar spine--position back in neutral spine. Remain in this position without movement at the spine, rib cage, or pelvis. (See figures.) Perform co-contraction while focusing on the TrA "abdominal sling" procedure (see figures). Think of this deepest abdominal muscle as a cylinder or muscle sling that pulls the lower abdomen up and towards the spine (back). Continue to breathe normally throughout exercise. The goal for these exercises is to hold the abdominal sling contraction for 10 seconds times 10 sets. Please perform these exercises on non-treatment days and keep a record of this in the attached exercise diary.

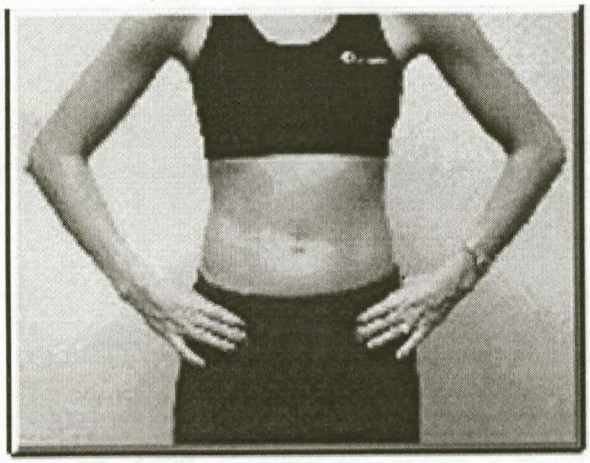
Standing TrA "Abdominal Sling" exercise



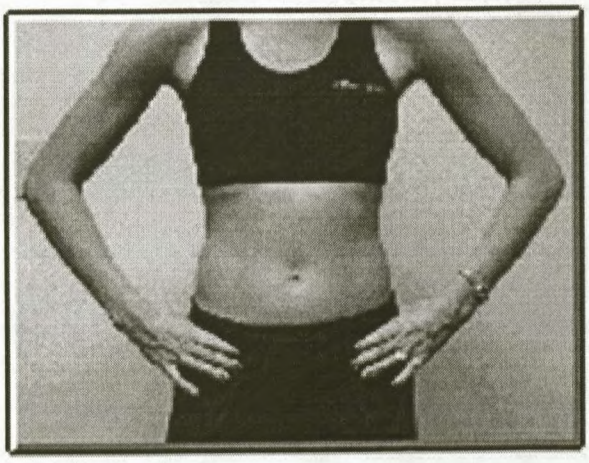
NORMAL

ABNORMAL
Substitiution patterns

1) Dominant obliques



2)Inhalation



(1) dominant obliques

Do not use this substitution strategy utilizing predominately the external oblique muscle. Note the depressed ribcage and the skin crease across the upper-middle abdomen.

(2) inhalation

Do not use this substitution strategy utilizing breath holding and rib elevation. Note the different shape of the abdomen and rib cage compared to the correct abdominal bracing.

Exercise Table

Please tick the time of exercise and the number of completed reps, remember 10 reps of 10 seconds each, 3 times per day.

Date	Morning	# of reps	Noon	# of reps	Evening	# of reps