A STUDY TO DETERMINE THE EFFICACY OF CHIROPRACTIC MANIPULATION COMBINED WITH KINESIO® TAPING IN THE TREATMENT OF CHRONIC LOWER BACK PAIN

A research dissertation presented to the Faculty of Health Sciences, University of Johannesburg, as partial fulfilment for the Master’s degree in Technology, Chiropractic by

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DECLARATION

I Mark Hugo Meyer, declare that this dissertation is my own, unaided work. It is being submitted as partial fulfilment for the Master’s Degree in Technology, in the program of Chiropractic, at the University of Johannesburg. It has not been submitted before for any degree or examination in any other University or Technikon.

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Herewith declare that my academic work is in line with the Plagiarism Policy of the University of Johannesburg. I further declare that the work presented in a study to determine the efficacy of Chiropractic manipulation combined with Kinesio® taping in the treatment of chronic lower back pain minor dissertation is authentic and original, and that there is no copyright infringement in the work. I declare that no unethical research practices were used or material gained through dishonesty. I understand that plagiarism is a serious offence.

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DEDICATIONS

I dedicate this dissertation to my dearest parents Hugo and Rosa Meyer. Without all your support, my many years of studying would not be possible. I truly hope I made you proud.

To all my friends, thank you for all the good times that we had together. You made the many years of studying more bearable.
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ABSTRACT

**Purpose:** Chronic lower back pain is a very common condition affecting 60-80% of the world's population at sometime in their lives. Manual therapy, including chiropractic manipulation, has been proven to be very successful in the treatment of chronic lower back pain and reduction in muscle tension. Although chiropractic treatment alone is effective in the treatment of chronic lower back pain, chiropractors often search for adjunctive modalities to enhance the positive outcomes of their treatment. Kinesio® tape application to the lumbar para-spinal muscles has been proven to be effective in increasing lumbar range of motion and in decreasing lower back pain. The purpose of this study was to determine whether the combination of Chiropractic manipulation and Kinesio® taping of the lumbar para-spinals is a more efficient, and possibly effective, treatment protocol in the treatment of chronic lower back pain.

**Method:** This study was a comparative study and consisted of three groups of ten participants. The participants were between the ages of eighteen and forty years of age, with a male to female ratio of 1:1. The potential participants were examined and accepted according to the inclusion and exclusion criteria. Group 1 received chiropractic manipulative therapy to the lumbar spine and sacroiliac joints. Group 2 only received the application of Kinesio® tape to the lumbar para-spinal muscles. Group 3 was the combination group, and received chiropractic manipulative therapy to the lumbar spine and sacroiliac joints together with the application of Kinesio® tape to the lumbar para-spinal muscles. Subjective measurements consisted of the Numerical Pain Rating Scale and the Oswestry Pain and Disability Index and objective measurements was range of motion of the lumbar spine.

**Procedure:** Treatment consisted of seven consultations over a three week period. Objective and subjective readings were taken at the beginning of the first, fourth and seventh consultations before treatment. Subjective readings were taken from the Numerical Pain Rating scale and the Oswestry Pain and Disability index.
Objective Readings were taken from measurements taken from the Digital Inclinometer device measuring lumbar range of motion. At the first to sixth consultation participants each received their groups’ specific treatment protocol, the seventh consultation consisted of data collection only.

Results: Clinically significant improvements were seen in all three groups over the course of the study with regards to lumbar range of motion, pain and disability. Statistically significant difference between the groups in the Numerical Pain Rating Scale, at the seventh consultation was seen and a statistically significant difference between groups one and three, at the seventh consultation in flexion range of motion was seen.

Conclusion: The results show that all three treatment groups were effective in decreasing lower back pain and disability and increasing lumbar spine range of motion. Group 3, receiving the combination treatment showed the greatest improvement clinically and statistically. Group 2, receiving only the application of Kinesio® tape show the smallest improvement, between the groups clinically and statistically.
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CHAPTER ONE – INTRODUCTION

1.1 Problem statement

Chronic lower back pain is a very common condition affecting 60-80% of the world’s population at sometime in their lives (Davidson, 2006). Chronic lower back pain is generally defined as pain that persists for more than three months. The pain may be progressive, or may occasionally flare up and then return to a lower level of pain. With chronic pain, the exact cause of the pain can sometimes be difficult to determine (Ullrich, 2007).

Manual therapy, including chiropractic manipulation, has been proven to be successful in the treatment of chronic lower back pain and reduction in muscle tension (Kirkaldy-Willis and Cassidy, 1992). Although chiropractic treatment alone is effective in the treatment of chronic lower back pain (Bronfort, 2004), chiropractors often search for adjunctive modalities to enhance the positive outcomes of their treatment.

Kinesio® tape application to the lumbar para-spinal muscles has been proven to be effective in increasing lumbar range of motion and in decreasing lower back pain (Yoshida and Kahanov, 2007), facilitating or inhibiting muscle function and supporting joint structure (Jacakzewsk and Long, 2006). However, the efficacy of the combination of these two treatments has not been shown.

1.2 Aim of the study

The aim of this study is to determine whether the combination of chiropractic manipulation and Kinesio® taping of the lumbar para-spinals is a more efficient, and possibly effective, treatment protocol in the treatment of chronic lower back pain.
1.3 Benefits of the study

It is expected that chiropractic manipulative therapy as well as Kinesio® taping alone will be effective in the reduction of lower back pain. Chiropractic manipulative therapy in conjunction with Kinesio® tape application could prove to be more efficient and possibly effective in reducing pain and muscle spasm in the study group and in increasing lumbar range of motion. The results of this study could demonstrate that Kinesio® tape is a good adjunctive and supportive therapy for chiropractic manipulative therapy in the treatment of chronic lower back pain, and therefore help the chiropractic community to treat chronic lower back pain more efficiently.
CHAPTER 2 - LITERATURE REVIEW

2.1 Introduction

Chronic lower back pain is a common condition affecting 60-80% of the world’s population at sometime in their lives (Davidson, 2006). Lower back pain may or may not be preceded by a recallable injury but could also be insidious (Davidson, 2006).

Chiropractic manipulative therapy, is defined by Gatterman and Hansen (1994) as: “Any Chiropractic therapeutic procedure that utilises controlled force, leverage, direction, amplitude, and velocity, which is directed at specific joints or anatomical regions.”

Chiropractic manipulative therapy is used in the treatment of biomechanical dysfunction of the spine and the symptoms thereof (Licht, Christensen, Svendsen et al., 1999). Symptoms of biomechanical dysfunction include local tissue hypersensitivity, changes in joint motion, local muscle tenderness and localised pain (Peterson and Bergmann, 2002).

Kinesio tape was invented by Dr. Kenzo Kase in 1973. The tape was designed to mimic the human skin qualities (Kase, Wallis and Kase, 2003). The therapeutic benefits of Kinesio tape include: Providing positional stimulation through the skin; supply of sensory stimulation to assist or limit motion as well as helping with removal of oedema by directing exudates towards lymphatic ducts (Kase et al., 2003).

Relevant lumbar spine anatomy and biomechanics will be discussed in detail in this review chapter. The review will then discuss the aetiology of chronic lower back pain and the effects of Kinesio tape and Chiropractic Manipulative Therapy.
2.2 Functional anatomy of the lumbar spine and pelvis

2.2.1 Lumbar vertebrae

The bony skeleton of the lumbar spine is made up of five lumbar vertebrae, located between the thoracic spine and the sacrum. Lumbar vertebrae are characteristically larger than the other vertebrae. This is to support the weight of the trunk (Moore and Dalley, 2006).

A Lumbar vertebra is made up of a body, two pedicles, two articulating facets, two transverse processes, two laminae and a single spinous process.

![Superior view of a lumbar vertebra](image)

**Fig 2.1: Superior view of a lumbar vertebra (Moore and Dalley, 2006).**

The lumbar vertebral body is large and kidney shaped and is wider laterally and deep anteroposterioly. The body is broader than it is high. It has a deeply hollowed shape, with the posterior portion nearly flat (Kapanje, 1974; Moore and Dalley, 2006).

The pedicles are two bony segments that join the vertebral body to the vertebral arch. The pedicles attach posterior laterally to the vertebral body. This constitutes the superior and inferior border of the intervertebral foramen and posteriorly it
provides an attachment for the articular processes (Kapanje, 1974; Moore and Dalley, 2006).

The transverse processes are attached at the level of the articulating facets. They are long and slender and run an oblique course posteriorly and laterally. At the base of each transverse process is an accessory process, this serves as a site for muscle attachment (Kapanje, 1974; Moore and Dalley, 2006).

The superior articulating process lies on the superior border of the lamina as it joins the pedicle. The articulating facet is directed posterolaterally. On the posterior aspect of the process is a mammillary process which serves as an attachment site for muscles (Kapanje, 1974; Moore and Dalley, 2006).

The inferior articulating process arises from the inferior border of the vertebral arch near the junction of the lamina with the spinous process. The inferior articular facets are directed anteriorly and slightly medially (Kapanje, 1974; Moore and Dalley, 2006).

The two laminae are set highly. They run posteriorly and medially and meet in the midline to form the spinous process (Kapanje, 1974).

The spinous process is formed by the two joining laminae. It is long, large and triangular in shape and slopes posteriorly and slightly inferiorly. The end of the spinous process is bulbous and wide, providing a bigger attachment site for muscles (Kapanje, 1974; Moore and Dalley, 2006).

The fifth lumbar vertebra is slightly modified to articulate with the sacrum. The body is higher anteriorly than posteriorly, causing it to be wedge shaped and the inferior articulating processes are more widely separated to accommodate articulation with the sacrum (Kapanje, 1974; Moore and Dalley, 2006).
2.2.2 The bony pelvis

The bony pelvis consists of the sacrum posteriorly, the hip bone laterally and the coccyx posteriorly.

Fig 2.2: Anterosuperior view of the bony pelvis (Martini, 2004).

2.2.2.1 The sacrum

The sacrum consists of five fused sacral vertebrae. The sacrum is triangular in shape, with the base superiorly and the apex inferiorly. It is located inferior to the lumbar spine and between the two hip bones. The sacrum forms the roof and posterolateral wall of the pelvic cavity (Martini, 2004).

The anterior surface of the sacrum is smooth and concave. Four transverse lines indicate where fusion of the sacral vertebrae occurred in the adult pelvis. The dorsal or posterior surface of the sacrum is rough and convex. It has five prominent longitudinal ridges, each representing remnants of the sacral vertebrae. The medial sacral crest represents the fused spinous processes. The intermediate sacral crest represents the fused articular processes. The lateral sacral crest represents the tips of the fused transverse processes. The lateral surface of the sacrum has an ear shaped surface at the superior half. This auricular surface is the
articulation point with the ilium, to form the sacroiliac joint (Moore and Dalley, 2006).

The base of the sacrum is the broad superior surface of the sacrum. A prominent bulge at the anterior tip of the base is the sacral promontory, and is the remnant of the anterior surface of the first sacral vertebra's body. At the posterior aspect of the base are two articulating facets for articulation with the inferior articulating facets of the fifth lumbar vertebra. The apex of the sacrum has articulating facets for articulation with the coccyx (Martini, 2004).

The sacrum has a central canal, the sacral canal, to house the cauda equina, and four sacral foramina on each side, where the sacral nerves exit the sacral canal (Martini, 2004).

2.2.2.2 The hip bone

The hip bone is formed by the fusion of three bones, the ilium, the pubis and the ischium. The two hip bones merge anteriorly at the pubic symphysis. The ilium composes the main and largest part of the hip bone. The ilium has a thick medial portion for weight bearing, and a thin lateral portion, the ala, for bulky muscle attachments. The edge of the ilium is thickened, and called the iliac crest (Martini, 2004).

Anteriorly the ilium has stout anterior superior and anterior inferior iliac spines for attachment of ligaments and muscles. Running posteriorly from the anterior superior iliac spine to the posterior superior iliac spine is the thick iliac crest, this crest also serves as a site for muscle attachment. The lateral surface of the ala of the ilium has three curved lines, the posterior, anterior and inferior gluteal lines. These demarcate the proximal attachments of the large gluteal muscles. Medially each ala has a depression, the iliac fossa, for the attachment of the iliac muscles. On the posterior medial aspect of the ilium is an auricular surface. This surface
corresponds to the auricular surface on the sacrum, to form the Sacroiliac joint (Moore and Dalley, 2006).

2.2.2.3 The coccyx

The coccyx is a small triangular bone, consisting of three to five fused coccygeal segments. The coccyx serves as an attachment point for muscles and ligaments (Martini, 2004).

2.2.3 Joints of the vertebral arches

The zygapophyseal joints

The zygapophyseal joints are plane synovial joints between the superior and inferior articular processes of adjacent vertebrae. Each joint is surrounded by a thin, loose articular capsule. The capsule is attached to the margins of the articular processes of adjacent vertebrae. Accessory ligaments unite the laminae and transverse processes and help to stabilise the joints (Moore and Dalley, 2006).

The zygapophyseal joints permit gliding movement between the vertebrae. In the lumbar region, the zygapophyseal joints bear some weight, sharing this function with the intervertebral discs. The zygapophyseal joints are innervated by articular branches that arise from medial branches of the dorsal primary rami of the spinal nerves. Each articular branch supplies two adjacent joints; thus each joint is supplied by two nerves (Moore and Dalley, 2006).

2.2.4 Intervertebral disc

The joints of the vertebral bodies are secondary cartilaginous joints. They are very strong and fulfil a weight bearing function. The intervertebral disc connects the two adjacent vertebral bodies. These intervertebral discs fulfil many different functions, including providing a strong attachment between the vertebral bodies,
forming the inferior half of the anterior border of the intervertebral foramen, shock absorption and producing the secondary curves of the spine by altering their shape (Moore and Dalley, 2006).

![Intervertebral Disc Diagram](image)

**Figure 2.3: Illustration of a lumbar intervertebral disc (Moore and Dalley, 2006).**

The intervertebral disc consist of an annulus fibrosis, forming the outer margin of the disc. The annulus fibrosis consists of concentric lamellae of fibrocartilage. The other portion of the intervertebral disc is the nucleus pulposus. This is the central portion of the disc. The nucleus pulposus is semi fluid in nature, and consists, at birth, of 88% water. As the body ages this percentage decreases. Due to the discs’ semi fluid nature, it allows for some flexibility in the spine. The intervertebral discs are the thickest in the lumbar spine, affording their good shock absorption and weight bearing properties (Moore and Dalley, 2006).

### 2.2.5 The sacroiliac joint

Gatterman (2002) states that the paired sacroiliac joints lie within the pelvic ring at an oblique angle to the sagittal plane. Lawrence (1991) describes the nature of the cartilaginous surface of the sacroiliac joint as a cause of confusion as the surfaces are C-shaped and irregular, with marked depressions on the sacral and iliac side.
The sacral surface of the sacroiliac joint is lined by hyaline cartilage and appears smooth and glistening, while the iliac surface is covered by fibrous cartilage appearing dull and dark. The coronal section of the sacroiliac joint is divided into an anterior, middle and posterior segment. The anterior articular surfaces are almost parallel to each other and show slight sinuosities. The centre of the middle segment is concave into which the middle portion of the ilial surface fits. Therefore, an interlocking mechanism is formed. The posterior segment articular surfaces are slightly concave and the ventral width of the sacrum is greater than the dorsal surface (Lawrence, 1991).

Moore (2006), describes the sacroiliac articulations as strong synovial joints between the sacrum and ilium articular surfaces. The articular surfaces have irregular depressions and elevations, resulting in a partial interlocking of the bones.

2.2.6 Muscles of the lumbar spine

2.2.6.1 Intermediate muscle group

The lumbar erector spinae muscles consist of two important muscles, the more medial longissimus and the laterally placed iliocostalis thoracis. They arise from the anterior aspect of a flat broad aponeurotic tendon, the erector spinae aponeurosis and the iliac crest. Both these muscles extend across the thoracic spine with only the iliocostalis muscle reaching the sacrum across the lumbar spine (Simons and Travell, 1999).

The longissimus muscle, lying medially, extends superiorly and attaches to the transverse processes of all the thoracic vertebrae and the adjacent first to nine ribs. Inferiorly, it attaches to the lumbar transverse processes and the lumbocostal aponeurosis (Simons and Travell, 1999).
Both muscles are innervated by the medial branch of the posterior rami of the lumbar spinal nerves (Moore and Dalley, 2006).

2.2.6.2 The deep extensors

The multifidus muscle

The multifidus muscle, being one of the more deeply placed intersegmental muscles, is inherently important for lumbar stability. In the lumbopelvic region the multifidus arises from the posterior surface of the sacrum, sacrotuberous ligament, erector spinae aponeurosis, medial surface of the posterior superior iliac spine and the posterior sacroiliac ligament. The muscle then travels superiomedially and attaches to the spinous processes of the lumbar and sacral vertebrae (Simons and Travell, 1999).

The multifidus muscle is innervated by the medial branches of the posterior rami of the lumbar and sacral spinal nerves (Moore and Dalley, 2006).

The multifidus muscle spans several spinal segments and plays a major role as the primary mover and stabilizer of the lumbar spine. The attachment of the muscle to the spinous processes results in an effective lever arm for lumbar extension. Contraction of the muscle helps to control the rate and magnitude of the forces of flexion and anterior shear during flexion (DeRosa and Porterfield, 1998). The multifidus muscle is active throughout the entire trunk flexion range, especially when rotary forces are induced (Cox, 1999). The extensive direct attachment of the multifidus muscle to the lower spine, makes it a prime candidate for reflex muscle guarding due to low back injury (Johnson, 2002).

According to Johnson (2002), morphological changes, such as wasting or atrophy of the multifidus muscle, have been demonstrated on the symptomatic side shortly after the first episode of low back pain. These changes often persist long after the remission of symptoms from the first episode of low back pain. It is evident from
the literature that optimising the strength and girth of the multifidus and erector spinae muscle is essential for a successful spinal rehabilitation program (DeRosa and Porterfield, 1998).

The rotatores muscle

The rotatores muscle originates from the transverse processes of the vertebrae. The fibers pass superomedially to attach to the junction of the lamina and the transverse process or the spinous process of the vertebra immediately (brevis), or two segments superior to the vertebra of origin (longus) (Moore and Dalley, 2006).

The rotatores is innervated by the posterior rami of the spinal nerves (Moore and Dalley, 2006)

The function of the rotatores is to stabilise the vertebrae and assist with local extension and rotatory movements of the vertebral column. The rotatores muscle also plays an important role in proprioception (Moore and Dalley, 2006).

The interspinales muscle

The interspinales muscle orinates from the superior surface of spinous processes of the lumbar vertebrae. The fibers run superiorly to insert into the inferior surface of the spinous processes above (Moore and Dalley, 2006).

The interspinales muscle is innervated by segmental posterior rami of the respective spinal nerves (Moore and Dalley, 2006).

The interspinales muscle aids in extension and some rotation of the vertebral column (Moore and Dalley, 2006).
2.2.7 The integumentary system

The integumentary system plays an integral part in the functioning of the human body. The integumentary system consists of two major components, the cutaneous membrane or skin and the accessory structures (Martini, 2004).

The skin again consists of two components, the epidermis which forms the outermost layer and the dermis, just deep to the epidermis. The accessory structures include the nails, exocrine glands and hair (Martini, 2004).

The integumentary system does not function in isolation. It is supported by the large network of blood vessels and nerves that run within the subcutaneous layer of the skin, to perform its function. According to Martini (2004), the general functions of the skin and subcutaneous layer include:

- Protection of underlying tissues and organs.
- Excretion of waste products.
- Maintenance of normal body temperature.
- Synthesis of Vitamin D.
- Storage of nutrients.
- Detection of touch, pressure, temperature and pain.

Due to the relevance to the study, the receptors of the skin will be discussed in detail.

2.2.7.1 Innervation of the skin

The segmental nerves innervating the skin originate from the dorsal rami of L1 to L5. The dorsal ramus splits into a medial and lateral branch. The medial branch supplies deep muscles and the lateral branch becomes cutaneous, to supply the segment over its specific vertebral level (Moore and Dalley, 2006). The skin is filled with sensory receptors. These receptors are highly sensitive and can detect from the lightest stimulation, like the weight of a fly, to the weight of a backpack.
on the back. The stimulation of various stimuli is due to various receptors in the skin that relay different stimuli. Nociception or pain perception is mostly relayed by the free nerve endings in the skin. Thermo or temperature receptors, are also free nerve endings found in the skin and skeletal muscles and transmit change in temperature to the nervous system (Martini, 2004).

Mechanoreceptors are sensitive to stimuli that distort the cell membranes. These membranes contain mechanically regulated ion channels, that respond to stretching, twisting or compression of the cell membrane. There are three classes of mechanoreceptors:

- Tactile receptors; provide sensations of touch, pressure and vibration.
- Baroreceptors; detect pressure changes in the walls of blood vessels.
- Proprioceptors; detect positional changes in joints (Martini, 2004).

Tactile receptors are further divided into fine touch and pressure receptors. These receptors provide detailed information of the source of stimulation, including the exact location, shape, size, texture and movement. These receptors have a very high sensitivity, but small receptive field. Crude touch and pressure receptors provide poor localisation of stimuli, due to the large receptive field of the receptor (Martini, 2004).

Tactile receptors range in complexity, from free nerve ending, to specialised sensory complexes with supporting structures. Martini (2004), describes six types of tactile receptors that are found in the skin:

1. Free nerve endings are sensitive to touch and pressure and are situated between the epidermal cells.
2. Nerve endings of the root hair plexus monitor distortions and movements across the body surface.
3. Tactile discs or Merkel discs, are fine touch and pressure receptors and are found in contact with epithelial cells.
4. Tactile corpuscles, or Meissner’s corpuscles, perceive sensation of fine touch, pressure and low-frequency vibration, they adapt very quickly to stimulation.

5. Lamellated or Pacinian corpuscles are sensitive to deep pressure and high-frequency or pulsing vibration.

6. Ruffini corpuscles are sensitive to deep pressure and are located in the deep dermis. These receptors are slow and have little or no adaptation.

![Skin with its’ tactile receptors](image)

**Figure 2.4: Skin with its’ tactile receptors (Martini, 2004).**

2.3 Biomechanics of the lumbar spine and sacroiliac joint

The lumbar spine is a very complex structure that sustains large loads whilst providing considerable mobility to the trunk (Giles and Singer, 1997). Episodes of back pain are thus thought to have some component of mechanical overload or fatigue in their origin. It is therefore evident that the study of spinal biomechanics has great potential for illuminating the function of the spine and what loads might be acceptable before mechanical damage results (Giles and Singer, 1997).

According to Schafer and Faye (1990), the body’s gravity line extends from the middle of the anterior surface of T12 and L1, down toward to the anterior aspect of the sacral base. In the lumbar region, the distribution of weight is governed primarily by the inclination of each vertebral body (Schafer and Faye, 1990).
During flexion of the lumbar spine, the weight line moves forward as the body of the vertebra above tilts and slides anteriorly, while the inferior facets move superiorly and away from the lower vertebra. A compressive force is thus generated at the anterior aspect of the intervertebral discs and vertebral bodies. As a result, a wedge-shaped disc forms as the posterior aspect of the disc becomes stretched (Schafer and Faye, 1990) (Figure 2.5).

![Figure 2.5: Biomechanics of the lumbar vertebrae – flexion (left) and extension (right) (Bergmann & Peterson 2002).](image)

As the motion of flexion continues, the joint capsule and the posterior ligamentous system specifically the ligamentum flavum, interspinous and the supraspinous ligament check the anterior shear stress of the inferior articular processes of the upper vertebra. In addition, the posterior longitudinal ligament also becomes stretched thereby limiting flexion (Kapandji, 1974).

Lumbar flexion allows the connective tissues, located posterior to the axis of lumbar motion, to generate extensor movement by subsequent contraction of the deep erector spinae muscles (DeRosa and Porterfield, 1998).

During extension the weight line is shifted posteriorly causing the bodies of the upper vertebra to tilt and shift posteriorly (Figure 2.5), the disc becomes
compressed at its posterior aspect, whilst the anterior aspect is stretched (Kapandji, 1974).

The sacroiliac joint

The space between the articular processes of the superior and inferior vertebrae is maximally reduced, as extension continues and the joint surfaces become tightly locked. The approximation of the spinous processes, as well as the structures of the vertebral arch and the tautness of the anterior longitudinal ligament, fundamentally controls the extent of lumbar extension (Schafer and Faye, 1990).

In the most simplistic analysis, the sacroiliac joint lies at the intersection of the trunk and the ground forces (DeRosa and Porterfield, 1998). A keystone effect is created, which effectively distributes axial compressive forces through the sacroiliac joints. Forces from the lower extremities divide, heading upward toward the spine, while downward forces of gravity on the spine produced by body weight split to both sides (Bergmann and Peterson, 2002).

2.4 Lower back pain

2.4.1 Causes of lower back pain

Most chronic low back pain (LBP) conditions do not arise from a structural disorder apparent on imaging and standard medical examination. An integral part of most chronic back pain is functional pathology, which include weakness and or loss of ROM in the muscles, joints and other structures of the spine and pelvis (Chapman-Smith, 1990).

Kirkaldy-Willis (1992), described a pattern of spinal degeneration based on the principle that spinal degeneration is often initiated by local mechanical derangement in which no structural alteration exists. He postulates that the process often begins with the development of individual motion segment
dysfunction, secondary to alteration in segmental muscle tone and function. As a consequence, joint hypomobility develops (Kirkaldy-Willis, 1992).

Potential anatomical sources of LBP include the nociceptors, muscle, facet joints, sacroiliac joints, spinal dura, intervertebral disc, ligaments, nerve roots as well as referred pain (DeRosa and Porterfield, 1998).

A large percentage of dysfunction is self-limiting or so minor that the individual adapts and compensates to the change with limited structural or functional alteration. If dysfunction persists, however, the process of local and distant joint degeneration may follow. A point of emphasis and concern for the chiropractic profession is, therefore, to detect persistent mechanical dysfunction at an early stage of alteration and to strive to eliminate it before it develops into irreversible or permanent disorders (Kirkaldy-Willis, 1992).

2.4.2 The Vertebral Subluxation Complex

The Vertebral Subluxation Complex (VSC), according to Lantz (1995), is defined as being a theoretical representation of dysfunction of a motion segment also known as a subluxation. It integrates the complex interaction of pathological changes in nerve, muscle, ligamentous, vascular and connective tissues. The current model of the VSC acknowledges that a dysfunctional spine incorporates all tissues since they are all closely integrated. Due to its complexity it is therefore impossible to differentiate the origin of involvement of one tissue from another.

According to Schafer and Faye (1990), a subluxation is caused by any physical, functional, or psychic mechanism, resulting in a loss of segmental mobility within one or more of its normal physiological ranges of motion. For another joint to remain in this abnormal state of “subluxation,” something must be holding it there to restrict its mobility; otherwise it would spontaneously reduce and produce minimal clinical concern. This mechanism of “holding” or “restriction of mobility” is referred to as a “fixation” (Shafer and Faye, 1990). Gatterman (2002),
defines a fixation to be a reversible mechanical joint derangement and a primary indicator for manipulation.

When mechanical derangement persists, the stress caused by repetitive abnormal loading eventually leads to fatigue and attenuation of the articular soft tissues. As a result, capsular laxity and internal disruption of the intervertebral disc develops leading to local joint instability. Consequently, if the derangement is of sufficient magnitude, osseous structural alteration results thus making degenerative joint disease radiographically visible (Kirkaldy-Willis, 1992).

Trauma and repetitive stress are two important factors contributing to degenerative changes and dysfunctional states of the neuromusculoskeletal system (Lantz, 1995).

The theoretically pathological components of the VSC, as they relate to the chiropractic concept, are interdependent and closely connected with each other.

According to Chapman-Smith (1997), the components at tissue level constitute the following:

- **Kinesiological component**: having pre-eminent significance in this model, since restoring movement, in a restricted joint, is the primary goal of chiropractic.
- **Neurological tissue**: controls and directs the tissues involved in movement. The nervous system has been viewed as the mediator of health and vitality to all the individual organs and tissues.
- **Myologic tissue**: since the muscles produce and affect joint movement.
- **Connective tissue**: these guide, restrain and stabilize movement.
- **Vascular tissue**: plays a role in providing essential nutrients and cleansing of the tissues. It is also a mediator of inflammatory reactions.
- **Lymphatic tissue**, which provides a link to the immune system.
These tissue components are responsible for permitting and sustaining adequate segmental motion. Any disturbance of any of these individual tissue components of the VSC is perceived to have inevitable effects on all the other components (Lantz, 1995).

2.4.3 Myofascial trigger points

Definition: a myofacial trigger point (MFTP) or trigger point is a discrete, focal, hyperirritable point in a muscle, located in a tight band of skeletal muscle or facia. A MFTP is painful on compression and can produce referred pain, referred tenderness, motor dysfunction and autonomic changes (Travell and Simons, 1999).

MFTP can be classified into latent and active trigger points. Latent trigger points do not cause spontaneous pain, may restrict movement and may cause muscle weakness. A patient presents with muscle restrictions or weakness and may become aware of the trigger point only when pressure is applied. Active trigger points are in turn painful at rest, tender upon palpation, with a referred pattern similar to the patient’s pain complaint. The pain is often described as radiating (Travell and Simons, 1999).

The sympathetic spindle theory on MFTPs states the short muscle fibers, about 1cm in length, called intrafusal muscle fibers are overstimulated. Only the intrafusal muscle fibers inside the spindle are activated by adrenaline via the sympathetic nervous system. When the spindles are over-activated by adrenaline they become painful. This theory may support the idea that increased stress and decrease of moderate physical activity in the modern lives have increased the occurrence of myofascial pain and trigger points (Travell and Simmons, 1999).

Patients with MFTP often present with regional persistent pain, that usually results in a restricted range of motion. The pain is reproducible and does not follow a dermatomal or nerve root distribution (Travell and Simmons, 1999).
Figure 2.6 illustrates the location of the MFTPs of the lumbar para-spinal muscles. Patients with para-spinal trigger points often complain of lower back pain that radiates outwards from the trigger point location. The trigger points may also refer pain to the buttock or sacroiliac region (Travell and Simmons, 1999).

![Figure 2.6: Illustration of lumbar paraspinal MFTPs and their referral pattern (Travell and Simmons, 1999).](image)

**2.4.4 Pain perception**

Pain is perceived in a specific manner, Figure 2.6 illustrates the pathway of the nervous system in which a stimulus is relayed to the pain centres in the brain.
A painful stimulus is perceived anywhere in the body. The stimulus travels along the slow A-Beta and C fibres, via the dorsal root ganglion. These stimuli enter the spinal cord through the dorsal horn and travel up the spinal cord via the spinothalamic tract. Pass through the pons and medulla in the brainstem, towards the somato sensory cortex where the pain is perceived (Espisito and Philipson, 2005).

2.5 Chiropractic manipulative therapy

2.5.1 The chiropractic hypothesis

According to Bergmann and Peterson (2002), chiropractic is considered to be a health care science concerned with optimising health through the maintenance of the body’s homeostatic mechanism. The human body is perceived as being charged at birth with an innate ability (innate intelligence) to respond to the environment.

Paramount to the principle of chiropractic is the significance of the nervous system in the human being and its influences to all the other systems in the body. The nervous system, in addition, also has a role to play in the body’s ability to
fight disease through its immune response (Bergmann and Peterson, 2002). Chiropractors rely on spinal manipulation or adjustments as the primary therapeutic tool to enhance the body’s ability to self-regulate through its effects on the nervous system and hence, all other systems.

The mechanism of chiropractic therapy involves restoring normal functioning to a joint, thus ultimately promoting homeostasis of the body. Haldeman (1993), states that manipulative therapy causes a change in the musculoskeletal system, which affects the nervous system, which in turn prevents organ dysfunction, tissue pathology or organ symptom complex.

2.5.2 Vertebral subluxation

According to Gatterman and Hansen (2002), a subluxation is defined as a motion segment in which alignment, movement integrity, or physiology is altered, although contact between the joint surfaces remains intact. This causes an alteration in the biomechanical or neurophysiologic reflections of these articular structures or body’s’ systems, that may be directly or indirectly affected by them. The concept of subluxation has always combined two elements, namely altered joint range of motion and related physiological changes, primarily through the nervous system (Chapman-Smith, 1997). In addition, a subluxation results in biomechanical compensations and fixations in the spinal column and pelvis, referred pain throughout the soma and viscera that mimics other conditions, as well as, effects general health due to the restricted capacity of the nervous system to perform its full regulatory functions.

At the level of the subluxation, the related muscles are in a permanent state of hyperirritability (Bergmann and Peterson, 2002). Further, the production of pain is facilitated at the levels of the subluxation; therefore the pain threshold is lowered. Thus skilled adjustments or manipulation to correct the subluxation would accordingly not only relieve pain, but also remove interference with the nervous
system, thereby making the body more resistant to stress disease (Shafer and Faye, 1990).

2.5.3 Vertebral adjustment

Gattermann and Hansen (2002), define the adjustment as a specific form of joint manipulation using either long or short-leverage techniques with specific anatomical contacts. It is characterized by a low-amplitude dynamic thrust of controlled velocity, amplitude, and direction used to restore normal nervous function and cure disease.

According to Shafer and Faye (1990), an adjustment is applied at the point of resistance to restore adequate mobility to the area, to initiate the recovery process.

2.5.4 Reflex theories of the adjustment

The reflex theory is concerned with the subluxation, being an aberrant biomechanical relation within the spine, which stimulates the receptors within the spinal, and para-spinal tissues such as muscle, ligaments and facets. The stimulation of these spinal structures generates impulses, which activate the neural reflex centres within the spinal cord or higher centres, causing somatovisceral responses in sympathetic and para-sympathetic nerves, resulting in muscle spasm (Haldeman, 1993).

Stimulus-produced analgesia is bolstered by past research that suggests that chiropractic adjustments induce sufficient force to simultaneously activate both superficial and deep somatic mechanoreceptors, proprioceptors and nociceptors. This stimulation produces a strong afferent barrage of sensory impulses capable of inhibiting the central transmission of pain (Bergmann and Peterson, 2002).

Gillette (2002), suggests that chiropractic adjustments may induce a short-lived phasic response triggered by the stimulation of both deep and superficial
mechanoreceptors. A longer-lived tonic response may also be initiated, which is triggered by the noxious stimulation of nociceptive receptors.

Sensory receptors are present in muscle, ligaments, facet joints, skin, meninges and the periphery of the intervertebral disc. These receptors are sensitive to mechanical, inflammatory and temperature changes (Bergmann and Peterson, 2002).

Spinal manipulative therapy has been shown to produce a consistent reflex from a multi-receptor origin, resulting in clinical observed benefits, which include the reduction of pain and muscle hypertonicity (Halderman, 1993). A specialized receptor referred to as the golgi organ, is present, within gross muscle structures and inhibits muscle contraction when excessively tensed (Martini, 2004).

2.6 Taping

2.6.1 Regular sports taping

Today, there are many therapy choices to address problems involving patients and athletes. Many of the more popular choices are devices that give direct stabilization and support to the affected area. These devices do a good job of temporarily decreasing symptoms and pain (Kase et al., 2003).

White athletic taping

White athletic taping technique is the most commonly used. White athletic tape is extremely rigid and requires a pre wrap prior to application. It is used for acute and preventative injuries. It is normally left on for a short period of time, typically applied immediately prior to an activity and taken off immediately thereafter. This technique may cause skin irritation due to moisture entrapment, high latex content, skin compression, joint compression and muscle compression (Kase et al., 2003).
McConnell taping technique

McConnell Taping is a bracing or strapping technique using a super-rigid, cotton mesh adhesive tape (EnduraTape®, LuekoTape®). This tape is most commonly used for patellofemoral syndrome, shoulder subluxation, lumbar, foot, and hip impingement. It should not be left on for more than 18 hours to prevent adverse skin reactions. The tape is meant to affect the biomechanics of a patient. Primarily McConnell Taping is used for neuromuscular re-education of the affected area. McConnell Taping is widely accepted by the medical community (Kase et al., 2003).

The non-stretch rigid tape is used to limit unwanted joint movement or to protect and support a joint structure (Grelsamer and McConnell, 1998). However, data suggest that regular athletic tape does not restrict joint movement. Bragg et al. (2002), found that athletic tape loses its ability to restrict joint motion after, 15–20 minutes of exercise. Therefore, the effects of taping may be due to the cutaneous stimulation of the sensorimotor and proprioceptive systems (Simoneau, Degner, Kramper and Kittleson, 1997).

2.6.2 Kinesio® taping

Kinesio® taping is a technique based on the body's own natural healing process. Kinesio® taping can activate neurological and circulatory systems and promote proper venous and lymphatic flow. It effectively reduces inflammation and provides stability to injured joints (Kase et al., 2003).

The Kinesio® taping method is applied over muscles to reduce pain and inflammation, relax overused muscles, and to support muscles and joints without restricting normal range of motion. Kinesio® tape may be used for many conditions including: ankle sprains and plantar fasciitis, carpal tunnel syndrome, lower back and neck pain, knee conditions, shoulder injuries, whiplash, tennis
elbow, patella tracking problems, pre and post surgical oedema, and ankle sprains (Kase et al., 2003).

Kinesio® tape is designed to mimic the qualities of the skin. The thickness of the tape approximates the thickness of the skin and its stretch is designed to approximate the elastic qualities of the skin. The tape may stay on the skin and remain effective for 3-5 days. The elastic strands are wrapped by cotton fibres which allow for evaporation and quick drying so it can be worn in the shower or while swimming (Kase et al., 2003).

According to Kenzo Kase, the creator of Kinesio® tape, these proposed mechanisms may include:

1. Correcting muscle function by strengthening weakened muscles.
2. Improving circulation of blood and lymph by eliminating tissue fluid or bleeding beneath the skin by lifting the muscle.
3. Decreasing pain through neurological suppression, and
4. Repositioning chiropractic subluxed joints by relieving abnormal muscle tension, helping to return the function of fascia and muscle (Kase et al., 1996).

A fifth mechanism has been suggested by Murray (2001), which describes Kinesio® tape causing an increase in proprioception through increased stimulation to cutaneous mechanoreceptors. This proposed fifth mechanism has been examined using our current research method.

Taping provides immediate sensorimotor feedback regarding functional abilities. With the Kinesio® Tape applied, patients often report symptom relief, improved comfort level, or stability of the involved joint. The elasticity of Kinesio® Tape conforms to the body, allowing for movement. The tape is latex-free, very thin, and stretches in the longitudinal plane. Kinesio® Tape has been suggested to provide proprioceptive input in the acute phase of the injury process for lateral ankle sprain (Murray and Husk, 2001).
When the application procedure is followed correctly, the taped area can be used to facilitate a weakened muscle or to relax an overused muscle. The method for applying the tape varies depending on the specific goals: improve active range of motion, relieve pain, adjust misalignment, or improve lymphatic circulation (Kase et al., 2003).

Theoretically Kinesio® Tex is applied based on treatment goals. The variables in tape application include the amount of pre-stretch applied to the tape, position of the area to be taped, treatment goals (pain reduction, subcutaneous blood flow and improved muscle function). Pain reduction occurs due to the mechanical stimulation that the tape has on the skin. Kinesio® tape stimulates the mechano receptors in the skin (Kase et al., 2003), Figure 2.7 illustrates the pathways of pain reduction via motor input by means of the Pain Gate Theory (Esposito and Philipson, 2005).

**Figure 2.8: The Sensory stimulation and its hypothesised effects upon the dorsal horn, modified from Esposito and Philipson, (2005)**
Melzack and Wall introduced their “gate control” theory of pain in the 1965 *Science* article “Pain Mechanisms: A New Theory”. The authors proposed that thin nociceptive and large diameter innocuous nerve fibers carry information from the site of injury to two destinations in the dorsal horn of the spinal cord: the “inhibitory” cells and the “transmission” cells. Signals from both thin and large diameter fibers excite the transmission cells, and when the output of the transmission cells exceeds a critical level, pain begins. The job of the inhibitory cells is to inhibit activation of the transmission cells. The transmission cells are the gate on pain, and inhibitory cells can shut the gate. When thin (pain) and large (touch, mild pressure and vibration) fibers, activated by a noxious event, excite a spinal cord transmission cell, they also act on its inhibitory cells. The thin fibers impede the inhibitory cells (tending to leave the gate open) while the large diameter fibers excite the inhibitory cells (tending to close the gate). So, the more large fiber activity relative to thin fiber activity coming from the inhibitory cell’s receptive field, the less pain is felt. The authors had conceived a neural “circuit diagram” to explain why we rub a “smack”. Small nerve fibers (pain receptors) and large nerve fibers (“normal” receptors) synapse on projection cells, which go up the spinothalamic tract to the brain, and inhibitory interneurons within the dorsal horn. The interplay among these connections determines when painful stimuli go to the brain:

1. When no input comes in, the inhibitory neuron prevents the projection neuron from sending signals to the brain (gate is closed).
2. Normal somatosensory input happens when there is more large-fiber stimulation (or only large-fiber stimulation). Both the inhibitory neuron and the projection neuron are stimulated, but the inhibitory neuron prevents the projection neuron from sending signals to the brain (gate is closed).
3. Nociception (pain reception) happens when there is more small-fiber stimulation or only small-fiber stimulation. This inactivates the inhibitory neuron, and the projection neuron sends signals to the brain informing it of pain (gate is open).
Descending pathways from the brain close the gate by inhibiting the projector neurons and diminishing pain perception. This theory doesn’t tell us everything about pain perception, but it does explain some things. If you rub or shake your hand after you bang your finger, you stimulate normal somatosensory input to the projector neurons. This opens the gate and reduces the perception of pain. It is proposed that Kinesio® tape, in the same manner, provides a mechanical stimulation via the skin, closing the gate to the nociceptive stimulation caused by the chronic lower back pain. In effect decreasing pain (Espisito and Philipson, 2005).
CHAPTER THREE - METHODOLOGY

3.1 Introduction

In this chapter the method in which the research was performed will be discussed. It outlines the treatment protocols for the different groups and the measurement techniques used during the study.

3.2 Participant recruitment

Thirty participants with lower back pain for more than two months were included into the study. The participants were recruited through advertisements (Appendix A) placed in and around the University of Johannesburg campuses and via word of mouth.

3.3 Sample selection and size

The thirty participants who voluntarily partook in this study were randomly separated into three groups. The participants were asked to draw a number from a sealed container. Equal male to female rations were ensured. All participants were screened for lumbar para-spinal muscle myofacial trigger points and a history of lower back pain for longer than two months. All participants were screened, by means of a case history and physical examination, including orthopaedic tests, to see if they were suitable for the study and that they met all the inclusion criteria and to rule out any of the exclusion criteria. Once the researcher was satisfied that all the criteria had been met, a thorough history and physical examination were performed.

3.4 Inclusion criteria

Participant had to have:
- Been between the ages of 18 to 40 years old.
• Have had suffered with lower back pain for more than two months duration.
• Not have taken medication for lower back pain such as any muscle relaxants or analgesics, for the duration of the study as well as 1 week prior to the study.
• Not have taken part in any other therapy that may interfere with this study.
• Have had latent trigger points in the lumbar para-spinal muscles.

3.5 Exclusion criteria

• Participants older than 40 years of age and younger than 18 years of age.
• Participants suffering of any of the contraindications to Chiropractic manipulative therapy (Appendix B).
• Participants suffering of any of the contraindications to Kinesio® tape (Appendix C).

3.6 Group allocation

Randomized protocols were used when placing participants into groups. Participants were asked to draw their grouping from a sealed container. Initially the container contained thirty numbers, each number was randomly allocated to a specific group prior to the participant drawing the number. This ensured the randomisation of the participants into the three treatment groups. The first group received only chiropractic manipulative therapy to restricted lumbar vertebral segments. The second group received only the application of Kinesio® tape to the lumbar para-spinal muscles bilaterally. The third group received Chiropractic Manipulative therapy to the restricted lumbar vertebral segments in combination with the application of Kinesio® tape to the lumbar para-spinal muscles bilaterally.
3.7 Treatment protocol

3.7.1 Initial consultation

- Once all the inclusion and exclusion criteria had been realized, the participants who qualified for the study, were asked to read an information sheet on the study (Appendix D).
- The study was then explained to the participant, and he/she was asked to sign a consent form (Appendix D).
- A case history (Appendix E),
- physical examination (Appendix F),
- lumbar regional examination (Appendix G) and
- lumbar and sacroiliac joint motion palpation were performed on participants of all three treatment groups.
- A summary of these forms was included on a SOAP note (Appendix H) and signed by a clinician at the University of Johannesburg Chiropractic Clinic.
- Subjective data, including the Numerical Pain Rating Scale (Appendix I) and the Oswestry Pain and Disability Index (Appendix J), were obtained.
- Objective data was obtained by measuring the lumbar spine range of motion with a Digital inclinometer.
- Group 1 received chiropractic manipulative therapy to all restricted lumbar spine segments and sacroiliac joints.
- Group 2 received the application of Kinesio® tape to the para-spinal muscles bilaterally.
- Group 3 received the combination of chiropractic manipulative therapy to restricted segments of the lumbar spine and sacroiliac joints and thereafter the application of Kinesio® tape to the lumbar para-spinal muscles.
3.7.2 Follow-up consultations

Follow-up consultations consisted of:

- Each treatment group received their respective treatment protocol, Group 1 receiving chiropractic manipulative therapy, Group 2 application of Kinesio® tape to the lumbar paraspinal muscles and Group 3, the combination of the two treatment modalities.

- In the groups where Kinesio® tape was applied, a new application was done at each treatment.

- Subjective and objective data was collected on the third consultation prior to treatment and at the final consultation, where no treatment occurred. The participants continued according to their respective treatment protocols.

- All participants were treated in a total of six consultations with two treatments per week, over three weeks. With the seventh consultation being data collection only.

3.8 Motion palpation

Motion palpation was used to assess the joint dysfunction and the direction of motion restriction. Motion palpation helps chiropractors to specifically assess the motion in which movement is lost and to aid the chiropractor in utilising the correct method of correction and thrust of the adjustment (Haldeman, 1993).

Motion palpation was divided into lumbar spine motion palpation and Sacroiliac joint motion palpation.

The lumbar spine was palpated for the loss in motion in the following directions:

- Rotation
- Lateral flexion
- Flexion
- Extension

(Appendix K).
The sacroiliac joint was palpated for loss of motion, in flexion and extension, at the sacroiliac joint using the Gillet’s test (Appendix L) (Esposito and Philipson, 2005).

3.9 Chiropractic manipulation

In the study, specific short lever diversified chiropractic manipulative techniques were chosen according to the findings of the motion palpation.

3.9.1 Spinous hook pull technique (Peterson and Bergmann, 2002)

The spinous hook pull was used for lumbar spine restrictions found on motion palpation.

- Patient position
  The patient is in a side-posture position, with the dorsum of the upper foot placed in the popliteal fossa of the lower leg and the arms crossed over the chest as to balance the patient.

- Doctor position
  Square stance to the patient with the doctor’s knee placed on the patient’s upper knee.

- Contact hand
  Reinforced fingertip contact on the first three fingers of the caudad hand on the lower side of the restricted spinous process. The forearm resting on the patient’s posterolateral iliac crest.

- Indifferent hand
  The cephalad hand contacts the patients upside shoulder and overlapping hand.

- Thrust
  The doctor’s forearm rotates the patient’s pelvis anterioly. The thrust is delivered as a body drop at the end of expiration. The line of drive is anteriorly with the forearm, upwards with the contact hand and down with the knee. All occur simultaneously.
3.9.2 Thigh-ilio-deltoid technique (Esposito and Philipson, 2005)

The thigh-ilio-deltoid technique was used to manipulate sacro-iliac joint restrictions found on motion palpation of the joints.

- **Patient Position**
  Side-lying with the restricted side uppermost. The arms are placed across the chest so as to balance the patient. The dorsum of the upper foot is placed in the popliteal fossa of the lower leg which is kept straight.

- **Doctor position**
  Facing the patient. Grasp the patient’s knee between the thighs. At the point where the correct amount of hip flexion is achieved, adduct the patient’s thigh and assume fencer stance.

- **Contact hand**
  Caudad hand contacts with a specific pisiform contact on the inferomedial aspect of the PSIS. The elbow is flexed and the forearm is kept perpendicular to the contact hand.

- **Indifferent hand**
  The cephalad hand takes contact on the upper shoulder and provides cephalad traction.

- **Thrust**
  Rotate the inominate anteriorly into extension. The thrust is delivered at the end of expiration as a body drop with an impulse. The line of drive is posterior to anterior and slightly superior. The contact hand drives the PSIS anteriorly with slight ulnar torque.

3.10 Kinesio® taping of the lumbar para-spinal muscles

Kinesio® tape was applied according to the instructions in the KT-1 and KT-2 course offered in March 2011 and according to the Clinical Therapeutic Applications of Kinesio Taping Method Manual (Kase et al., 2003). The Kinesio® tape was pre cut by the researcher into 20cm X 5.0cm pieces with all the corners rounded, to prevent the corners of the tape catching onto clothes.
Procedure of tape placement

Step 1:
Patient was asked to stand upright with the back exposed.

Step 2:
Two 5cm X 5cm portions of the strips were applied to the skin over the PSIS on each side, after the paper backing was removed.

Step 3:
The patient was asked to flex forward as far as possible, to facilitate stretching of the skin.

Step 4:
The remainder of the backing of the tape was removed and the tape was then applied to the skin. Note: no stretch was applied to the tape in this application and the patient was still in forward flexion.

Step 5:
The researcher rubbed the tape application to insure that the adhesive was activated.

Step 6:
Patient was asked to stand upright, and the application was checked for proper adhesion.

Patients were instructed to keep the tape on for two to three days, until new taping would be applied in the following consultation.
3.11 Subjective data collection

3.11.1 Numerical Pain Rating Scale (NPRS)

The participant was asked to choose a number between zero and ten, to indicate the pain they were currently experiencing. Zero representing no pain and ten representing the worst pain they have experienced in their life. The number was noted in a file. The NPRS has been shown to be reliable and valid by Bolton and Wilkenson (1998).

3.11.2 Oswestry Pain and Disability Questionnaire

The Oswestry Pain and Disability Questionnaire (Fairbank and Pynsent, 2000) indicates the extent of a persons’ functional level of disability due to back or leg pain. The questionnaire consists of ten sections with six statements under each section. The first section pertaining to the level of pain, and the following nine rate the effect that the pain has on daily activities such as; sleep, personal care, walking, sitting, lifting, travel and social life. Therefore the questionnaire rather concentrates on the effect the pain has on life than the nature of the pain (McDowell and Newell, 1996).

The participant was asked to mark a statement under each unit that best describes the level of disability he/she were experiencing at that particular time. If two statements were marked the more severe one was used. Each section was scored out of five, the higher values representing higher levels of pain, thus greater level of disability. The sum of the ten sections was expressed as a percentage, this being the Oswestry Disability Index (ODI) (McDowell and Newell, 1996).

Scoring of the ODI is shown in the table below:
Table 3.1: ODI scores and their meanings

<table>
<thead>
<tr>
<th>ODI Scores</th>
<th>Minimal Disability</th>
<th>Moderate Disability</th>
<th>Severe Disability</th>
<th>Severely Disabled or Malingering</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20% - 40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40% - 60%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60% and over</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fisher and Johnston (1997), and Gronblad and Hupli (1989), found that the Oswestry Disability Index Questionnaire was a valid and reliable method of subjectively measure severity of low back pain.

3.12 Objective data collection

Range of motion of the lumbar spine was performed by using a Digital inclinometer. Inclinometers make use of the constant vertical direction of gravity as a reference point and require that only one surface of the instrument is in contact with the participants body. Inclinometers have been proven to be a reliable method of range of motion measurement by Fisher and Johnston (1997).

Table 3.2: Normal range of motion of the lumbar spine (Kapanje, 1974)

<table>
<thead>
<tr>
<th>Forward Flexion</th>
<th>Extension</th>
<th>Lateral Flexion</th>
<th>Axial Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>40° - 60°</td>
<td>20° - 35°</td>
<td>15° - 20°</td>
<td>3° - 18°</td>
</tr>
</tbody>
</table>

For the purpose of measuring range of motion of the lumbar spine, two readings were taken. The first reading was taken on the interspinous space between T12 spinous process and L1 spinous process. The second reading was taken at the lumbosacral junction between L5 spinous process and the first sacral tubercle. The second reading was then subtracted from the first reading to isolate the degree of movement in the lumbar spine. Table 3.2 shows normal ranges of motion of the lumbar spine.
For flexion and extension the device was placed vertically lengthwise on the inter
space between L1 and T12, with the participant standing upright. The device was
reset to zero and the participant was asked to flex forward as far as their pain
allowed them. A reading was taken. The participant was asked to stand upright
again, the device was reset to zero and the participant was asked to extend
backwards as far as their pain allowed them, a second reading was taken. The
procedure was then repeated at the lumbosacral junction.

For lateral flexion of the lumbar spine, the device was placed horizontally flat on
the interspace between T12 and L1 with the participant in an upright position. The
device was reset, and he/she was asked to laterally flex to the left hand side as far
as their pain allowed them. A reading was noted. The same procedure was applied
on the right hand side and then repeated at the lumbosacral junction.

For rotation of the lumbar spine, the device was placed horizontally upright on the
interspace between T12 and L1 with the participant in a standing position with the
trunk in forward flexion. The device was reset and the participant was asked to
rotate the trunk to the left hand side. A measurement was noted. And the same
procedure was repeated on the right hand side and at the lumbosacral junction.

The digital inclinometer measurement was proven to be a valid and reliable
method of determining the lumbar range of motion by Saur, Ensink, Frese, et al.,
(1996).

3.13 Data analysis

Data analysis testing for normality within the groups was done using the Fishers
Exact test and the ANOVA one way test. If underlying assumptions were met,
parametric analysis was done for the inter- and intra-group analysis, failure of this
lead to non-parametric tests being used. For the inter-group, the Kruskal-Wallis
test was used, with the Mann-Whitney U test as follow-up if differences were
found. For the intra-group, the Wilcoxon signed rank test was used. Analysis was performed by a statistician at Statkon, University of Johannesburg.

### 3.14 Ethical considerations

All participants that wished to partake in this particular study were requested to read and sign the information and consent form specific to this study. The information and consent form outlined the following: name of the researcher; purpose of the study; the benefits of partaking in the study; participant assessment; and treatment procedure. Any risks, benefits and discomforts pertaining to the treatments involved were also explained. The participant’s safety was ensured (prevention of harm). The information and consent form also explained that the participant’s privacy will be protected by ensuring their anonymity and confidentiality when compiling the research dissertation. The participants were informed that their participation was on a voluntary basis and that they were free to withdraw from the study at any stage. If the participant had any further questions, they were explained by the researcher - contact details were made available. The participants were then required to sign the information and consent form, signifying that they understood all that is required of them for this particular study. Results of the study will be made available on request.

With regards to this particular study, normal post manipulative soreness may have been experienced. Some discomfort is also normal with the Kinesio® tape application. An increase in pain however should not have been present with the Kinesio® tape application and the researcher should have been contacted if an increase in pain or allergies and/or skin changes were perceived. The benefits of this study would include a reduction in pain, and increased blood flow to the lumbar para-spinal muscles and an increase in the range of motion of the lumbar spine.

No participants suffered any adverse reactions to any of the treatment modalities during the studies, thus no participants had to be referred.
CHAPTER FOUR – RESULTS

4.1 Introduction

This chapter will present the results obtained during the clinical trial of the study. The sample group consisted of thirty participants. Group 1 is representative of the group that only received chiropractic manipulative treatment. Group 2 is representative of the group that only received the application of Kinesio® taping to the lumbar para-spinal muscles. Group 3 is representative of the group that received both the treatments as a combination. The statistical results only represent a small group of subjects and therefore no assumptions can be made with respect to the population as a whole. The p-value for all tests is set at 0.05 and represents the level of significance of the results. Therefore a p-value less than or equal to 0.05 would be statistically significant.

The data analysis included:

- Demographic data analysis consisting of age and gender.
- Subjective measurements consisting of the Numerical Pain Rating Scale and the Oswestry Pain and Disability Index.
- Objective measurements consisting of readings from the Digital Inclinometer device, these readings include lumbar spine flexion, extension, lateral flexion and rotation.

4.2 Demographic data analysis

<table>
<thead>
<tr>
<th></th>
<th>Mean age</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>27.6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Group 2</td>
<td>26.5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Group 3</td>
<td>25.7</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mean of groups</td>
<td>26.6</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Clinical interpretation

The participants for this study were between 18 and 40 years of age, with a total group mean age of 26.6 years. Group 1 had a mean age of 27.6 years. Group 2 had a mean age of 26.5 years. Group 3 had a mean age of 25.7 years.

The Fishers Exact test was used to evaluate gender distribution. The values were found to be statistically insignificant \((p=1.000)\) and therefore comparable.

The ANOVA one way test was used to evaluate the age distribution. These values were also found to be statistically insignificant \((p=0.492)\) and therefore comparable.

4.3 Subjective data analysis

4.3.1 The Numerical Pain Rating scale

Figure 4.1: Bar graph comparing mean Numerical Pain Rating Scale values
4.3.1.1 Clinical interpretation

Figure 4.1 illustrates the Numerical Pain Rating Scale values measured at first, fourth and seventh consultation. At the first consultation Group 1 had a mean value of 5.7, Group 2 had a value of 5.4 and Group 3 had a value of 6.6. At the fourth consultation Group 1 had a mean value of 3.4, Group 2 had a value of 3.5 and Group 3 had a value of 3.7. At the seventh consultation Group 1 had a mean value of 1.6, Group 2 had a value of 2.3 and Group 3 had a value of 0.8. This therefore indicates that the mean decrease in the Numerical Pain Rating Scale value for Group 1 was 71.9%, for Group 2 was 57.4% and Group 3 was 87.9%.

4.3.1.2 Statistical analysis

Intragroup analysis

The non-parametric Wilcoxon signed rank test compared the scores of the Numerical Pain Rating Scale before treatment at the first, fourth and seventh consultation within Group 1. A statistically significant difference (p= 0.005) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the scores of the Numerical Pain Rating Scale before treatment at the first, fourth and seventh consultation within Group 2. A statistically significant difference (p= 0.005) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the scores of the Numerical Pain Rating Scale before treatment at the first, fourth and seventh consultation within Group 3. A statistically significant difference (p= 0.004) was found between the first and seventh consultation.
The non-parametric Wilcoxon signed rank test therefore showed that all three groups showed a statistically significant decrease in the participants perception of pain, over the time of treatment.

**Intergroup analysis**

The Kruskal-Wallis test compared the scores of the Numerical Pain Rating Scale before treatment at the first consultation, between Groups 1, 2 and 3. No significant difference \((p=0.177)\) was found. This indicates that the groups were comparable as a baseline reading.

The Kruskal-Wallis test compared the scores of the Numerical Pain Rating Scale before treatment at fourth consultation, between Groups 1, 2 and 3. No significant difference \((p=0.707)\) was found.

The Kruskal-Wallis test compared the scores of the Numerical Pain Rating Scale at the seventh consultation, between Groups 1, 2 and 3. A significant difference \((p=0.000)\) was found.

Due to the statistically significant difference between the groups at the seventh consultation, the Mann-Whitney U test was performed to evaluate between which groups the difference was found. The test showed a statistically significant difference between Group 1 and Group 2 \((p=0.039)\), a statistical significant difference between Group 1 and Group 3 \((p=0.003)\) and a statistical significant difference between Group 2 and Group 3 \((p=0.000)\).

According to the Kurskal-Wallis test, there was no statistical difference between the groups at the first and fourth consultation, in terms of the patients perception of pain according to the Numerical Pain Rating Scale. The test showed a statistically significant difference of the participants perception of pain at the seventh consultation. The Mann-Whitney U test was then performed to see where the greatest difference was between the groups. The greatest difference of
perception of pain was seen between Groups 2 and 3, and the smallest difference between Groups 1 and 2.

4.3.2 Oswestry Pain and Disability Index

![Bar graph comparing mean Oswestry Pain and Disability Index values](image)

**Figure 4.2: Bar graph comparing mean Oswestry Pain and Disability Index values**

4.3.2.1 Clinical interpretation

Figure 4.2 illustrates the Oswestry Pain and Disability Index values measured at the first, fourth and seventh consultation. At the first consultation Group 1 had a mean value of 28.2, Group 2 had a value of 26 and Group 3 had a value of 26. At the fourth consultation Group 1 had a mean value of 14, Group 2 had a value of 14.2 and Group 3 had a value of 11.8. At the seventh consultation Group 1 had a mean value of 3.5, Group 2 had a value of 8.0 and Group 3 had a value of 2.8. This therefore indicates that the mean decrease in the Numerical Pain Rating Scale value for Group 1 was 80.1%, for Group 2 was 69.2% and Group 3 was 89.2%.
4.3.2.2 Statistical analysis

Intragroup analysis

The non-parametric Wilcoxon signed rank test compared the scores of the Oswestry Pain and Disability Index before treatment at the first, fourth and seventh consultation within Group 1. A statistically significant difference ($p=0.005$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the scores of the Oswestry Pain and Disability Index before treatment at the first, fourth and seventh consultation within Group 2. A statistically significant difference ($p=0.005$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the scores of the Oswestry Pain and Disability Index before treatment at the first, fourth and seventh consultation within Group 3. A statistically significant difference ($p=0.005$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test showed that all three groups had a statistically significant decrease in the participants’ perception of pain and disability according to the Oswestry Pain and Disability Index.

Intergroup analysis

The Kruskal-Wallis test compared the scores of the Oswestry Pain and Disability Index before treatment at the first consultation, between Groups 1, 2 and 3. No significant difference ($p=0.642$) was found. Meaning that the groups had comparable baseline readings.
The Kruskal-Wallis test compared the scores of the Oswestry Pain and Disability Index before treatment at the fourth consultation, between Groups 1, 2 and 3. No significant difference ($p=0.509$) was found.

The Kruskal-Wallis test compared the scores of the Oswestry Pain and Disability Index at the seventh consultation, between Groups 1, 2 and 3. No significant difference ($p=0.107$) was found.

The Kruskal-Wallis test compared the difference of the Oswestry Pain and Disability Index scores of the three groups. No statistical difference was found between the groups throughout the treatment time.

4.4 Objective data analysis

4.4.1 Digital Inclinometer readings of lumbar spine flexion

![Figure 4.3: Bar graph comparing mean lumbar spine flexion values](image-url)
4.4.1.1 Clinical interpretation

Figure 4.3 illustrates lumbar spine flexion measured in degrees (°). At the first consultation Group 1 had a mean range of motion of 49.6°. Group 2 had a mean range of motion of 51.7°. Group 3 had a mean range of motion of 53.8°. At the fourth consultation Group 1 had a mean range of motion of 50.1°. Group 2 had a mean range of motion of 51°. Group 3 had a mean range of motion of 54.9°. At the seventh consultation Group 1 had a mean range of motion of 50°. Group 2 had a mean range of motion of 54.9°. Group 3 had a mean range of motion of 65.3°. Therefore the mean increase in lumbar spine flexion range of motion for Group 1 was 0.8%, for Group 2 6.1% and for Group 3 21.4%.

4.4.1.2 Statistical analysis

Intragroup analysis

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion, before treatment, at the first and fourth consultation and seventh consultation within Group 1. No statistically significant difference (p= 0.540) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion, before treatment at the first and fourth consultation and seventh consultation within Group 2. No statistically significant difference (p= 0.284) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion, before treatment at the first and fourth consultation and seventh consultation within Group 3. A statistically significant difference (p= 0.016) was found between the first and seventh consultation.
The non-parametric Wilcoxon singed rank test showed that only Group 3 had a statistically significant increase in lumbar spine flexion range of motion. Groups 1 and 2 had an increase in lumbar spine flexion range of motion but it was not statistically significant.

**Intergroup analysis**

The Kruskal-Wallis test compared the values of the lumbar range of motion in flexion, before treatment at the first consultation, between Groups 1, 2 and 3. No statistically significant difference \( (p=0.767) \) was found. Meaning the groups had comparable baseline readings.

The Kruskal-Wallis test compared the values of the lumbar range of motion in flexion, before treatment at the fourth consultation 4, between Groups 1, 2 and 3. No statistically significant difference \( (p=0.273) \) was found.

The Kruskal-Wallis test compared the values of the lumbar range of motion in flexion, at the seventh consultation, between Groups 1, 2 and 3. A statistically significant difference \( (p=0.004) \) was found.

Due to the statistically significant difference between the groups at the seventh consultation, the Mann-Whitney U test was performed to evaluate, between which groups the differences were found. The test showed a statistically insignificant difference between Group 1 and Group 2 \( (p=0.494) \), a statistical significant difference between Group 1 and Group 3 \( (p=0.000) \) and a statistical insignificant difference between Group 2 and Group 3 \( (p=0.068) \).

The Kruskal-Wallis test compared the difference in lumbar spine flexion range of motion at the first, fourth and seventh consultation between the three groups. No statistically significant difference was found at the first and fourth consultation. At the seventh consultation a statistically significant difference was found in the flexion range of motion and the Mann-Whitney U test was used to see where the
biggest difference was found. Groups 1 and 3 showed a statistically significant difference between the groups. No statistically significant difference was found between Groups 1 and 2, and Groups 2 and 3.

4.4.2 Digital Inclinometer readings of lumbar spine extension

![Figure 4.4: Bar graph comparing mean lumbar spine extension values](image)

**Figure 4.4: Bar graph comparing mean lumbar spine extension values**

4.4.2.1 Clinical interpretation

Figure 4.4 illustrates lumbar spine extension measured in degrees (°). At the first consultation Group 1 had a mean range of motion of 10.6°. Group 2 had a mean range of motion of 16.7°. Group 3 had a mean range of motion of 22.0°. At the fourth consultation Group 1 had a mean range of motion of 14.3°. Group 2 had a mean range of motion of 17.3°. Group 3 had a mean range of motion of 22.5°. At the seventh consultation Group 1 had a mean range of motion of 17.7°. Group 2 had a mean range of motion of 17.8°. Group 3 had a mean range of motion of 29.1°. Therefore the mean increase in lumbar spine flexion range of motion for Group 1 was 66.9%, for Group 2 6.5% and for Group 3 32.3%.
4.4.2.2 Statistical analysis

**Intragroup analysis**

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in extension, before treatment, at the first, fourth and seventh consultation within Group 1. A statistically significant difference ($p=0.011$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in extension, before treatment at the first, fourth and seventh consultation within Group 2. No statistically significant difference ($p=0.203$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in extension, before treatment at the first, fourth and seventh consultation within Group 3. A statistically significant difference ($p=0.005$) was found between consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine extension range of motion over time of the three groups. Groups 1 and 3 showed a statistically significant increase in lumbar spine extension. Group 2 showed an increase in the extension range of motion, but statistically insignificant.

**Intergroup analysis**

The Kruskal-Wallis test compared the lumbar spine range of motion in extension, before treatment at the first consultation, between Groups 1, 2 and 3. A statistically significant difference ($p=0.046$) was found.

Due to the statistically significant difference between the groups at the seventh consultation, the Mann-Whitney U test was performed to evaluate, between which
groups the differences were found. The test showed a statistically insignificant difference between Group 1 and Group 2 ($p=0.075$), a statistical significant difference between Group 1 and Group 3 ($p=0.025$) and a statistical insignificant difference between Group 2 and Group 3 ($p=0.306$).

The Kruskal-Wallis test compared the lumbar spine range of motion in extension, before treatment at the fourth consultation, between Groups 1, 2 and 3. No statistically significant difference ($p=0.128$) was found.

The Kruskal-Wallis test compared the lumbar spine range of motion in extension, at the seventh consultation, between Groups 1, 2 and 3. A statistically significant difference ($p=0.021$) was found.

Due to the statistically significant difference between the groups at the seventh consultation, the Mann-Whitney U test was performed to evaluate the differences between the groups. The test showed a statistically insignificant difference between Group 1 and Group 2 ($p=0.970$), a statistical significant difference between Group 1 and Group 3 ($p=0.021$) and a statistical significant difference between Group 2 and Group 3 ($p=0.014$).

The Kruskal-Wallis test compared the lumbar spine extension values at the first, fourth and seventh consultations, a statistically significant difference between the groups was found at the first consultation, thus the groups could not be compared from the start.
4.4.3 Digital Inclinometer readings of lumbar spine lateral flexion to the left

![Bar graph comparing mean lumbar spine lateral flexion to the left values](image)

Figure 4.5: Bar graph comparing mean lumbar spine lateral flexion to the left values

4.4.3.1 Clinical interpretation

Figure 4.5 illustrates lumbar spine lateral flexion to the left measured in degrees (°). At the first consultation, Group 1 had a mean range of motion of 22.5°. Group 2 had a mean range of motion of 27.4°. Group 3 had a mean range of motion of 24.3°. At the fourth consultation, Group 1 had a mean range of motion of 29.2°. Group 2 had a mean range of motion of 30.9°. Group 3 had a mean range of motion of 28.9°. At the seventh consultation, Group 1 had a mean range of motion of 29.7°. Group 2 had a mean range of motion of 34.6°. Group 3 had a mean range of motion of 33.4°. Therefore the mean increase in lumbar spine flexion range of motion for Group 1 was 32.0%, for Group 2 26.3% and for Group 3 37.4%.
4.4.3.2 Statistical analysis

**Intragroup analysis**

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in left lateral flexion, before treatment, at the first, fourth and seventh consultation within Group 1. A statistically significant difference ($p=0.009$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion left lateral flexion, before treatment at the first, fourth and seventh consultation within Group 2. A statistically significant difference ($p=0.014$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion left lateral flexion, before treatment at the first, fourth and seventh consultation within Group 3. A statistically significant difference ($p=0.005$) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine left lateral flexion range of motion over time of the three groups. All three groups showed a statistically significant increase in lumbar spine lateral flexion range of motion over time.

**Intergroup analysis**

The Kruskal-Wallis test compared the lumbar spine range of motion left lateral flexion, before treatment at the first consultation, between Groups 1, 2 and 3. No statistically significant difference ($p=0.302$) was found. Meaning the groups had comparable baseline readings.
The Kruskal-Wallis test compared the lumbar spine range of motion left lateral flexion, scores before treatment at fourth consultation, between Groups 1, 2 and 3. No statistically significant difference (p=0.641) was found.

The Kruskal-Wallis test compared the lumbar spine range of motion left lateral flexion, at the seventh consultation, between Groups 1, 2 and 3. No statistically significant difference (p=0.366) was found.

The Kruskal-Wallis test compared the difference in lumbar spine left lateral flexion range of motion of the three groups at the first fourth and seventh consultations. No statistically significant difference was throughout the treatment time.

4.4.4 Digital Inclinometer readings of lumbar spine lateral flexion to the right

![Bar graph comparing mean lumbar spine lateral flexion to the right values](image)

**Figure 4.6:** Bar graph comparing mean lumbar spine lateral flexion to the right values
4.4.4.1 Clinical interpretation

Figure 4.6 illustrates lumbar spine lateral flexion to the right measured in degrees (°). At the first consultation, Group 1 had a mean range of motion of 25.5°. Group 2 had a mean range of motion of 30.7°. Group 3 had a mean range of motion of 28.2°. At the fourth consultation, Group 1 had a mean range of motion of 31.5°. Group 2 had a mean range of motion of 33.3°. Group 3 had a mean range of motion of 28.2°. At the seventh consultation, Group 1 had a mean range of motion of 32.4°. Group 2 had a mean range of motion of 35.7°. Group 3 had a mean range of motion of 34.8°. Therefore the mean increase in lumbar spine lateral flexion to the right range of motion for Group 1 was 27.1%, for Group 2 16.3% and for Group 3 23.4%.

4.4.4.2 Statistical analysis

Intragroup analysis

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in lateral flexion to the right, before treatment, at the first, fourth and seventh consultation within Group 1. A statistically significant difference (p= 0.008) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in lateral flexion to the right, before treatment at the first, fourth and seventh consultation within Group 2. No statistically significant difference (p= 0.080) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in lateral flexion to the right, before treatment at the first and fourth consultation and seventh consultation within Group 3. A statistically significant difference (p= 0.008) was found between the first and seventh consultation.
The non-parametric Wilcoxon signed rank test compared the lumbar spine lateral flexion to the right range of motion over the time in the three treatment groups. All three groups showed an increase in lumbar spine lateral flexion to the right range of motion, with the change being statistically significant in Groups 1 and 3.

**Intergroup analysis**

The Kruskal-Wallis test compared the lumbar spine range of motion in lateral flexion to the right, before treatment at the first consultation, between Groups 1, 2 and 3. No statistically significant difference \((p=0.458)\) was found. Meaning the groups had comparable baseline readings.

The Kruskal-Wallis test compared the lumbar spine range of motion in lateral flexion to the right, before treatment at the fourth consultation, between Groups 1, 2 and 3. No statistically significant difference \((p=0.496)\) was found.

The Kruskal-Wallis test compared the lumbar spine range of motion in lateral flexion to the right, at the seventh consultation, between Groups 1, 2 and 3. No statistically significant difference \((p=0.826)\) was found.

The Kruskal-Wallis test compared the difference in lumbar spine lateral flexion to the right range of motion between the three groups at the first, fourth and seventh visits. No statistical difference was found between the groups at any point in the treatment time.
4.4.5 Digital Inclinometer readings of lumbar spine rotation to the left

Figure 4.7: Bar graph comparing mean lumbar spine rotation to the left values

4.4.5.1 Clinical interpretation

Figure 4.7 illustrates lumbar spine rotation to the left measured in degrees (°). At the first consultation, Group 1 had a mean range of motion of 5.3°. Group 2 had a mean range of motion of 9°. Group 3 had a mean range of motion of 7.4°. At the fourth consultation, Group 1 had a mean range of motion of 7.1°. Group 2 had a mean range of motion of 9.5°. Group 3 had a mean range of motion of 10.4°. At the seventh consultation, Group 1 had a mean range of motion of 8.6°. Group 2 had a mean range of motion of 10.8°. Group 3 had a mean range of motion of 12.1°. Therefore the mean increase in lumbar spine rotation to the left, range of motion for Group 1 was 62.3%, for Group 2 20% and for Group 3 63.5%.
4.4.5.2 Statistical analysis

Intragroup analysis

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in rotation to the left, before treatment, at the first, fourth and seventh consultation within Group 1. A statistically significant difference \( (p=0.043) \) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in rotation to the left, before treatment at the first, fourth and seventh consultation within Group 2. A statistically significant difference \( (p=0.049) \) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine range of motion in rotation to the left, before treatment at the first, fourth and seventh consultation within Group 3. A statistically significant difference \( (p=0.011) \) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine rotation to the left range of motion of each group over time. All three groups showed a statistically significant increase in the range of motion over the treatment time.

Intergroup analysis

The Kruskal-Wallis test compared the lumbar spine rotation to the left, before treatment at the first consultation, between Groups 1, 2 and 3. No statistically significant difference \( (p=0.086) \) was found. Meaning the groups had comparable baseline readings.
The Kruskal-Wallis test compared the lumbar spine rotation to the left, before treatment at the fourth consultation, between Groups 1, 2 and 3. No statistically significant difference \( (p=0.213) \) was found.

The Kruskal-Wallis test compared the lumbar spine rotation to the left at the seventh consultation, between Groups 1, 2 and 3. No statistically significant difference \( (p=0.230) \) was found.

The Kruskal-Wallis test compared the difference in lumbar spine rotation to the left range of motion between the three groups at the first, fourth and seventh visits. No statistical difference was found between the groups at any point in the treatment time.

### 4.4.6 Digital Inclinometer readings of lumbar spine rotation to the right

![Bar graph comparing mean lumbar spine rotation to the right values](image)

**Figure 4.8: Bar graph comparing mean lumbar spine rotation to the right values**

#### 4.4.6.1 Clinical interpretation

Figure 4.8 illustrates lumbar spine rotation to the right measured in degrees (°).
At the first consultation, Group 1 had a mean range of motion of 5.5°. Group 2 had a mean range of motion of 7.5°. Group 3 had a mean range of motion of 6.1°. At the fourth consultation, Group 1 had a mean range of motion of 8.4°. Group 2 had a mean range of motion of 9.5°. Group 3 had a mean range of motion of 9.1°. At the seventh consultation, Group 1 had a mean range of motion of 10.1°. Group 2 had a mean range of motion of 9.9°. Group 3 had a mean range of motion of 12.2°. Therefore the mean increase in lumbar spine rotation to the right, range of motion for group one was 83.6%, for group two 32% and for group three 100%.

4.4.6.2 Statistical analysis

Intragroup analysis

The non-parametric Wilcoxon signed rank test compared the lumbar spine rotation to the right range of motion, before treatment, at the first, fourth and seventh consultation within Group 1. A statistically significant difference (p = 0.008) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine rotation to the right range of motion, before treatment at the first, fourth and seventh consultation within Group 2. No statistically significant difference (p = 0.138) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine rotation to the right range of motion, before treatment at the first, fourth and seventh consultation within Group 3. A statistically significant difference (p = 0.005) was found between the first and seventh consultation.

The non-parametric Wilcoxon signed rank test compared the lumbar spine rotation to the right range of motion over time in the three treatment groups. Groups 1 and 3 showed a statistically significant increase in the lumbar spine
rotation to the right range of motion. Group 2 showed an increase in the range of motion, but was statistically insignificant.

**Intergroup analysis**

The Kruskal-Wallis test compared the lumbar spine rotation to the right, before treatment at the first consultation, between Groups 1, 2 and 3. No statistically significant difference \( p=0.674 \) was found. Meaning the groups had comparable baseline readings.

The Kruskal-Wallis test compared the lumbar spine rotation to the right, before treatment at the fourth consultation, between Groups 1, 2 and 3. No statistically significant difference \( p=0.923 \) was found.

The Kruskal-Wallis test compared the lumbar spine rotation to the right before treatment at the seventh consultation, between Groups 1, 2 and 3. No statistically significant difference \( p=0.386 \) was found.

The Kruskal-Wallis test compared the difference in lumbar spine rotation to the right range of motion between the three groups at the first, fourth and seventh visits. No statistical difference was found between the groups at any point in the treatment time.

4.4.7 **Summary of lumbar range of motion changes**

All the lumbar range of motion values showed a clinical improvement over the treatment time in all three treatment groups. Statistically significant changes for intra group analysis were seen in Group 1 for: Extension, left and right lateral flexion and right rotation. Group 2 for: Left lateral flexion and rotation and Group 3 showed statistically significant changes in all the lumbar ranges of motions. Inter group analysis for range of motion showed a statistically significant difference between groups 1 and 3, in flexion at the seventh consultation.
CHAPTER FIVE – DISCUSSION

5.1 Introduction

The purpose of this study was to compare the effects of spinal manipulative therapy, Kinesio® taping therapy and the combination of the two treatments, in the management of lower back pain.

This chapter will include a discussion of the results of the study with reference to chapter four as well as reference to the aim of the study described in chapter one. The results will also be compared with other literature and reference will be made to chapter two, the literature review.

The results of the statistical analysis will be discussed under subjective and objective results and further evaluated in terms of intra-group and inter-group comparisons.

The above results were obtained from statistical analysis of the lumbar range of motion, measured by means of the digital inclinometer, the Numerical Pain Rating scale and the Oswestry Pain and Disability Index.

5.2 Demographic Data Analysis

5.2.1 Age distribution

One of the inclusion criteria for the study was that the participants had to be between the ages of 18 and 40. The reason for this age limit was to avoid the lower back pain that is caused by degeneration. There is a significant increase in joint pathology linked to age-related degeneration in the intervertebral disc, facet joint and capsuloligamentous structures in individuals over the age of 45 (Magee, 2002).
All participants were within these age limits. There was no statistically significant difference between the three groups (p > 0.05). Therefore all three groups were comparable in terms of age.

5.2.2 Gender distribution

The groups were divided into equal male to female ratios. Each group consisted of ten participants. Group 1, 2 and 3 consisted of five male and five female participants each. There was no statistically significant difference between the three groups (p > 0.05), thus the groups were comparable in terms of gender.

5.3 Subjective Data Analysis

5.3.1 Numerical Pain Rating scale

The mean Numerical Pain Rating scale value for Group 1 decreased by 71.9%, the value for Group 2 decreased by 57.4% and the value for Group 3 decreased by 87.9%.

The non-parametric Wilcoxon singed rank test showed statistically significant changes in the Numerical Pain Rating scale values within all the treatment groups over the duration of treatment.

The Kruskal-Wallis test revealed no statistically significant difference between the groups at the first and fourth consultation, meaning the groups were comparable from the start of the trials, with no statistical difference at the fourth consultation. A statistically significant difference was found between the three groups at the seventh consultation.

To show the difference between the groups at the seventh consultation, the Mann-Whitney U test showed the greatest statistical significant difference between the Groups 2 and 3.
5.3.2 Oswestry Pain and Disability index

The mean Oswestry Pain and Disability Index value for Group 1 decreased by 80.1%, the value for Group 2 decreased by 69.2% and the value for Group 3 decreased by 89.2%.

The non-parametric Wilcoxon singed rank test revealed statistically significant change in the Oswestry Pain and Disability index in all three treatment groups throughout the duration of the treatment.

The Kruskal-Wallis test revealed no statistically significant difference between the groups at the first, fourth and seventh consultation. Meaning the groups were comparable from the start of the trials, but showed no statistical significant change between the groups, throughout the treatment time.

5.3.3 Discussion of the subjective data

Chronic lower back pain has many different causes as discussed in chapter two. Anatomic causes include nociceptors, muscle, facet joints, sacroiliac joints, spinal dura, intervertebral disc, ligaments, nerve roots as well as referred pain (DeRosa and Porterfield, 1998). The Vertebral Subluxation Complex (VSC), according to Lantz (1995), integrates the complex interaction of pathological changes in nerve, muscle, ligamentous vascular and connective tissues. Myofacial trigger points are also a large contributor to lower back pain (Travell and Simmons, 1999).

During this study different modalities of treatment for lower back pain were used, all proven to be effective in the treatment of lower back pain. Spinal manipulative therapy has been shown to produce a consistent reflex from a multi-receptor origin, resulting in clinically observed benefits, which include the reduction of pain and muscle hyper tonicity (Bronfort G, et al., 2008). A specialized receptor referred to as the golgi organ is present within gross muscle structures and inhibits muscle contraction when excessively tensed (Martini, 2004). Kinesio® taping also
has various ways it can reduce pain generally discussed in chapter two. The direct method of reduction of pain is via the activation of the “Gate Control Theory” by Melzack and Wall (1965). According to this theory the mechanical stimulation from the Kinesio® tape on the skin overrides the painful stimulation, and thus reduces the pain. Kinesio® tape also has a proprioceptive effect in the skin and muscles according to Kase et al., (2003).

When looking at the results of the study Group 3, the combination treatment group, showed the greatest reduction in pain and disability clinically according to the Numerical Pain Rating Scale and the Oswestry Pain and Disability Index. Group 3 statistically also had the greatest reduction in pain over the duration of treatment.

According to the literature in chapter two, pain is reduced in various ways. The reason why Group 3 may have had the greatest reduction in pain can be deducted from the method of pain reduction via the stimulation of mechanoreceptor in the facet joints, muscles and skin. Chiropractic manipulative therapy stimulates the mechanoreceptors in the joints and muscles. This is a short impulse stimulation of the mechanoreceptors. Kinesio® tape on the skin is a more prolonged stimulation of the mechanoreceptors in the skin, thus prolonging the stimulation. When these two modalities are combined, the effect may have longer lasting effects and thus could be more effective.

5.4. Objective Data Analysis

5.4.1 Digital Inclinometer readings of lumbar spine flexion

The mean Digital Inclinometer readings of lumbar spine flexion for Group 1 increased by 0.8%, the value for Group 2 increased by 6.1% and the value for Group 3 increased by 21.4%.
The non-parametric Wilcoxon signed rank test showed statistically significant changes within the groups in the Digital Inclinometer readings of lumbar spine flexion over time in all three groups.

The Kruskal-Wallis test only showed statistically significant changes in the Digital Inclinometer readings of lumbar spine flexion between Groups 1, 2 and 3 at the seventh consultation. Statistically insignificant differences were found between the groups at the first and fourth consultation, meaning the groups were comparable from the start of the trials. The Mann-Whitney U test showed the greatest statistical difference between Groups 1 and 3.

5.4.2 Digital Inclinometer readings of lumbar spine extension

5.4.2.1 Clinical impression

The mean Digital Inclinometer readings of lumbar spine extension for Group 1 increased by 66.9%, Group 2 increased by 6.5% and Group 3 increased by 32.3%.

The non-parametric Wilcoxon signed rank test showed statistically significant changes over time in Groups 1 and 3, with no statistical significant change in Group 2.

The Kruskal-Wallis test showed statistically significant difference between the groups at the first and seventh consultation. Due to the difference at the first consultation the groups were not comparable from the start.

5.4.3 Digital Inclinometer readings of lumbar spine lateral flexion to the left

The mean Digital Inclinometer readings of lumbar spine lateral flexion to the left for Group 1 increased by 32.0%, the value for Group 2 increased by 26.3% and the value for Group 3 increased by 37.4%.
The non-parametric Wilcoxon signed rank test revealed statistically significant values for all treatment groups throughout the duration of the treatment. Group 1 (p = 0.009), Group 2 (p = 0.014) and Group 3 (p = 0.005).

**Inter-group analysis**

The Kruskal-Wallis test revealed statistically insignificant difference between the groups at the first, fourth and seventh consultation, meaning the groups were comparable from the start of the trials, with no statistical difference between the groups at the fourth and seventh consultation.

**5.4.4 Digital Inclinometer readings of lumbar spine lateral flexion to the right**

The mean Digital Inclinometer readings of lumbar spine lateral flexion to the right, for Group 1 increased by 27.1%, the value for Group 2 increased by 16.3% and the value for Group 3 increased by 23.4%.

The non-parametric Wilcoxon signed rank test revealed statistically significant change in lumbar spine lateral flexion to the right for treatment Groups 1 and 3 throughout the duration of the treatment. Group 2 representing the Kinesio® taping group showed no statistically significant difference over time.

The Kruskal-Wallis test revealed no statistically significant difference between the groups at the first, fourth and seventh consultation, meaning the groups were comparable from the start of the trials, with no statistical significant difference between the groups at the fourth and seventh consultation.

**5.4.5 Digital Inclinometer readings of lumbar spine rotation to the left**

The mean Digital Inclinometer readings of lumbar spine rotation to the left, for Group 1 increased by 62.3%, the value for Group 2 increased by 20.0% and the value for Group 3 increased by 63.5%. 
The non-parametric Wilcoxon signed rank test revealed statistically significant changes in lumbar spine rotation to the left for all treatment groups throughout the duration of the treatment.

The Kruskal-Wallis test revealed statistically insignificant differences between the groups at the first, fourth and seventh consultation, meaning the groups were comparable from the start of the trials, with no statistical significant difference between the groups at the fourth and seventh consultation.

5.4.6 Digital Inclinometer readings of lumbar spine rotation to the right

The mean Digital Inclinometer readings of lumbar spine rotation to the right, for Group 1 increased by 83.6%, the value for Group 2 increased by 32% and the value for Group 3 increased by 100%.

The non-parametric Wilcoxon signed rank test revealed statistically significant changes in lumbar spine rotation to the right, for treatment Groups 1 and 3, throughout the duration of the treatment. Group 2 representing the Kinesio® taping group showed no statistically significant difference over time.

The Kruskal-Wallis test revealed statistically insignificant differences between the groups at the first, fourth and seventh consultation, meaning the groups were comparable from the start of the trials, with no statistical significant difference between the groups at the fourth and seventh consultation.

5.4.7 Discussion of objective data

Lower back pain has many different causes as discussed in chapter two. These causes include myofascial trigger points (Travell and Simons, 1999), and the vertebral subluxation complex (Chapman-Smith, 1997). Both myofascial trigger points and vertebral subluxations are known to reduce lumbar spine range of motion.
In flexion range of motion, trigger points in the para-spinal muscles reduce flexion by the muscle not reaching their full lengthening potential (Travell and Simons, 1999). Facet joint subluxations in the lumbar spine, decrease the flexion range of motion by not allowing the joint to achieve their full gliding motion and thus limiting range of motion at a spinal level (Kirkaldy-Willis, 1992). Sacroiliac joint restrictions in movement, especially flexion restrictions, play a large role in lumbar spine flexion, due to the muscle attachment of the erector spinae muscle to the sacroiliac area (Moore and Dalley, 2006).

In lateral flexion and rotation range of motion, the same principles can be applied when observing the reduced range of motion. The ranges of motion can be reduced by either the restricted range of motion of the specific joints or due to uni- or bilateral muscle hypertonicity, which in effect cause reduced range of motion, due to the muscles not reaching their full lengthening potential.

A part of the inclusion criteria of this study was that participants had to have myofascial trigger points present, and sacroiliac or lumbar spine subluxations. Both these inclusion criteria would likely cause limited lumbar spine range of motion.

Chiropractic manipulative therapy was proven to be successful in the treatment of lower back pain and to increase lumbar range of motion (Bronfort G, et al., 2008). Kinesio® tape applied to the lumbar para-spinal muscles has also been proven to be successful in increasing lumbar spine range of motion by application of Kinesio® tape to the lumbar para spinal muscles (Yoshida and Kahanov, 2007).

The effects of chiropractic manipulative therapy are discussed in detail in chapter two. Specifically how these effects influence lumbar range of motion is by directly restoring the segmental motion to a specific spinal level. The neurologic effect though, is very important in this discussion. Chiropractic manipulation causes activation of the mechanoreceptors found in the joint capsule of the lumbar facet joints (Bergmann and Peterson, 2002). The manipulation also stimulates a
specialized receptor referred to as the golgi organ, which is present, within gross muscle structures and inhibits muscle contraction when excessively tensed (Martini, 2004). The stimulation of the mechanoreceptors leads to the reduction in pain via the “Pain Gate Theory” of Melzack and Wall (1965), where nociceptive inputs to the nervous system is overpowered by the mechanical stimulation of the manipulation (Bergmann and Peterson, 2002). The chiropractic manipulation causes stimulation of the sympathetic nervous system, which then causes increased local blood supply to the affected area (Haldeman, 1992).

The above mentioned effects play a positive role in the reduction in lower back pain on various tissue levels. On a muscular level, the sympathetic stimulation aids in resolving the myofacial trigger points in the area by increasing local blood supply in the area and thus speeding the process of waste removal from the trigger point (Haldeman, 1992). On a biomechanical level the chiropractic manipulation restores normal biomechanics of the affected joint, which can then in turn function normally (Bergmann and Peterson, 2002). On a neurologic level the stimulation of the mechanoreceptors reduces pain and this leads to normal movement, because of the absence of pain (Bergmann and Peterson, 2002).

Kinesio® tape functions on various pathways to decrease lower back pain and to increase lumbar spine range of motion. The effects of Kinesio® tape have been discussed in detail in chapter two. For this discussion, a few points will be highlighted. The neurologic effect of Kinesio® tape is seen in the activation of the mechanoreceptors in the skin. As with the adjustment, the tape on the skin, causes mechanoreceptor stimulation, which in turn overrides the nociceptive input to the central nervous system caused by the lower back pain. The specific method of application in this study, causes the skin to be raised slightly, which it is then theorised by Kase et al. (2003) that there is more space in the subcutaneous tissue for blood to circulate, and then in turn toxins can be removed more effectively from muscles and deeper tissue, thus aiding in resolving trigger points in the underlying muscles (Ogura, 1998; Oliveria, 1999; Kase and Hashimoto, 2005; Murray, 2001). The theory is that Kinesio® tape stimulates a circulatory or
neurological activation based on the tape’s elastic properties, which supports the joint function (Garcia, 2001).

When looking at the two treatment protocols above, both have wide spread neurological and physiological effects on the neuromuscular and musculoskeletal systems, affecting both pain and range of motion. The effects of the chiropractic manipulative therapy are enhanced and supported by the longer lasting effects of the Kinesio® tape applied onto the lumbar para-spinal muscles.

Taking all the above information into account and looking at the statistical analysis. It is seen that Group 3, where the combination treatment was applied had the best results in terms of range of motion and pain perception.
6.1 Conclusion

The aim of this study was to determine whether the combination of chiropractic manipulation and Kinesio® taping of the lumbar para-spinals is a more efficient, and possibly effective, treatment protocol in the treatment of chronic lower back pain, with regards to pain, disability and lumbar range of motion. These effects were based on the findings of the Numerical Pain Rating Scale, the Oswestry Pain and Disability Index and Digital Inclinometer readings of lumbar spine range of motion. Both the questionnaires and the range of motion readings were taken before treatment at the first and fourth and seventh consultations.

On completion of the study, statistically significant and clinically significant changes were noted in the Numerical Pain Rating Scale and The Oswestry Pain and Disability Index for all three treatment groups. Group 1 showed a statistically significant increase in range of motion in extension, left and right lateral flexion and left and right rotation. Group 2 only showed a statistically significant change in lumbar range of motion in left lateral flexion and left rotation. Group 3 showed statistically significant changes in all lumbar ranges of motion.

When comparing the Numerical Pain Rating Scale, Oswestry Pain and Disability Index and Digital Inclinometer readings of the lumbar range of motion, between Groups 1, 2 and 3. Statistically significant differences were found at the seventh consultation of the Numerical Pain Rating Scale and Lumbar flexion. Indicating that Group 3, was significantly better in the treatment of lower back pain, with regards to Lumbar flexion and the Numerical Pain Rating Scale.

The aim of this study was to determine whether the combination of chiropractic manipulation and Kinesio® taping of the lumbar para-spinals is a more efficient, and possibly effective, treatment protocol, than the two treatments on their own, in the treatment of chronic lower back pain. This study therefore showed that all
three treatment groups were effective treatment protocols for treating chronic lower back pain. The evidence suggests that the combination of chiropractic manipulative treatment together with Kinesio® taping of the lumbar para-spinal muscles is the most effective treatment protocol, out of these three treatment protocols, in decreasing pain and disability and increasing lumbar range of motion.

6.2 Recommendations

The following recommendations can be used to further improve the results that were obtained in this study:

- Larger sample sizes in the different groups, may reveal the results to be more statistically viable.
- Including an extra follow up assessment 1 month after the last treatment to determine the longer term effects of the treatments.
- Algometer reading could be done on the lumbar para-spinal trigger points, to objectively measure pain on the trigger points.
- Different techniques of Kinesio® taping may be compared to each other
- A short term study may be performed to reveal the immediate effects of Kinesio® tape on lumbar range of motion.
- Pre and post application measurements may be helpful to indicate an immediate effect.
- A study could be performed to investigate the effects of Kinesio® tape and chiropractic manipulative therapy on muscle strength.
- A study could be performed to investigate the effects of the combination of chiropractic manipulative therapy and Kinesio® tape on neck pain.
REFERENCES


APPENDICES
Appendix A: Advertisements

Free Chiropractic Treatment!

(If you qualify for the study)

DO YOU SUFFER FROM CONSTANT LOWER BACK PAIN

Are you between the age of 18 and 40 years old?

Take part in a research study aimed to treat lower back pain.

Treatment is conducted in the Supervised UJ clinic at Gate 7, Sherwell road, Doornfontein.

Please contact me, Mark Meyer, if you are interested! It’s FREE!!!!!!!!!!!
APPENDIX B: Contraindications to Chiropractic manipulative therapy
(Esposito and Philipson, 2005)

1. Vascular conditions
   - Abdominal aortic aneurism
   - Tumours
   - Bone infection

2. Trauma
   - Fractures
   - Hypermobility or instability
   - Severe sprains

3. Arthritis
   - Reumatiod
   - Psoriatic
   - Ankylosing spondylitis
   - Osteoarthritis

4. Psychological
   - Malingering
   - Hysteria
   - Dependent personality

5. Metabolic
   - Clotting disorders
   - Osteoporosis

6. Neurologic
   - Advancing neurologic deficit
   - Cauda equina syndrome
APPENDIX C: Contraindications to Kinesio® taping (Kase et al. 2003)

1. Over active malignancy site
2. Over active cellulitis or skin infection
3. Open wounds
4. Deep vein thrombosis (clots)
APPENDIX D: Information and Consent form

I, Mark Meyer, hereby invite you to participate in my research study. I am currently a Chiropractic student, completing my Masters Degree at the University of Johannesburg.

The aim of my study is to determine if Chiropractic manipulation in conjunction with Kinesio® taping of the lumbar para-spinal muscles is a useful combination in treating lower back pain.

Group one will receive only Chiropractic manipulation to the lumbar spine. Group two will receive the application of Kinesio® tape to the lumbar para-spinal muscles, and group three will receive a combination of chiropractic adjustment of the lumbar spine and the application of kinesio® tape to the lumbar para-spinal muscles. Abnormal joint motion will be detected by motion palpation. The Chiropractic manipulation is a safe, non-invasive treatment technique.
The research will take place at the University of Johannesburg Day Clinic. Your privacy will be protected by ensuring your anonymity and confidentiality when compiling the research dissertation.

All procedures will be explained to you and all participation is entirely on a voluntary basis; withdrawal at any stage will not cause you any harm. Potential benefits of this study include increase in the lumbar range of motion, reduction in pain and resolution of the myofacial triggerpoints. Discomfort experienced may be post adjustment soreness which is normal. Any irritation to the skin that might be caused by the Kinesio® tape must be reported to the researcher immediately. After this study is complete, I will provide you feedback regarding the outcome if you so wish.

I have fully explained the procedures and their purpose. I have asked whether or not any questions have arisen regarding the procedures and have answered them to the best of my ability.

Date: ____________________________
Researcher: ____________________________

I have been fully informed as to the procedure to be followed and have given a description of the discomfort, risks and benefits expected from the treatment. In signing this consent form I agree to this form of treatment and understand my rights and that I am free to withdraw my consent and participation in this study at any time. I understand that if I have questions at any time, they will be answered.

Date: ____________________________
Participant: ____________________________

Should you have any concerns or queries regarding the current study, the following persons may be contacted:

Researcher: Mark Meyer: (082 223 7119)
Supervisor: Dr. C. Bester (011 559 6936)
APPENDIX E: Case History

RESEARCH

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

CASE HISTORY

Date: ____________

Patient: ___________________________ File No: ________

Age: _______ Sex: _________ Occupation: ______________

Student: __________________________ Signature: ____________

Complies with Inclusion criteria of the research:

Clinician: __________________________
Signature: _________________________

Examination:

Previous: UJ Other
Current: UJ Other

X-ray Studies:

Previous: UJ Other
Current: UJ Other

Clinical Path. Lab:

Previous: UJ Other
Current: UJ Other

Case status:

PTT: Conditional: Signed off: Final sign out:

Recommendations:
Students case history

1. Source of history:

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

3. Present illness:
   - Location
   - Onset
   - Duration
   - Frequency
   - Pain (character)
   - Progression
   - Aggravating factors
   - Relieving factors
   - Associated Sx's and Sg's
   - Previous occurrences
   - Past treatment and outcome
4. Other complaints:

5. Past history
   General health status
   Childhood illnesses
   Adult illnesses
   Psychiatric illnesses
   Accidents/injuries
   Surgery
   Hospitalisation

6. Current health status and lifestyle
   Allergies
   Immunizations
   Screening tests
   Environmental hazards
   Safety measures
   Exercise and leisure
   Sleep patterns
   Diet
   Current medication
   Tobacco
   Alcohol
   Social drugs
7. Family history:
   Immediate family:
   Cause of death
   DM
   Heart disease
   TB
   HBP
   Stroke
   Kidney disease
   CA
   Arthritis
   Anaemia
   Headaches
   Thyroid disease
   Epilepsy
   Mental illness
   Alcoholism
   Drug addiction
   Other

8. Psychosocial history:
   Home situation
   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 F: Case history

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

(NOTE: only if Lumbar Regional is complete)

Underline abnormal findings in RED.  Date: ________________

Patient: ___________________  File No: ________________
Clinician: ___________________  Signature: ________________
Student: ___________________  Signature: ________________

Height: ______  Weight: ______  Temp: ______
Rates:  Heart: ______  Pulse: ______  Respiration: ______

<table>
<thead>
<tr>
<th>Blood pressure:</th>
<th>Arms:</th>
<th>R</th>
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</table>

Legs: | L | R |
       |   |   |

General Appearance:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
STANDING EXAMINATION

1. Posture: Erect
   - Adam’s
5. Romberg’s sign
6. Pronator drift
7. Trendelenburg’s sign
9. Scapular winging
10. Muscle tone
11. Spasticity/Rigidity
12. Shoulder: skin
    - symmetry
    - ROM
    - glenohumeral
    - scapulo-thoracic
    - acromioclavicular
    - elbow
    - wrist
14. Chest measurement:
    - inspiration
    - expiration
    | L  | R  |
    |----|----|
    | cm | cm |
15. Visual acuity
16. Breast examination:
   - Inspection:
     - skin
     - size
     - contour
     - nipples
     - arms overhead
     - hands against hips
     - leaning forward
   - Palpation
     - axillary lymph nodes
     - breast incl. tail

SEATED EXAMINATION

1. Spinal posture
2. Head
   - hair
   - scalp
   - skull
   - face
   - skin
3. Eyes:
   - Observation
     - conjunctiva
     - sclera
     - eyebrows
     - eyelids
     - lacrimal glands
- nasolacrimal duct
- position and alignment
- corneas and lenses

- corneal reflex
- ocular movement
  | III | IV | VI | III | IV | VI |
- visual fields
- accommodation
- Ophthalmoscopic Examination
  - iris
  - pupils
  - red reflex
  - optic disc
  - vessels
  - general background
  - macula
  - vitreous
  - lens

4. Ears:
- Inspeccion
  - auricle
  - ear canal
  - drum
- auditory acuity
- Weber test
- Rinne test

5. Nose:
- External
- Internal
  - septum
  - turbinates
  - olfaction

6. Sinuses (frontal & maxillary):
  - tenderness
  - transillumination

7. Mouth and pharynx:
- lips
- buccal mucosa
- gums and teeth
- roof
- tongue
  - inspection
  - movement
- taste
- palpation

- pharynx - CN X
- inspection

9. Neck

- posture
- size
- swelling
- scars
- discoloration
- hair line

Ranges of motion (cervical spine)

The following are normal ranges of motion

Forward flexion = 45° chin to larynx or sternum
Extension = 55° forehead parallel to ground
L/R Rotation = 70°
L/R Lat Flexion = 40°

L. Rot   | Flex. | R. Rot
---|---|---
L. Lat Flex | | R. Lat Flex

Ext.

- lymph nodes
- trachea
- thyroid
- carotid arteries (thrills, bruit)
- Cranial Nerves
  - CN V
  - CN VII
  - CN VIII (nystagmus)
  - CN IX
  - CN XI
  - CN X11
9. Neurological Examination (Cervical Spine)

<table>
<thead>
<tr>
<th>Dermatomes</th>
<th>Left</th>
<th>Right</th>
<th>Myotomes</th>
<th>Left</th>
<th>Right</th>
<th>Reflexes</th>
<th>Left</th>
<th>Right</th>
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</thead>
<tbody>
<tr>
<td>C2</td>
<td>Neck Flexion C1/2</td>
<td></td>
<td>Biceps C5</td>
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<tr>
<td>C3</td>
<td>Lat. Neck Flexion C3</td>
<td></td>
<td>Brachio – radialis C6</td>
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<tr>
<td>C4</td>
<td>Shoulder Elevation C4</td>
<td></td>
<td>Triceps C7</td>
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<tr>
<td>C5</td>
<td>Shoulder Abduction C5</td>
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<tr>
<td>C6</td>
<td>Elbow Flexion C5</td>
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<tr>
<td>C7</td>
<td>Elbow Extension C7</td>
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9. Peripheral vasculature:
- Inspection
  - skin
  - nail beds
  - pigmentation
  - hair loss
- Palpation
  - pulses: - femoral - dorsalis pedis
  - popliteal - radial
  - post. Tibial - brachial
  - lymph nodes - epitrochlear
  - femoral (horizontal & vertical)
  - temperature (feet and legs)
- Manual compression test
• Retrograde filling (Tredelenburg) test
• Arterial insufficiency test

10. Musculoskeletal:
   (i) ROM
   • hip

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<tr>
<td>Actual</td>
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• knee
• ankle

(ii) leg length

• Co-ordination - point to point
  - dysdiachokinesia

10. TMJ
• Inspection - ROM
  - deviation
• Palpation - crepitus
  - tenderness

11. Thorax
• Inspection - skin
  - shape
  - respiratory distress
  - rhythm (respiratory)
  - depth (respiratory)
  - effort (respiratory)
  - intercostals/supraclavicular retraction
• Palpation - tenderness
- masses
- respiratory expansion
- tactile fremitus

- Percussion
  - lungs (posterior)
  - diaphragmatic excursion
  - kidney punch

- Auscultation
  (i) breath sounds
  - vesicular
  - bronchial
  (ii) adventitious sounds
  - crackles (rales)
  - wheezes (rhonchi)
  - rubs
  (iii) voice sounds
  - bronchophony
  - whispered pectoriloquy
  - egophony

- Cardiovascular
  - auscultation (aortic murmurs)
  - Allen’s test

**SUPINE EXAMINATION**

1. JVP
2. PMI
3. Auscultation heart
   (L. lat. Recumbent)
4. respiratory excursion
5. percussion chest
   (anterior)
6. breast palpation
7. Abdominal Examination
   - Inspection
   - skin
   - umbilicus
   - contour
   - peristalsis
   - pulsations
   - hernias (umbilical/incisional)

- Auscultation
  - bowel sound
  - bruit

- Percussion
  - general
  - liver
  - spleen

- Palpation
  - superficial reflexes
  - cough
  - light
  - rebound tenderness
- deep
- liver
- spleen
- kidneys
- aorta
- intra-/retro-abdominal wall mass
- shifting dullness
- fluid wave

- Acute abdomen
  - where pain began and now
  - cough
  - tenderness
  - guarding/rigidity
  - rebound tenderness
  - roving’s sign
  - psoas sign
  - obturator sign
  - cutaneous hyperaesthesia
  - rectal exam
  - Murphy’s sign

**MENTAL STATUS**

(i) Appearance and behaviour
  - level of consciousness
  - posture and motor behaviour
  - dress, grooming, personal hygiene
  - facial expression
  - affect

(ii) Speed and language
  - quantity
  - rate
  - volume
  - fluency
  - aphasia (pm)

(iii) Mood

(v) Memory and attention
  - orientation (time, place, person)
  - remote memory
  - recent memory
  - new learning ability

(vi) Higher cognitive functions
  - information and vocabulary
  - (general and specialised knowledge)
  - abstract thinking
APPENDIX G: Lumbar regional examination

RESEARCH
UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

REGIONAL EXAMINATION
LUMBAR SPINE AND PELVIS

Date: ______________________

Patient: ______________________  File No: _________________

Clinician: ______________________  Signature: _________________

Student: ______________________  Signature: _________________

A. STANDING

1. BODY TYPE
2. POSTURE
3. OBSERVATION: -
   - Muscle Tone
   - Bony + Soft Tissue Contours
   - Skin
   - Scars
   - Discolouration
   - Step deformity

4. SPECIAL TESTS
   - Schober’s Test
   - Spinous Percussion
   - Treadmill
   - Minor’s Sign
   - Quick Test
   - Trendelenburg Test
5. RANGE OF MOTION

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

6. GAIT

- Rhythm, pendulousness
- On Toes (S1)
- On Heels (L4, 5)
- Half Squat on one leg (L2, 3, 4)
- Tandem Walking

7. MOTION PALPATION – sacroiliac joints

B. SITTING

01. SPECIAL TESTS

- Tripod Test
- Kemp’s Test
- Valsalva Maneuvre
2. **MOTION PALPATION**

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<td></td>
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<td>T11</td>
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<td>L5</td>
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<td>L</td>
<td>S1</td>
</tr>
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</table>

C. **SUPINE**

01. **OBSERVATION**

   - Hair, Skin, Nails
   - Fasciculations

2. **PULSES**

   - Femoral
   - Popliteal
   - Dorsalis Pedis
   - Posterior Tibial

3. **MUSCLE CIRCUMFERENCE**

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4. **LEG LENGTH**

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<tr>
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5. **ABDOMINAL EXAMINATION**

- Observation
- Abdominal Reflexes
- Auscultation Abdomen and Groin
- Palpation Abdomen and Groin

Comments: _____________________________________________________________

_____________________________________________________________________

**NEUROLOGICAL EXAMINATION**

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<td>Patellar (L3, 4)</td>
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<td>Medial Hamstring (L5)</td>
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<tr>
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<td>Hip Abduction (L4/5)</td>
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7. SPECIAL TESTS

- SLR
- WLR
- Braggard’s
- Bowstring
- Sciatic Notch Pressure
- Sign of the Buttock
- Bilateral SLR
- Patrick Faber
- Gaenslen’s Test
- Gapping Test
- “Squish” Test
- Gluteus Maximus Stretch
- Thomas’ Test
- Rectus Femoris Contracture Test
- Hip Medial Rotation
- Psoas Test

LATERAL RECUMBENT

- Sacroiliac Compression
- Ober’s Test
- Femoral Nerve Stretch Test
- Myotomes:  - Quadratus Lumborum Strength
               - Gluteus Medius Strength
PRONE

• Facet joint challenge
• Myofascial Trigger points:
  * Quadratus Lumborum
  * Gluteus Medius
  * Gluteus Maximus
  * Piriformis
  * Tensor Fascia Lata
  * Hamstrings
• Skin Rolling
• Erichsen’s Test
• Sacroiliac Tenderness
• Pheasant’s Test
• Gluteal Skyline
• Myotomes:
  * Gluteus Maximus strength

NON-ORGANIC SIGNS

• Pin-point pain
• Axial Compression
• Trunk Rotation
• Burn’s Bench Test
• Flip Test
• Hoover’s Test
• Ankle Dorsiflexion Test
• Pin-point pain
# APPENDIX H: SOAP note

## CHIROPRACTIC DAY CLINIC

**SOAP NOTE:**

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<td>Date:</td>
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**S:**

**O:**

**A:**

**P:**

**Comments:**

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**Patient:**

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**File No:**

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<th>Clinician:</th>
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**S:**

**O:**

**A:**

**P:**

**Comments:**
APPENDIX I: Numerical Pain Rating

How much pain have you had because of your condition since the last treatment?
Please mark in one of the boxes to indicate how severe your pain has been:

1st consultation:

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4th consultation:

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7th consultation:

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APPENDIX J: Oswestry Pain and Disability index

The Revised Oswestry Disability Index (for low back pain/dysfunction)

Patient name: __________________________ Date: __________________________

File #: __________________________

SECTION 1: PAIN INTENSITY

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

SECTION 2: PERSONAL CARE

☐ I would not have to change any 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 increases 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 causes extra pain.
☐ 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 off the floor.
☐ 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 1/2 mile without increasing pain.
☐ I cannot walk more than 1/4 mile without increasing pain.
☐ I cannot walk at all without increasing pain.

SECTION 5: 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 1/4.
☐ Because of pain, my normal night’s sleep is reduced by less than 1/2.
☐ Pain prevents me from sleeping at all.

SECTION 6: 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 7: TRAVELLING

☐ I get no pain while travelling.
☐ I get some pain while travelling, but none of my usual forms of travel makes it any worse.
☐ I get extra pain while travelling, but it does not compel me to seek alternative forms of travel.
☐ I get extra pain while 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 8: CHANGING DEGREE OF PAIN

☐ My pain is rapidly getting better.
☐ My pain fluctuates, but is definitely getting better.
☐ My pain seems to be getting worse, but improvement is slow or present.
☐ My pain is neither getting better nor worse.
☐ My pain is gradually worsening.
☐ My pain is rapidly worsening.
Instructions:

1. This is a self-report questionnaire: the patient is instructed to fill it out.

2. The patient follows the general instructions given at the top of the questionnaire.

3. Each section must be completed. If the patient leaves one blank, instruct them to complete the form. It must be completed in one sitting.

4. Each section has 6 possible answers. Statement 1 is graded as 0 points; statement 6 is graded as 5 points. A total score of 50 is thus possible and would indicate 100% disability. So, for example, a total score of 10 of a possible 50 would constitute a 20% disability.

5. The following interpretation of disability scores is excerpted from the developers of the Oswestry system (457):

0%-20%: Minimal disability

This group can cope with most living activities. Usually no treatment is indicated, apart from advice on lifting, sitting posture, physical fitness, and diet. In this group, some patients have particular difficulty with sitting, and this may be important if their occupation is sedentary, e.g., a typist or lorry [truck] driver.

20%-40%: Moderate disability

This group experiences more pain and problems with sitting, lifting, and standing. Travel and social life are more difficult and they may well be off work. Personal care, sexual activity, and sleeping are not greatly affected, and the back condition can usually be managed by conservative means.

40%-60%: Severe disability

Pain remains the main problem in this group of patients, but travel, personal care, social life, sexual activity, and sleep are also affected. These patients require detailed investigation.

60%-80%: Crippled

Back pain impinges on all aspects of these patients’ lives—both at home and at work—and positive intervention is required.

80%-100%: Paraplegia

These patients are either bed-bound or exacerbating their symptoms. This can be evaluated by careful observation of the patient during medical examination.

6. It is recommended that clinicians focus their discussions of the results with patients in positive terms, rather than reporting disability scores. For example, point out the 10% improvement on a subsequent test.

* Note: in the revised Oswestry, sex life questions were replaced with recreation questions.
APPENDIX K: Motion palpation of the lumbar spine (Esposito and Philipson, 2005)

**Segmental Flexion**

**Patient position:**
Seated

**Doctor position:**
Standing at the side of the patient.

**Contact:**
Interspinous space with an finger pads of the index and middle finger above and below. The doctors’ forearm is draped across the patients shoulder.

**Line of drive:**
Superior to inferior with the arm across the patients shoulders.

**Procedure:**
The doctor keeps the fingers in the interspinous spaces stationary, it is used mainly to feel the spinous processes separate as the doctor induces flexion of the lumbar spine with the forearm. Feel for the gap between the spinous processes open and close.

If the gap does not open, the segment is restricted into flexion. Start at the level of T12/L1 and move down to the level of L5/S1

**Segmental Lateral flexion**

**Patient position:**
Sitting

**Doctor position:**
Standing behind the patient.

**Contact:**
Lateral and inferior aspect of the spinous process on the homo lateral of the doctor. Primary contact is the tip of the finger. 2 segments can be evaluated, using the index and middle finger.
Secondary contact is the forearm draped over the patient's shoulders.

**Procedure:**
Patient is laterally flexed. Relaxation of spinal tissues should be palpated. Coupling into the concavity, although subtle, may be detected using 2 contacts. Feel for the approximation of the two spinous processes. Start at the level of T12/L1 and move down to L5/S1

**Segmental Rotation**

**Patient position:**
Sitting

**Doctor Position:**
Standing behind the patient.

**Contact points:**
Side of the spinous process on the homolateral side of the patient.
Primary contact: Tip of middle and index finger.
Secondary contact: Forearm draped over the patient’s shoulder.

**Procedure:**
Rotate the patient towards the doctor, feel for the spinous process relative movement to the one below. The upper spinous process should move away from the lower one. Start at the level of T12/L1 and move down to the level of L5/S1.
APPENDIX L: Gillets’ test (Esposito and Philipson, 2005)

**Patient position:**
Standing while holding on to something for support.

**Doctor position:**
Kneeling behind patient so that eyes are level with contacts.

**Contact:**
Posterior superior iliac spine (PSIS)
Thumb contact on PSIS and other thumb on the 2nd sacral tubercle.

**Procedure:**
Phase I: Instruct patient to flex one hip to 90 degrees. Maintan careful contact with the PSIS of the Homo lateral side. The thumb contacting the homo lateral PSIS will drop inferiorly in relation to the 2nd sacral tubercle with normal sacroiliac extension. Have the patient return the foot to the ground.
Phase II: with the same contact points, have the patient flex the opposite hip past 90 deg. Maintain teh contact point but this time, watch what happens to the thumb on the 2nd sacral tubercle. In normal sacroiliac flexion the 2nd sacral tubercle drops inferiorly.

**Interpretation:**
Phase I: If the PSIS does not move inferiorly (or if it decreased from the contra lateral side), it is understood that side has decreased flexion.
Phase II: if the 2nd sacral tubercle does not or has decreased inferior movement, it is determined that the contact side has decreased extension.