THE EFFECT OF SPINAL MANIPULATIVE THERAPY
IN CONJUNCTION WITH SUBCUTANEOUS PARENTERAL TRAUMEEL®
IN THE TREATMENT OF CHRONIC MECHANICAL LOW BACK PAIN

A research dissertation presented to the Faculty of Health Sciences, University of Johannesburg, as partial fulfilment for the Masters Degree in Technology, Chiropractic by:

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DECLARATION

I, David Peyton, declare that this dissertation is my own, unaided work. It is being submitted as partial fulfillment 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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ABSTRACT

**Purpose:** This study aims to compare the effects of lumbar spine and/or pelvic manipulation, and lumbar spine and/or pelvic manipulation in conjunction with the application of subcutaneous parenteral Traumeel® in the treatment of chronic mechanical low back pain with regards to pain, disability and lumbar spine range of motion. These effects were evaluated using a questionnaire consisting of a Numerical Pain Rating Scale, and an Oswestry Low Back Pain and Disability Questionnaire, and by measuring lumbar spine range of motion using a digital inclinometer. The questionnaire was completed and the range of motion readings were taken prior to treatment on the first, fourth and seventh consultations.

**Method:** Thirty participants who met the inclusion criteria were stratified in number and gender between two groups of equal size (15 participants each). Group one received spinal manipulation to restricted lumbar spine and/or sacroiliac joints followed by the administration of subcutaneous parenteral Traumeel®. The second group received spinal manipulation to restricted lumbar spine and/or sacroiliac joints. Participants were treated six times out of a total of seven sessions, over a maximum three week period.

**Procedure:** Subjective data was collected at the beginning of the first and fourth consultations, as well as on the seventh consultation by means of a Numerical Pain Rating Scale (NPRS) and an Oswestry Low Back Pain Disability Questionnaire in order to assess pain and disability levels. Objective data was collected at the beginning of the first and fourth session, as well as on the seventh consultation by means of a digital inclinometer in order to assess lumbar spine range of motion. Analysis of collected data was performed by a statistician.

**Results:** Clinically significant improvements in group 1 and group 2 were noted over the duration of the study with reference to pain, disability, and lumbar spine range of motion. Statistically significant changes were noted in group 1 and group 2 with reference to pain and disability, and in group 1 with reference to lumbar spine range of motion.
Conclusion: The results show that both spinal manipulation, as well as spinal manipulation in conjunction with subcutaneous parenteral Traumeel® are effective treatment protocols (as demonstrated clinically, and to a lesser extent, statistically) in decreasing pain and disability, and increasing lumbar spine range of motion in patients with mechanical low back pain. However, neither treatment protocol proved to be preferential. The results carry a possible suggestion that chiropractic manipulation (common to both groups) is effective in ameliorating participant-rated pain and disability, and increasing lumbar spine range of motion in the case of chronic mechanical low back pain.
DEDICATIONS

I would like to dedicate this dissertation to my Lord, Jesus Christ with humble thanks for Your grace given in time of need, love which covers the multitude of my sins and for every good and perfect gift which comes down from above.

To my family, especially my parents. I am profoundly thankful for your love, help, prayers and presence.

Aan my geliefde Erika. Dankie, dankie met my hele hart vir al jou liefde, gebede en bemoediging. I am what I am and where I am by God's grace through you. Ek is so lief vir jou. Ebenezer! ♥
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CHAPTER ONE: INTRODUCTION

1.1. The Problem and its Setting

It is estimated that approximately 80% of individuals will experience an episode of low back pain within their lifetime (Hills, 2011). The Bone and Joint Decade Annual Report (2009) further asserts that almost half the working population will experience severe low back pain at least once a year.

The vertebral subluxation complex of the spine expounded by Gatterman (2005) provides a conceptual framework to understand the intrinsic pathologic processes which underlie symptomatic and observable manifestations in the musculoskeletal system. The subluxation complex is a theoretical model of motion segment subluxation comprising an interplay between neuropathology, kinesiopathology, myopathology, histopathology, connective tissue, vascular, inflammatory, anatomic, physiologic and/or biochemical changes within the vertebral complex. The net result of this interplay is a collection of signs and symptoms that are subjectively experienced by the patient and objectively observed by the examiner or practitioner (Gatterman, 2005).

Since 1987, numerous evidence-based clinical guidelines have been published with recommendations pertaining to the treatment approach to patients with low back pain (Koes, van Tulder, Lin, Macedo, McAuley and Maher, 2010). A systematic analysis of these studies has indicated that there is a general consistency regarding the prescription of allopathic medication in the management of low back pain (acute and chronic). However, it is clear that there is a lack of consensus with regard to the use of manual therapies in the treatment of low back pain (Koes et al., 2010). Many forms of therapy are employed in the treatment of low back pain, with exercises forming a major part of the conservative approach (van Middelkoop, Rubinstein, Verhagen, Ostelo, Koes and van Tulder, 2010).

One of the manual therapies frequently employed in this connection is spinal manipulation. A recent article published by the National Center for Complementary and Alternative Medicine (NCCAM) (2009) indicates that reviews of literature to date show that spinal
manipulation is both a safe and effective form of treatment in the management of low back pain (notably chronic low back pain).

Homeopathy is one discipline among others in the field of complementary and alternative medicine (CAM) which is used in the treatment of musculoskeletal disorders. Traumeel® is a safe and well tolerated homotoxicological product developed by Heel which has inflammatory regulating effects. Traumeel® also promotes the repair of affected tissues and extracellular matrix. The two effects in conjunction thus provide the subjective benefit of reduction in clinical symptoms (notably pain). Traumeel® is recognised as a useful product in the treatment of pain in the locomotor system (Biologische Heilmittel Heel GmbH, 2009).

1.2. Aim of the Study

The aim of this comparative study was to compare the effect of lumbar spine and/or sacroiliac joint manipulation versus lumbar spine and/or sacroiliac joint manipulation in conjunction with subcutaneous parenteral Traumeel® in the treatment of chronic mechanical low back pain with reference to pain, disability and lumbar spine range of motion.

1.3. Benefits of the Study

It was postulated that spinal manipulation directed to the lumbar spine and/or pelvis in conjunction with the use of subcutaneous parenteral Traumeel® could have a synergistic effect, with resultant decrease in the participants' presenting symptoms (notably pain and disability) and increase in lumbar spine range of motion over the course of the study.

It is clear that there is a lack of consensus with regard to the use of manual therapies in the treatment of low back pain. This study may assist in affirming and augmenting the current theoretical paradigm relative to the connection between mechanical pain and the anatomical structures of the lumbar spine and pelvis (muscles, ligaments and joints). Furthermore, the study may illustrate that spinal manipulation in conjunction with
subcutaneous parenteral Traumeel® is a safe, cost effective and minimally invasive form of treatment for mechanical low back pain.
CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

It is estimated that approximately 80% of individuals will experience an episode of low back pain within their lifetime (Hills, 2011). The Bone and Joint Decade Annual Report (2009), further asserts that almost half the working population will experience severe low back pain at least once a year.

The socioeconomic burden placed upon society as a result of low back pain is primarily as a result of the number of work days lost and not the treatment costs incurred (Krismer and van Tulder, 2007). This burden is felt more in countries where there is a higher per capita income and where compensation funds are available, based upon the apparent evidence of a higher incidence of low back pain which is encountered in these countries (Hills, 2011). Patient usage of ineffective and inappropriate procedures and services offered for the management of low back pain, as well as evidence-based, clinically effective treatment results in many lost working days population-wide (Haldeman, 2004).

Low back pain is defined as pain located between the last rib and the inferior gluteal folds, with or without leg pain (Krismer and van Tulder, 2007). The use of the term “mechanical” indicates a reference to the working parts of the low back in relation to internal and external physical forces (Stedman's Medical Dictionary, 2010). The term “low back pain” in connection with “mechanical” refers to pain which results from, or relates to, physical phenomena within the working parts of the low back (Merriam-Webster's Medical Dictionary, 2010).

Since 1987, numerous evidence-based clinical guidelines have been published with recommendations pertaining to the treatment approach to patients with low back pain (Koes, van Tulder, Lin, Macedo, McAuley and Maher, 2010). A systematic analysis of these studies has indicated that there is a general consistency regarding the prescription of allopathic medication in the management of low back pain (acute and chronic). However, it is clear that there is a lack of consensus with regard to the use of manual therapies in the treatment of low back pain (Koes et al., 2010). Many forms of therapy are employed in the
treatment of low back pain, with exercises forming a major part of the conservative approach (van Middelkoop, Rubinstein, Verhagen, Ostelo, Koes and van Tulder, 2010).

One of the manual therapies frequently employed in this connection is spinal manipulation. A recent article published by the National Center for Complementary and Alternative Medicine (NCCAM) (2009), indicates that reviews of literature to date show that spinal manipulation is both a safe and effective form of treatment in the management of low back pain (notably chronic low back pain).

It is recognised by the National Institute of Neurological Disorders and Stroke (2011), in their Low Back Pain Fact Sheet that one of the major pain producing factors in chronic mechanical low back pain is an inflammatory component (not an inflammatory condition). Gatterman (2005) also indicates that there is a direct correlation between inflammation (biochemical changes) in the motion-segment structures of the spine (ligaments, muscles, IVDs, bone, periosteum, meninges, vascular structures and zygapophyseal joints) and the production of local pain.

Homeopathy is a form of Complementary and Alternative Medicine (CAM) which is used in the treatment of musculoskeletal disorders. Traumeel® is a safe and well tolerated homeopathic product developed by Heel which has inflammatory regulating effects. Traumeel® also promotes the repair of affected tissues and extracellular matrix. The two effects in conjunction thus provide the subjective benefit of reduction in clinical symptoms (notably pain). Traumeel® is recognised as a useful product in the treatment of pain in the locomotor system (Biologische Heilmittel Heel GmbH, 2009).

Relevant lumbar spine and pelvic anatomy and biomechanics are discussed in the literature review that follows. The review will then define the etiology of mechanical low back pain, and investigate the use of Traumeel®, as well as the use of spinal manipulation in the treatment of mechanical low back pain.
2.2. Functional Anatomy of the Lumbar Spine and Pelvis

Functionally, the lumbar spine acts as a weight bearing, load resisting and load distributing system between the head, arms and trunk (HAT) and the lower part of the body in both static and dynamic situations (Levangie and Norkin, 2005). It is recognised that there are three passive subsystems in the lumbar spine: vertebrae, intervertebral discs, and ligaments (Panjabi, 1992), with shear force resistance being provided for by the zygapophyseal joints (Adams and Hutton, 1983). Mechanical forces are generated by the complex muscular apparatus which crosses and attaches to the lumbar spine (Levangie and Norkin, 2005).

2.2.1. The lumbar spine

Lumbar vertebrae

The lumbar spine consists of five vertebrae. There are five sacral and four coccygeal vertebrae caudal to the lumbar vertebrae. Significant motion, however, only occurs in the lumbar vertebrae and at the lumbosacral junction (Moore and Dalley, 2006).

Viewed from above, typical lumbar vertebrae (refer to Figure 2.1, 2.2 and 2.3) have large, kidney-shaped bodies in order to support the weight of the HAT. The anterior and lateral aspects of the bodies are slightly concave in shape. This contributes to a significant portion of the thickness of the lower trunk in the median plane (Bogduk, 2005).
Two stout pillars of bone called pedicles project from the posterior aspects of the vertebral bodies. These pillars lie between the neural arch (a bony arch which forms part of the vertebral canal) and the vertebral body. Projecting from the pedicles toward the median plane are the leaf or plate-like laminae which form the roof of the neural arch (Bogduk, 2005). Long and slender, axe-like spinous processes extend posteriorly from the junction of the laminae. Inferolaterally, on left and right, there is a specialised extension of the laminae called the inferior articular process. On its lateral surface is a smooth area of bone covered with articular cartilage called the articular facet. A similar extension from the junction of the lamina with the pedicle occurs, extending upwards, to form the superior articular process which also has facet on its medial surface (Bogduk, 2005).

The articular processes of the lumbar spine have a vertical extension. In a typical lumbar vertebra, the inferior articular facets face more laterally while the superior articular facets face more sagitally. Mamillary processes are found on the posterior surfaces of the superior articular processes to which the multifidus and medial intertransverse muscles attach (Moore and Dalley, 2006).
The long and slender transverse processes (TVPs) project laterally and posterosuperiorly. An accessory process is found on the posterior surface of the base of each TVP to which the medial intertransverse lumborum muscle attaches (Moore and Dalley, 2006).

The vertebral foramen (or canal) is a space formed by the neural arch (with its two laminae joining in the midline and the two pedicles anchored to the vertebral body) as well as the posterior aspect of the vertebral body. Another space formed by the bony structures of the lumbar vertebrae is the intervertebral foramen, formed by two vertebral notches of adjacent vertebrae. These notches are formed inferior and superior to the pedicles and lie between the neural arches and bodies (Bogduk, 2005).
An atypical vertebra, L5 (refer to Figure 2.4), is the largest of the lumbar vertebrae which has a massive body and TVPs. The lumbosacral angle formed between the long axes of the lumbar spine and sacrum is largely formed by the deep anterior body of L5. The weight of the HAT is transmitted through L5 to the base of the sacrum (superior surface of S1) (Moore and Dalley, 2006).
**Intervertebral discs**

Adjacent articulating surfaces of vertebrae are anatomically connected by intervertebral discs (IVDs) (refer to Figure 2.5) and adjoining ligaments. These joints between the vertebral bodies are known as symphyses (secondary cartilaginous joints). The IVDs and their ligamentous connections between vertebrae help create the semirigid spinal column as well as a significant height of the vertebral column (approximately 20—25%) (Moore and Dalley, 2006). Their resilient, though deformable structure helps to facilitate both shock absorption and adequate movement between vertebrae. Each IVD is attached to the vertebral bodies above and below via cartilaginous endplates (Shankar, Scarlett and Abram, 2009).

The cartilaginous endplates are thin layers of hyaline cartilage and collagen fibers at the cephalad and caudad zones of the IVDs adjoining the annulus fibrosus and vertebral body (Shankar, Scarlett and Abram, 2009).

Each IVD has an outer, fibrous ring called the annulus fibrosus. The annulus fibrosus is constituted of approximately 15-25 concentric lamellae of fibrocartilage which insert, via the cartilaginous endplates, into the ephiphyseal rims on the vertebral bodies (Shankar, Scarlett and Abram, 2009). Each lamella has obliquely oriented fibers which run perpendicularly to its adjacent lamella. The outermost layers of the annulus are innervated by nociceptors. This allows minimal, though well-supported intervertebral movement. A thin band of fibrous tissue surrounds the nucleus pulposus as one nears the core of the disc. This band is still part of the annulus fibrosus and is referred to as the transitional zone. Cytoplasmic extensions exist between the nucleus pulposus and annulus fibrosus and are considered to be responsible in the transferral of mechanical strain (Shankar, Scarlett and Abram, 2009).

The inner, fleshy central core of the IVD is called the nucleus pulposus. Its hydrophilic fleshy, semifluid and turgid constituency lends flexibility and resilience to the IVDs. The nucleus pulposus is located toward the posterior pole of the IVD since the annulus fibrosus is thinner posteriorly. It is an avascular structure which receives nourishment via diffusion.
from blood vessels overlying the annulus fibrosus and the vertebral body (Moore and Dalley, 2006).

When compared to the rest of the vertebral column, the IVDs in the lumbar spine are thickest—with the greatest amount of function at the L5/S1 level. Being thicker anteriorly creates the lordotic curve in the lumbar spine and the thickness in this region allows for greater range of motion (Moore and Dalley, 2006).

**The zygapophyseal joints**

The zygapophyseal joints (refer to Figure 2.6) are often called facet joints for the sake of brevity. As is the case throughout the spinal column, the facet joints in the lumbar spine are plane-type synovial joints located between the articular processes (superior and inferior) – or zygaphophyses – of adjacent vertebrae. The articular facets at the T12-L1 joints and toward the superior pole of the lumbar spine are sagitally oriented. Descending the column, the facets face more coronally until a distinct coronal orientation is observed at the L5-S1 junction (Binder and Nampiaparampil, 2009). Loose articular capsules, lined with a synovial membrane, are attached to the rim of the articular processes and surround each joint. These joints permit gliding movement. In contrast to the cervical spine, the articular capsules in the lumbar spine are more taught with a resultant greater degree of restriction in forward flexion. In conjunction with the size of the IVDs in the lumbar spine,
the orientation of the facets as described above allow for easy forward flexion, extension and lateral flexion, but not rotation (Moore and Dalley, 2006).

Facet joints are innervated by articular branches from the medial branches of the posterior rami of the spinal nerves. The sum of its innervation is from both its own as well as the spinal level above (Moore and Dalley, 2006).

An additional and important component, now recognised to form part of all spinal zygapophyseal joints, is the meniscoid. Also known as intraarticular joint inclusions (synovial folds), meniscoids consist of three parts: 1) loose connective tissue arising from the joint capsule, 2) inclusion zone which is highly vascularised and 3) a tip of dense connective tissue which projects into the joint space. Their functions are to fill the joint periphery space, to transfer loads by increasing surface area contact between the two articulating surfaces and to cover the exposed articular surfaces thereby protecting joint margins during movement (Gatterman, 2005).

![Figure 2.6: Zygapophyseal (facet) joint (Trammell, 2008)](image-url)
The lumbosacral articulation

The unique lumbosacral joint located between L5 and S1 has an articulation at the anterior intervertebral joint (formed by the two adjacent vertebral bodies and their wedge-shaped interconnecting IVD). The angle formed between L5 and S1 is called the lumbosacral angle which varies with pelvic position. The greater the lumbosacral angle, the greater the lumbar spine lordosis and consequent shear forces at both the lumbar and lumbosacral articulations (Levangie and Norkin, 2005). The lumbosacral articulations are two zygapophyseal articulations located posteriorly between the respective articular processes. The S1 facets face posteromedially to interlock with the anterolaterally facing inferior facets of L5. This prevents anterior slippage of the lumbar vertebrae. These joints are reinforced by the iliolumbar ligaments which extend from the TVPs of L5 to the ilia in a fan-like manner (Moore and Dalley, 2006).

Muscles of the lumbar spine

Muscles in the back may be compartmentalised into two groups: the extrinsic back muscles (with superficial and intermediate layers) and the intrinsic, or deep back muscles (refer to Figure 2.7 and 2.8). The superficial extrinsic group produces and controls limb movement; the intermediate extrinsic group produces and controls respiratory movement; the intrinsic group produces vertebral column movement and maintains posture (Moore and Dalley, 2006).

The superficial extrinsic muscles (latissimus dorsi, levator scapulae, rhomboids and trapezius), though located in the back, receive their innervation from anterior rami of the cervical nerves, and trapezius from the eleventh Cranial Nerve (spinal accessory nerve) (Moore and Dalley, 2006).

The intermediate extrinsic muscles (serratus posterior superior and inferior) are innervated by the first four and last four intercostal nerves respectively and are believed to be primarily proprioceptive, rather than motor in function (Vilensky, Baltes, Weikel, Fortin and Fourie, 2001).
Figure 2.7: Superficial layer of back muscles (Gray, 1918)
The intrinsic muscles of the back are all innervated by the posterior rami of spinal nerves. They traverse the back from the pelvis to the cranium and are enclosed by a deep fascia which attaches medially to the spinous processes of the vertebrae, nuchal ligament and supraspinous ligament as well as the median crest of the sacrum. Laterally, the fascia blends with the cervical and lumbar TVPs and the angle of the ribs in the thoracic region. The thoracolumbar fascia is thus constituted of the thoracic and lumbar components of the deep fascia of the back. Extending laterally from the spinous processes, the thoracolumbar fascia thinly invests the intrinsic muscles of the thoracic region and strongly and thickly invests the intrinsic muscles in the lumbar region. The intrinsic (deep) muscles of the back are further subdivided into superficial, intermediate and deep layers (Moore and Dalley, 2006).

The superficial layer of intrinsic back muscles—collectively known as the splenius muscle (splenius cervicis and capitis), extends from the mid thoracic spine to the cervical spine and cranium (Moore and Dalley, 2006). Their location precludes them from an in depth discussion in this review of the functional anatomy of the lumbar spine.

The intermediate layer of intrinsic back muscles—collectively known as the erector spinae muscles (or “long muscles” of the back) lie between the spinous processes and angle of ribs laterally. This group is composed of three columns: iliocostalis (laterally), longissimus (intermediate) and spinalis (medially) (Morris, Benner and Lucas, 1962). Each column is then further subdivided into three parts according to its superior attachment, viz. iliocostalis lumborum, iliocostalis thoracis and iliocostalis cervicis; longissimus lumborum, longissimus thoracis and longissimus cervicis; spinalis lumborum, spinalis thoracis and spinalis cervicis. The posterior part of the iliac crest, the posterior aspect of the sacrum, sacroiliac ligaments and the lumbar and sacral spinous processes serve as the common origin for the erector spinae muscles which attach to these structures by means of a broad tendon. They attach superiorly to the cranium, mastoid processes, ribs, cervical and thoracic TVPs and spinous processes in the upper thoracic region. Acting bilaterally, they concentrically extend the vertebral column and head and eccentrically regulate forward flexion of the back. Acting unilaterally, they laterally flex the vertebral column (Moore and Dalley, 2006).
The deep layer of the intrinsic back muscles (semispinalis, multifidus and rotatores muscles) are collectively known as the transversospinal muscle group. These muscles are located between the spinous processes and transverse processes of vertebrae:

Semispinalis muscle (the superficial layer of the deep intrinsic back muscles) which is divided into three parts (semispinalis capitis, semispinalis thoracis and semispinalis cervicis) which are named according to their superior attachments. This muscle arises from the TVPs of C4-T12 and inserts onto the spinous processes of superior vertebrae in the cervical and thoracic region as well as the occipital bone. Semispinalis extends the head, cervical and thoracic regions and rotates them contralaterally (Moore and Dalley, 2006).

Multifidus muscle (the middle layer of the deep intrinsic back muscles) is thickest in the lumbar region and arises from the posterior sacrum, posterior superior iliac spine of the ilium, erector spinae aponeurosis, sacroiliac ligaments, lumbar mamillary processes, TVPs of T1-T3 and articular processes of C4-C7. It inserts onto the spinous processes of superior vertebrae 2—4 segments above. Multifidus extends the spine and stabilises vertebrae during local movements (Moore and Dalley, 2006).

Rotatores muscle (the deep layer of the deep intrinsic back muscles) arises from TVPs of vertebrae. Rotatores brevis inserts onto the junction of laminae and TVPs or spinous processes of vertebrae immediately above. Rotatores longus inserts onto the same points two segments above. Rotatores function is to stabilise vertebrae as well as assist local extension and rotation. An additional three minor deep muscles form part of the deep layer of the intrinsic back muscles, viz.: interspinales, intertransversarii and levator costorum. Interspinales attach between the spinous processes in the cervical and lumbar region and aids in extension and rotation of the vertebral column. Intertransversarii muscles attach between the transverse processes in the cervical and lumbar region and aid in lateral flexion and stabilisation of the vertebral column (Moore and Dalley, 2006).
Figure 2.8: Intermediate and deep layer of back muscles (Gray, 1918)
Ligaments of the lumbar spine

The anterior longitudinal ligament (ALL) has a strong, broad and fibrous quality. It envelops and connects the anterolateral aspects of the vertebral bodies and the IVDs. The ligament extends from the occipital bone (anterior to foramen magnum) and the anterior tubercle of C1 to the anterior surface of the sacrum. The ALL, acting alone limits extension of the spine (Moore and Dalley, 2006).

The posterior longitudinal ligament (PLL) is narrower and weaker than the anterior longitudinal ligament. It runs on the interior of the vertebral canal on the posterior aspect of the vertebral bodies, attaching mainly to the IVDs. It weakly prevents hyperflexion of the spine and is richly innervated with nociceptors (Moore and Dalley, 2006).

The yellow coloured ligamenta flava span between laminae of adjacent vertebrae and those of opposite sides blend in the midline (Meguid and Ahmad, 2007). It is thickest in the lumbar region, resisting abrupt flexion of the spine and preventing disc injury. Their strength assists the maintenance of vertebral curvatures and their elasticity assists return to erect posture after flexion (Moore and Dalley, 2006).

Interspinous ligaments connect adjoining spinous processes. The supraspinous ligament connects the tips of the spinous processes from C7 to the sacrum (Kirkaldy-Willis and Bernard, 1999). To view lumbar vertebrae and their associated ligaments, refer to Figure 2.9.

![Figure 2.9: Lumbar vertebrae and associated ligaments (Eidelson, 2010)](image-url)
2.2.2. Pelvic joints

The sacroiliac (SI) joints, in conjunction with the pubic symphysis, form the three-joint complex of the pelvic girdle.

The SI joints are strong, weight-bearing joints. They are compound joints consisting of a synovial joint anteriorly between the auricular (“C-shaped”) surfaces of the sacrum and ilium and a syndesmosis posteriorly between the tuberosities of both bones. The auricular surfaces have irregular joint surfaces (with elevations and depressions) which interlock congruently and allow only limited movement. The sacral surface is covered with a thick layer of hyaline cartilage (3mm) while the iliac surface is covered with a thinner (1mm) layer of fibrocartilage (Haldeman, 2004). These surfaces can be significantly variable in shape, contour, size and length between individuals as well as between sides in the same individual. The synovial portion of the SI joint, which is visible on plain radiograph, is located on the caudal portion of the joint with its convexity facing anteriorly at the level of S2. The bony landmarks of the SI joint are the postero-inferior and postero-superior iliac spines as well as the postero-lateral border of the sacrum (Haldeman, 2004).

The pubic symphysis articulation is located between the ends of the pubic bones and is a cartilaginous joint. The ends of the pubic bones are covered with hyaline cartilage, between which the fibrocartilaginous disk resides. Numerous ligamentous and aponeurotic extensions attach to and provide support to the articulation (Levangie and Norkin, 2005).

Ligaments of the sacroiliac joints

The sacrum is suspended between the iliac bones and firmly attaches to them by means of the interosseous and posterior ligaments (refer to Figure 2.11). The former ligaments transfer most of the weight of the body; the latter are a continuation of the interosseous ligament. The interosseous ligament itself can form the posterior component of the SI joint if a definitive posterior capsule is not present (Solonen, 1957). The thin anterior sacroiliac ligament (refer to Figure 2.10) forms part of the anterior aspect of the synovial component of the joint by means of its continuity with the well developed anterior joint capsule.
(Haldeman, 2004). The sacrotuberous ligament forms as a continuation of the posterior sacroiliac ligament inferiorly as well as fibers converging from between the posterior superior and posterior inferior iliac spines and the base of the coccyx. This large ligament attaches to the ischial tuberosity. The sacrospinous ligament similarly passes from the lateral aspect of the sacrum and coccyx to the ischial spine. So while not directly attaching across the SI joint, the sacrotuberous and sacrospinous ligaments provide the joint with additional support (Haldeman, 2004).

Figure 2.10: Sacroiliac joint ligaments - anterior view (Gray, 1918)
2.2.3 Innervation of the lumbar spine and sacroiliac joints

As previously mentioned, the zygapophyseal joints of the vertebral column are innervated by articular branches from the medial branches of the posterior rami of the spinal nerves. The sum of their innervation is from both their own as well as the spinal level above. For example: the L2-L3 facet joint is innervated by the L1 and L2 spinal nerves (Haldeman, 2004). By virtue of their being richly innervated by low threshold mechanoreceptors which line the joint capsules, the lumbar facet joints serve an important proprioceptive function (Binder and Nampiaparampil, 2009). The lumbar facet joint capsules have been shown to have all four receptor types as part of their innervation (Types I, II and III are mechanoreceptors, Type IV are nociceptors) (Haldeman, 2004).
The SI joint capsule has a rich nerve supply via a dense plexus of unmyelinated nerve fibers carrying nociceptive signals. Significant variability of segmental innervation is evident between individuals and can range from L2 to S4 (Duckworth, 1970) with a consistent pattern of L4-L5 innervating the anterior part of the joint and S1-S2 innervating the posterior part of the joint (Haldeman, 2004).

The other component of the vertebral column innervation derives from the recurrent meningeal nerves. These nerves arise from the mixed spinal nerve immediately after its formation and before its division into anterior and posterior rami. They may also arise from the anterior ramus immediately after its formation. Two to four branches arise on each side at each spinal level. A sympathetic component is delivered to the recurrent meningeal nerve via the gray rami communicantes. While most recurrent meningeal nerves bear a recurrent quality by passing through the intervertebral foramen (IVF), some remain outside the vertebral canal and supply the IVDs (especially the annulus fibrosus and anterior longitudinal ligament) and anterolateral aspects of the periosteum of the vertebral bodies. Within the vertebral canal itself, the recurrent meningeal nerve supplies the periosteum covering the posterior surface of the bodies, pedicles and laminae, ligamenta flava, posterior and posterolateral aspects of the annuli fibrosi, posterior longitudinal ligament, spinal dura mater and blood vessels within the vertebral canal. Proprioceptive fibers innervate the annuli fibrosi and ligaments; nociceptive fibers innervate the periosteum as well as the annuli fibrosi, ligaments and periosteum (Moore and Dalley, 2006).

The spinal cord, the major conduction pathway and reflex center of the central nervous system, lies within the vertebral canal. It is cylindrical in shape, flattened anteriorly and posteriorly and begins as a continuation of the brainstem. It extends to the level of L1 or L2 in adults, with a tapering inferior end called the medullary cone. The cord has a cervical enlargement for the brachial plexus and a lumbosacral enlargement for the lumbar and sacral plexuses made up from the anterior rami of spinal nerves. Since the spinal cord ends at about the level of L2, spinal nerve roots are much longer at lower levels since they have to pass a greater distance to exit the IVFs. This bundle of nerve roots (arising from the lumbosacral enlargement and medullary cone) is carried within the lumbar cistern and is called the cauda equina because it resembles a horse's tail (Moore and Dalley, 2006).
2.3. Biomechanics

2.3.1. Biomechanics of the lumbar spine

Globally, the morphology of the lumbar spine permits flexion, extension, lateral flexion and rotation. Extension is less limited than flexion (Levangie and Norkin, 2005). The biomechanical functional unit for the spine, known as a functional spinal unit (FSU), consists of two vertebrae with their interconnecting ligamentous tissue (including the IVD). Each FSU has qualitatively the same biomechanics as the rest of the spine (Haldeman, 2004). These functional units of the lumbar spine favour flexion and extension particularly because of the orientation of their facet joints. The most movement and mechanical weight bearing occurs at the lumbosacral joint (the apex of the region of greatest mobility in the lumbar spine, viz. L4-S1) (Levangie and Norkin, 2005).

During physiologic movement, coupling movement occurs at the facet joints of the FSUs in lateral flexion and rotation. In the lumbar spine, left lateral flexion is coupled with right rotation; right lateral flexion is coupled with left rotation. Coupling is also present between lumbar and sacral motion: lumbar flexion is coupled with anterior sacral tilting (nutation); lumbar extension is coupled with posterior sacral tilting (counter-nutation) (Carnes and Vizniak, 2009). While coupling movements occur in lateral flexion and rotation, Cholewicki, Crisco, Oxland, Yamamoto and Panjabi (1996), maintain that pure flexion and extension can occur in the lumbar spine.

First discovered by Henke (1863), in the upper cervical spine, coupled movements occur most notably in the lumbar spine as documented by Panjabi, Oxland, Yamamoto and Crisco (1994). In vitro studies demonstrated that it is a result of the combined constraints and restraints of bony geometry (facet joints), lumbar lordosis, IVDs, facet joint capsules and ligaments that contributes to the coupling (Cholewicki, Crisco, Oxland, Yamamoto and Panjabi, 1996). An in vivo study performed by Steffen, Rubin, Baramki, Antoniou, Marchesi and Aebi (1997), however, has demonstrated that the dynamic component of lumbar movement (facilitated by musculature) contributes to significant variability in the intersegmental coupling movements. In this case, these movements are indisputably
observed using dynamic measurements and can be demonstrated with average values even between a sample of different individuals. Further, variability in the morphology of the articular facets of the lumbar spine contributes to the inconsistent degree of coupling in the lumbar spine during lateral flexion and rotation (Levangie and Norkin, 2005).

2.3.2. Lumbopelvic rhythm

During flexion and extension of the lumbar spine, simultaneous and coordinated lumbar spine flexion and anterior pelvic tilting (about the hip joint) occurs. The combined movement has been termed lumbar-pelvic rhythm (Cailliet, 1996) (refer to Figure 2.12). Forward flexion to touch the toes is a typical example of this rhythm: the first phase of flexion involves lumbar movement; the second phase involves anterior pelvic tilting. The sequence of movements is reversed when extending from a forward flexed position. In both forward flexion and extension, restriction in either the lumbar spine or hip joints of the pelvis may result in hypermobility in the other region (Levangie and Norkin, 2005).

Figure 2.12: Lumbopelvic rhythm. The lumbar spine flexes (A), and the pelvis rotates anteriorly (B) in the sagittal plane (Levangie and Norkin, 2005)
2.3.3. Pathomechanics of the lumbar spine

The term “pathomechanics,” is according to its varied usage, a nondescript term. It has been used to refer to non-specific back pain (i.e. pain without observable pathology) (Wilson, Hickey, Gorham and Childers, 1997). It has also been used to refer to people without significant pain, yet with manifest pathology such as scoliosis (Cordover, Betz, Clements and Bosacco, 1997). Notwithstanding these different usages, it is clearly established that altered tissue in the lumbar spine results in altered loading patterns, which if they become permanent, result in further alteration (deterioration) in the lumbar tissues (Haldeman, 2004). Haldeman further explains that on the basis of current theory and research, it is theoretically and practically difficult to prove that the chiropractic subluxation is classified together with other pathomechanical lesions. It is nevertheless clear that a chiropractic subluxation falls within the category of “abnormal biomechanics” whether the term “pathomechanical” is applied to it or not (Haldeman, 2004).

Another significant factor in the generation of abnormal biomechanics is facet tropism. Tropism is a congenital, anomalous condition which results in an asymmetric orientation of the facet joints, with consequential altered force loading and greater strain on the articular surfaces during rotational movements (Gatterman, 2005).

2.3.4. Biomechanics of the sacroiliac joints

The SI joints are stable and therefore capable only of little movement (Levangie and Norkin, 2005). Its stability and limited movement is afforded by the strong interosseous ligament (primarily) and the other ligaments mentioned previously. One of the main functions of the SI joints is, together with the pubic symphysis, to act as a “shock absorber” between the HAT and lower limbs (Haldeman, 2004). The biomechanical interconnectedness of the three joint complex of the pubic symphysis and two SI joints creates a closed kinematic chain. Thus movement at the SI joints precipitates movement at the pubic symphysis and vice versa (Levangie and Norkin, 2005).

Though movement is demonstrable in the SI joints in many cases, there is significant
variability between the joints in the same individual as well as between individuals. This movement decreases with age (Haldeman, 2004).

By virtue of the shapes of the articulating surfaces of the SI joint, they have a congruency that contributes to “form closure” – a resistance to rotation and shear. Additionally, the strong ligaments and muscles acting on the joint contribute to “force closure.” Together, these forms of closure contribute to the “self-locking” mechanism of the joint. Nutation (which is discussed in a forthcoming paragraph) contributes to the tension in the ligamentous structures, by causing them to wind up, strengthening force closure (Vleeming, Snijders, Stoekart and Mens, 1995).

Nutation (forward “nodding”) of the sacrum (refer to Figure 2.13) occurs on the ilium (such as when standing) (Haldeman, 2004). The sacral promontory moves antero-inferiorly while the coccyx moves posteriorly in relation to the ilium. This has direct bearing on the pelvic brim and outlet diameters: the brim diameter becomes smaller and the outlet diameter becomes larger (Levangie and Norkin, 2005).

Counter-nutation (backward “nodding”) of the sacrum (refer to Figure 2.13) occurs on the ilium (such as when lying supine) (Haldeman, 2004). The sacral promontory moves postero-superiorly while the coccyx moves anteriorly in relation to the ilium. This too has direct bearing on the pelvic brim and outlet diameters: the brim diameter becomes larger and the outlet diameter becomes smaller (Levangie and Norkin, 2005).

Figure 2.13: Nutation and counter-nutation occurring at the sacroiliac joints

(Levangie and Norkin, 2005)
2.3.5. Pathomechanics of the sacroiliac joints

Dysfunction of the SI joints is difficult to understand, given the limited understanding of the normal mechanics of the joint (Haldeman, 2004). In fact, movement is so minimal that it is difficult to both measure as well as detect. SI dysfunction is a contributor not only to SI joint pain, but also low back pain (Carnes and Vizniak, 2009).

2.4. Mechanical Low Back Pain

2.4.1. Aetiology

Krismer and van Tulder (2007), state that most cases of low back pain are non-specific (i.e. no specific cause is identified). Most cases are transient, with resolution of the pain within 6 weeks. A minority will experience persistent pain lasting for more than two months (Haldeman, 2004). Among this minority, it is estimated that approximately 5—10% have a specific cause. The majority of low back pain incidents in which a specific cause can be identified are attributed to either acute trauma or cumulative trauma. There is a general consensus that repetitive occupational activities and postures as well as heavy lifting are risk factors for the development of low back pain (Wai, Roffey, Bishop, Kwon and Dagenais, 2010). Other factors include: spinal stenosis, inflammatory conditions, referred pain, psychogenic pain, infective and neoplastic causes, metabolic bone disease, and congenital disorders and degenerative conditions (Krismer and van Tulder, 2007).

2.4.2. Pathogenesis

The three-joint complex of the spine forms an integral part of the pathoanatomical group of structures that are involved in the pathogenesis of low back pain. This three-joint complex is composed of the two zygapophyseal joints posteriorly and an intervertebral disc anteriorly. The integrated relationship between these parts is such that injury to one, will result in injury or alteration to the others. Principally, the two major forces involved in the generation of injury at the three-joint complex level are rotational and compressive forces (Kirkaldy-Willis and Bernard, 1999).
The Kirkaldy-Willis model expounding the phases of degeneration will be the theoretical bedrock for the next part of this discussion, the first phase of which is representative of the patients who participated in this study. The three phases are dysfunction, instability and stabilisation. It should be noted that there is not a uniform or linear progression from phase I to phase II to phase III. This cause for this inconsistent relationship has not yet been definitively discovered (Kirkaldy-Willis and Bernard, 1999).

**Dysfunction**

Kirkaldy-Willis and Bernard (1999), asserts that this phase of degeneration is the cause of most cases of low back pain.

The injurious mechanisms of rotational and compressive forces mentioned above are believed to be the primary mechanism by which this phase is initiated (Treleaven, Jull and Sterling, 2003). The zygapophyseal joint as well as the annulus fibrosus is strained (i.e. minor tearing of the collagen fibers occurs) with resultant synovitis and subluxation at the level of the zygapophyseal joint (Kirkaldy-Willis and Bernard, 1999).

Muscular splinting (notably involving segmental musculature) then occurs at the level of dysfunction in order to provide stability, which yet also maintains the subluxation. This spasm results in muscle ischaemia and metabolite build-up which are both painful nociceptive stimuli (Kirkaldy-Willis and Bernard, 1999).

**Instability**

As the three-joint complex continues to sustain repeated micro-trauma by virtue of rotational and compressive mechanisms, incomplete annular and capsular collagen healing occurs. At the posterior zygapophyseal joints: further capsular attenuation occurs with resultant laxity of the capsule in conjunction with facet hyaline cartilage degeneration. At the IVD: annular tears begin to coalesce, nuclear material loses its integrity and the annulus bulges circumferentially (Tehranzadeh, Seibert and Gangi, 2010). Thus, recurrent
dysfunction terminates in instability, which at this point in the degenerative process of the three-joint complex, is now detectable on physical and radiographic examination (Kirkaldy-Willis and Bernard, 1999).

**Stabilization**

Previous pain and instability are the precursors to this final phase of the degenerative process. This phase is usually entered after years of low back pain and its accompanying repetitive micro-trauma. At the posterior zygapophyseal joints, the following processes occur: ongoing hyaline cartilage destruction, intra-articular and peri-articular fibrosis as well as articular enlargement result in stabilisation of the facet joint. At the IVD the following processes occur: loss of disc height, generalised loss of disc integrity, including further loss of nuclear material and intradiscal fibrosis (Kirkaldy-Willis and Bernard, 1999). Osteophyte formation around the periphery of the disc and endplate destruction results in stabilisation (Lories and Luyten, 2009). Complete bony ankylosis is a possible last-phase sequela. Furthermore, by virtue of their proximity, the spinal nerves can suffer entrapment as a result as a result (Kirkaldy-Willis and Bernard, 1999).

**2.4.3. The pain syndromes**

The chief musculoskeletal pain syndromes, which are a catalogue of progenitors to mechanical low back, are presented here with an outline of their mechanism and clinical picture.

**Zygapophyseal facet syndrome**

Facet syndrome has been defined by Gatterman (2005), as “pain or dysfunction arising primarily from the zygapophyseal joints and their immediately adjacent soft tissues.” Thus, a close theoretical correlation between the zygapophyseal facet syndrome and phase I of the Kirkaldy-Willis model of spinal degeneration may be observed (Kirkaldy-Willis and Bernard, 1999).
Notwithstanding this theoretical connection, the facet joints of the vertebrae have, by multiple authorities, been long considered a source of both pain as well as dysfunction (Gatterman, 2005). Cox (1990), goes further to state categorically that “facet subluxation syndromes [are] probably the most common condition encountered in low back pain patients.”

In the case of the facet syndrome, the progenitors of pain are the capsule and its associated synovium, adjacent subchondral bone and the meniscoid. Gatterman (2005), outlined several diagnostic studies which conclusively demonstrated a reproduction of lumbago and “sciatica-like” pain upon stimulation of facet joints.

Thus, the clinical picture of a classic lumbar facet syndrome includes: low back pain (with morning stiffness), hip, buttock and posterior thigh pain. Functionally, pain will be felt on movement, especially hyperextension. There will be an absence of nerve root tension signs and any neurological fallout (Gatterman, 2005).

**Sacroiliac joint syndrome**

Though previously considered to be an immobile joint, the sacroiliac joint is now recognised to be a mobile joint (as previously discussed) and prone to the same dysfunction and subluxation to which other diarthrodial joints are prone (Gatterman, 2005).

With altered loading patterns and a possible change in the axis of joint rotation, the SI joint can acquire a position in which the joint surfaces are not optimally complementary. Either hypermobility (excessive motion) or hypomobility (restricted motion) of the sacroiliac joint are two of the principal contributing factors in connection with the syndrome (Haldeman, 2004).

The syndrome itself encompasses dysfunction of the joint, muscle spasm of associated muscles, ligament stretching and local as well as referred pain (Gatterman, 2005). It is believed to be a significant source of low back pain (Kirkaldy-Willis and Bernard, 1999), an assertion which has received a general consensus (Slipman, Whyte, Chow, Chou, Lenrow
and Ellen, 2001). Ipsilateral piriformis muscle dysfunction is frequently associated. Pain from the syndrome is usually experienced in the ipsilateral buttock and down the postero-lateral calf to the ankle, foot and toes. Pain is also reported to refer within the distribution of the L5, S1 and S2 dermatomes. When the anterior ligaments refer pain, the L2 and L3 dermatomes are involved, particularly the region immediately caudal to the groin (Gatterman, 2005). Local pain and tenderness within the region of the SI joint is an additional associated clinical sign (Haldeman, 2004).

**Intervertebral disc syndrome**

Since the IVD forms an integral part of the three-joint complex of the spine, it is necessarily affected by altered biomechanics in the other parts of the complex.

Decades ago, Mixter and Barr (1934), published their discovery of lumbar disc herniation and its association with low back pain and sciatica. This provided a “mechanical construct for lumbar pain” which was the precursor to hundreds of further studies and investigations into discogenic low back pain (Slipman, Whyte, Chow, Chou, Lenrow and Ellen, 2001). With the onset of Magnetic Resonance Imaging (MRI) and the discovery of almost universal disc degeneration in the population (symptomatic or asymptomatic), the absolutised view that back pain is linked to disc degeneration was supplanted (Haldeman, 2004). Furthermore, it is now recognised that genetic links play an important role in the connection between disc degeneration and and low back pain (Cheung, 2010).

Notwithstanding this, given the anatomical makeup of IVDs, and the supporting evidence of decades of research, a definite link between lumbago and disc degeneration is agreed upon (Haldeman, 2004). Notably, disc space narrowing, osteophytosis, and subchondral sclerosis are the degenerative processes observed accompanying discogenic low back pain. Nucleus pulposus extrusion and associated pain-generating chemical release (such as nitric oxide) is considered to be a tributary of pain-generating mechanisms (Haldeman, 2004).
Myofascial pain syndrome

Myofascial Pain Syndrome (otherwise known as Myofascial Syndrome) refers to the “sensory, motor and autonomic symptoms caused by myofascial trigger points” (Simons, Travell and Simons, 1999). As part of their benchmark work on myofascial pain syndromes and trigger points, the authors go on to demonstrate that in each case of the Syndrome, a specific muscle or muscle group is responsible for the cause of the symptoms. Trigger points and their associated syndromes are common progenitors of low back pain, hence the inclusion of this musculoskeletal disorder under the range of syndromes causing low back pain (Malanga and Colon, 2010).

Abram (2006), states that lower lumbar pain and arthropathy-like associated symptoms are experienced in the case of the “extremely common” gluteus medius trigger point syndrome. Njoo and Van der Does (1994) support this in a study based on the common occurrence of, and link between, low back pain and quadratus lumborum and gluteus medius trigger points.

A trigger point is defined as a hyperirritable localised point (locus) in skeletal muscle with characteristic firmness located within a taut band as well as referred pain to non-dermatomal zones (Abram, 2006). Pressure applied to the trigger point will reproduce a referred pain pattern, local twitch response and a possible associated “jump sign” (in which the patient's body part or body will move or recoil involuntarily). Muscle stretch will be painfully limited and a restriction of full range of motion will be manifest in the affected body part (Malanga and Wolff, 2008). Simons, Travell and Simons (1999), indicate that spontaneous pain is not a characteristic of latent trigger points, while limitation of muscle range and extensibility is common to both active and latent trigger points.

The physiology (histopathology) of trigger points is debated and controversial. However, the causative factors precipitating the development of trigger points is generally observed to be repetitive activity or sustained contraction of the muscle in one position (Malanga and Wolff, 2008).
2.5. Chiropractic

2.5.1. Overview of chiropractic theory

The World Health Organization (2005) provided a working definition of chiropractic in their guidelines on basic training and safety in chiropractic as the following: “A health care profession concerned with the diagnosis, treatment and prevention of disorders of the neuromusculoskeletal system and the effects of these disorders on general health. There is an emphasis on manual techniques, including joint adjustment and/or manipulation, with a particular focus on subluxations.”

The World Federation of Chiropractic (2001) definition closely corresponds to this definition, with several nuances of difference in the latter clause: “There is an emphasis on manual treatments including spinal adjustment and other joint and soft-tissue manipulation.”

The Association of Chiropractic Colleges (2010) emphasised the inherent restorative physiological mechanisms of the body by means of optimal bodily structure and function relations: “Chiropractic is a healthcare discipline that emphasizes the inherent recuperative power of the body to heal itself without the use of drugs or surgery. The practice of chiropractic focuses on the relationship between structure (primarily the spine) and function (as coordinated by the nervous system) and how that relationship affects the preservation and restoration of health.”

2.5.2. The subluxation complex

Lantz (1995) maintains that the subluxation has become, and was originally (in an earlier understanding of the term) central to the practice, science and philosophy of chiropractic. The Consortium for Chiropractic Research (CCR) reached a consensus on a definition of the chiropractic subluxation: “A motion segment in which alignment, movement integrity, and/or physiologic function are altered although contact between the joint surfaces remains intact” (Gatterman and Hansen, 1994). Lantz (1995), building on the work of others,
expanded on the term and developed the concept of the vertebral subluxation complex (VSC) to provide a comprehensive model which encompasses the multifactorial components of a vertebral subluxation (refer to Figure 2.14).

**Figure 2.14: A schematic representation of the hierarchical organization of the Vertebral Subluxation Complex (VSC) (Lantz, 1989)**

The vertebral subluxation complex of the spine expounded (after Lantz's groundwork) by Gatterman (2005), provides a conceptual framework to understand the intrinsic pathologic processes which underlie symptomatic and observable manifestations in the musculoskeletal system. The subluxation complex is a theoretical model of motion segment subluxation comprising an interplay between neuropathology, kinesiopathology, myopathology, histopathology, connective tissue, vascular, inflammatory, anatomic, physiologic and/or biochemical changes within the vertebral complex. The net result of this interplay is a collection of signs and symptoms that are subjectively experienced by the patient and objectively observed by the examiner/practitioner (Gatterman, 2005).
2.5.3. The chiropractic adjustment

A definition formulated by the World Health Organisation (WHO) (2005), encapsulates the main lines of thought agreed upon by reputable authorities within the profession (Gatterman and Hansen, 1994). The WHO defines the adjustment as “any chiropractic therapeutic procedure that ultimately uses controlled force, leverage, direction, amplitude and velocity, which is applied to specific joints and adjacent tissues. Chiropractors commonly use such procedures to influence joint and neurophysiological function.”

In other words, the articular adjustment, or manipulation, is a manual therapy in which specific contacts are employed. Once appropriate anatomical contacts have been made, a controlled, high velocity, low amplitude thrust is delivered to the joint in a specific, pre-defined direction. The intent for which this procedure is utilised by chiropractors is in order to positively “influence joint and neurophysiologic function” (Peterson and Bergmann, 2002).

2.5.4. Effects of the chiropractic adjustment

Dysfunction and disease of the neuromusculoskeletal system has historically been the principal area of concern for chiropractors, and has thus been the major category of complaint for which they have been consulted. Subjectively and objectively, chiropractic spinal manipulation has been shown to be at least as effective as a diversity of other forms of treatment (Cherkin, Sherman, Deyo and Shekelle, 2003). Numerous sources as outlined by Peterson and Bergmann (2002) have brought to light the safety, relevance, effectiveness, cost-effectiveness, disability-reducing and positive economic impact of chiropractic care. It is the present concern of this section, however, to address the various physiological and biomechanical effects of chiropractic spinal manipulation.

Mechanical hypothesis

The mechanical hypothesis relates primarily to the cause and effect relationship of mechanical derangement in the neuromusculoskeletal system. With reference to the cause: dysfunction at one or more points in the system is initiated by some noxious
stimulus such as acute trauma, repetitive overload, postural imbalance, reflexive changes, developmental or degenerative changes. With reference to the effect: the manifestations are usually twofold, viz. soft tissue adaptions such as loss of flexibility, shortening, fibrosis development and secondly, altered joint biomechanics (Peterson and Bergmann, 2002).

Principally, the adjustment is aimed at alleviating symptoms associated with neuromusculoskeletal mechanical derangements as well as improving the function of the affected region. A recent study performed by Cramer, Ross, Pocius, Cantu, Laptook, Fergus, Gregerson, Selby and Raju (2011), showed that chiropractic adjustment positively improves a joint's degree of gapping and hence, its range of motion. Early manipulation prevents the development of the previously mentioned soft tissue adaptations, notably restoring muscle function and preventing atrophy and imbalanced biomechanics of the associated joints in the locomotive chain. Additionally, it is proposed that detrimental psychosocial (illness behaviour) and avoidance behaviour (pain avoidance) can be deflected by early manipulation by means of removing precipitating factors (Peterson and Bergmann, 2002).

Cavitation and its effects

Though not strictly and universally associated with all applications of spinal manipulation, joint cavitation is a frequent occurrence. While the precise mechanical phenomena of cavitation are not discussed within the scope of this thesis, suffice it to say that cavitation is the formation of bubbles (probably carbon dioxide) in the synovial fluid by means of a reduction in local pressure after the joint has been moved to its end range of motion (Cramer et al., 2011).

The sequelae of cavitation are of more central relevance to the discussion about the effects of manipulation. Some of these post-cavitation effects of manipulation include: a temporary increase in passive range of motion of the associated joint as well as the joint space. Joint separation is also achieved. These effects cannot be reproduced for another 20 minutes (approximately) – a time known as the refractory period (Peterson and Bergmann, 2002). More peripherally, cavitation and its effects (in conjunction with
manipulation) result in stretching of periarticular soft tissue as well as joint mechanoreceptor and nociceptor stimulation. Herzog (1996), and Brodeur (1995), propose that these effects in turn result in the amelioration of pain, muscle hypertonicity, joint hypomobility and periarticular inflexibility.

**Interarticular block**

As discussed earlier, intraarticular joint inclusions (synovial folds) are a part of synovial joints (refer to Figure 2.15). These inclusions can become entrapped within the posterior spinal (zygapophyseal) joints. This results in back pain and joint locking. It is hypothesised that these inclusions are drawn and “locked” into their abnormal positions by means of aberrant or sustained spinal postures. Reactive pain and muscular splinting (hypertonicity), fatigue and ischaemia results which further augments the original problem (Peterson and Bergmann, 2002). This malpositioning, as Mercer and Bogduk (1993) point out, is a possible mechanism in the genesis of cervical torticollis.

![Figure 2.15: Schematic illustration of a facet joint with synovial fold (left) and entrapped synovial fold (right) (Murphy, 2011)](image)

Another model of malpositioned intraarticular joint inclusion is proposed by Bogduk and Jull (1985), with the suggestion that the inclusions are extrapped, rather than entrapped. That is, upon a certain movement, the inclusion moves out of the joint space, and upon return to original position, the inclusion fails to return to its original position, becoming extrapped beneath the articular capsule.

Spinal manipulation, in the case of malpositioned or entrapped synovial folds, will enable the fold to return to its original position (Hyde and Gengenbach, 2007). Gapping of the
joint (produced by rotational adjustments) would encourage improved and functional positioning of the fold. The principal causative agent behind the associated muscular splinting and pain will be removed, and thus will ameliorate symptoms (Peterson and Bergmann, 2002).

**Intradiscal block**

Various forms of IVD damage or degeneration are the progenitors of this proposed “intradiscal block” phenomenon. The types of IVD injury referred to are trauma, accumulated micro-trauma, degenerative disc disease and degenerative aging of the disc material. Internal disc derangement (bulging of the nucleus pulposus and tearing of the annulus fibrosus) in the case of torsional and flexion injuries will also result in inflammation (Peterson and Bergmann, 2002).

As radial fissures begin to occur in the annulus fibrosus of the IVD, it is postulated that intradiscal blockage can occur when fragments of the nuclear material gets impacted in the radial fissures. Thus, upon spinal extension, these fragments get entrapped and cannot return to their original position. By virtue of this unnatural occurrence, the annular fibers are stretched and thus pain of mechanical origin is produced. As in the case of interarticular joint locking, muscular splinting is an associated sequela (Peterson and Bergmann, 2002).

In conjunction with the discussion regarding IVD degeneration, it is understood that as the IVD loses its turgidity and hydrophilic properties by virtue of internal disruption, the annular fibers are more prone to stretching upon certain movements (notably forward flexion and rotation). This is another pain-producing mechanism (Peterson and Bergmann, 2002).

Specifically in connection with the mechanism and effect by which manipulation ameliorates the symptoms associated with intradiscal block: there are two proposed mechanical concepts. The first is that presented by the Gonstead model in which the migrating nuclear material is forced toward the IVD center and the side of migration is closed off, a so-called “repositioning of the nucleus” (Cooperstein, 2003). The second is
that proposed by Sandoz in which it is believed that the distractive and coiled or spiralled force produced by side-posture manipulation draws the nuclear material toward the IVD center (Cooperstein and Good, 2003).

**Muscle spasm**

Muscles produce as well as inhibit movement. A balance between the agonists and antagonists is required in order to promote this end. If the fine balance between the two opposing muscle groups is lost, then joint movement may become restricted in its full range or quality. Muscle spasm is one primary means by which this balance is disturbed (Liebenson, 2006).

Principally, there are two mechanisms by which muscle spasm occurs: firstly by means of direct noxious stimuli to the muscle (such as minor tearing) following which reflexive splinting occurs; secondly and more indirectly, by means of noxious articular stimuli. Segmental spinal skeletal muscle is not under voluntary control and is particularly sensitive to provocative stimuli and aberrant movement. It is thus the type of muscle most prone to the development of spasm (Peterson and Bergmann, 2002).

As spasm ensues, nociceptive and mechanoreceptor stimulation increases and a cycle of spasm, muscle fatigue and pain results. High-velocity manipulation is an effective means of manual therapy used to intersect and interrupt this cycle of events. Upon delivery of the adjustment, the Golgi tendon organ is stimulated by means of stretch, bringing about neurophysiological or autogenic inhibition of α and δ motor neurons (reflex muscle relaxation) (Kirkaldy-Willis and Bernard, 1999).

**Periarticular fibrosis and adhesions**

Joint hypomobility is an end result of the soft-tissue-associated sequelae of acute or repetitive trauma. The pathoanatomical sequence of events begins with trauma, advances to fibrosis, adhesions and contractures. Manipulation is advanced as a manual therapy effective in the severance of adhesions, promotion of tissue stretch and restoration of joint
mobility. Notably, it is the distractive force provided by the adjustment that accomplishes this goal (Peterson and Bergmann, 2002).

**Joint instability**

As a general rule, manipulation is aimed at restoring normal movement to hypomobile joints. However, in the case of clinical joint instability (as opposed to gross orthopaedic instability associated with degenerative or traumatic conditions) – which is produced by repetitive trauma and compensatory joint overload – limited usage of manipulation is proposed as a beneficial adjunct (albeit palliative) to stability exercise. Manipulation, in this case, is intended to prevent subluxation, pain and muscle hypertonicity (Peterson and Bergmann, 2002).

**Analgesic hypothesis**

Post-manipulative pain reduction is a documented and recognised effect of chiropractic manipulation. One of the hypotheses brought forward to support this clinical evidence is the analgesic hypothesis. This hypothesis is based on the proposed mechanism that the manipulation is able to remove pain and inflammation inducing stimuli—viz. structural or functional derangements (Peterson and Bergmann, 2002).

Furthermore, experimental evidence suggests that chiropractic adjustments induce sufficient force to activate deep and superficial somatic nociceptors, proprioceptors and mechanoreceptors (Hyde and Gengenbach, 2007). As a consequence, central transmission of pain is inhibited by means of segmental spinal cord sensory stimulation (Haldeman, 2000).

A further proposition put forward by Gillette (1987), is that superficial and deep mechanoreceptor stimulation initiates short-lived phasic responses (lasting the duration of treatment), while noxious stimulation of nociceptors initiates longer-lived tonic responses (lasting longer than the duration of treatment) (refer to Figure 2.16). Anatomically, nociceptive stimulation of this nature can occur under the influence of chiropractic adjustive
therapy (which includes joint cavitation and capsular stretching). An additional proposed consequence of the burst-like stimulation of mechanoreceptors and nociceptors is the release of neurochemical pain inhibitors (Peterson and Bergmann, 2002).

![Figure 2.16: The inhibition of central pain transmission through activation of mechanoreceptors and nociceptors (Peterson and Bergmann, 2002)](image)

**Circulatory hypothesis**

The theorised mechanism by which circulatory improvements result following adjustive therapy is that the autonomic nervous system has been stimulated or that the musculoskeletal system experienced a functional improvement. Joint dysfunction/subluxation has been submitted as a source of aberrant segmental sympathetic tone. Altered skin texture, moisture and temperature are among the cutaneous signs associated with this segmental dysfunction. Adjustive therapy would have the potential to remove the sympathetic neurological irritation (Peterson and Bergmann, 2002). A further proposition is that chiropractic adjustments increase zygapophyseal diameter and therefore promote intra-articular circulation (Leach, 2003).
Further, lymphatic and venous flow is directly influenced by intrathoracic and intraabdominal pressures. Proper function of these pressures is dependent on efficacious spinal, diaphragmatic and rib biomechanics. Thus, chiropractic adjustments aimed at restoring and maintaining spinal biomechanics will inhibit the impedance and promote adequate physiological lymphatic and venous circulation (Peterson and Bergmann, 2002).

2.6. Homeopathy and Traumeel®

2.6.1. Introduction to Homeopathy

The term “homeopathy” is derived from the Greek words homoios (similar) and pathos (suffering). Homeopathy finds its origin in the early 19th century, when Hahnemann (1811), described the 'drug picture' to determine a preparation appropriate to the disease (Biologische Heilmittel Heel GmbH, 2006). A principle central to homeopathy is that there is a reciprocal behaviour of disease symptoms, towards symptoms that a healthy subject develops after the intake of a diluted substance (potency) or mother tincture. Or as described by the National Center for Complementary and Alternative Medicine (2010), “a disease can be cured by a substance that produces similar symptoms in healthy people.” This principle of action is a derivation from the Simile Principle (Similia Similibus Curentur = Likes may be cured by likes). Thus, the approach is to cure the disease syndrome by the artificial induction of similar disease (Biologische Heilmittel Heel GmbH, 2006).

Classical homeopathy works with either botanical extractions which contain numerous constituents in a complex mixture, or single preparations which contain single-constituent preparations (e.g. arsenic, sulphur, mercury, etc.) Repertories—lists of symptoms that are produced by drugs—aid an appropriate selection of a homeopathic preparation (Biologische Heilmittel Heel GmbH, 2006).
2.6.2. Introduction to Homotoxicology

The term “homotoxins” was coined by Dr Hans-Heinrich Reckeweg to describe substances (chemical/biochemical) and non-material influences (physical/physchical) which are causative agents in the development of disease in humans (Biologische Heilmittel Heel GmbH, 2006). Thus, these homotoxins are believed to originate either from within the body, or from the surrounding environment (Ferrara, Marrone, Emmanuele, Nicoletti, Mastrangelo, Tiberi, Ruggiero, Fasano and Paolini, 2007). Conversely, it is believed that health is the expression of the absence of these homotoxins (Ernst and Schmidt, 2004).

Dr Reckeweg developed homotoxicology in 1952 to combine a conventional medical indication-oriented approach, with the homeopathic method of potency treatment. Anti-homotoxic medicine utilises this indication-oriented approach, the preparations of which contain mid to low potencies of anti-homotoxic substances which follow the Arndt-Schultz Principle. This Principle states that “weak stimuli stimulate life functions; moderately strong stimuli accelerate them; strong stimuli act as inhibitors; the strongest stimuli suspend life functions” (Biologische Heilmittel Heel GmbH, 2006).

As promulgated by Reckeweg in his description of Homotoxicology, these weak or moderately strong stimuli are created by the antitoxins that are present within the anti-homotoxic preparations which, in their action, “serve poison defense and detoxification” (Biologische Heilmittel Heel GmbH, 2006).

In summary, homotoxicology utilises homeopathically diluted remedies to therapeutically eliminate homotoxins from the body. To accomplish this, three therapeutic strategies are employed: prevent homotoxins from challenging the body, eliminate already existing homotoxins and regulate existing homotoxicoses (Ernst and Schmidt, 2004).
2.6.3. Traumeel®

**Definition of Traumeel®**

Traumeel® is a homeopathic inflammation regulating drug (IRD), as well as an analgesic, anti-edematous and anti-exudative agent that promotes healing (Heel USA, 2008).

**Traumeel® Composition**

Table 2.1 lists all the components of Traumeel® with their potencies and characteristics:
# Table 2.1: Components and characteristics of Traumeel® (Biologische Heilmittel Heel GmbH, 2009)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Characteristics</th>
<th>Ointment (per 100 g)</th>
<th>Tablets (per 300 mg)</th>
<th>Ampoules for injection (per 2.2 ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Achillea millefolium</em> (milfoil)</td>
<td>Hemorrhages, especially precapillary arteriovenous (anastomosis), oozing hemorrhages</td>
<td>90 mg</td>
<td>0.015 mg</td>
<td>0.0022 µl</td>
</tr>
<tr>
<td><em>Aconitum napellus</em> (monkshood)</td>
<td>Fever with hot, dry skin, neuralgia, inflammatory rhematism, improvement of the vascular, analgetic, hemostatic</td>
<td>5 mg</td>
<td>0.03 mg</td>
<td>0.0132 µl</td>
</tr>
<tr>
<td><em>Arnica montana</em> (mountain arnica)</td>
<td>To stimulate the healing of wounds, fractures, dislocations, contusions, hematomas, myocardial weakness, neuralgia, myasthenia, analgetic, hemostatic</td>
<td>1.5 mg</td>
<td>0.015 mg</td>
<td>0.022 µl</td>
</tr>
<tr>
<td><em>Atropa belladonna</em> (deadly nightshade)</td>
<td>Localized reaction phases, cerebral sensitivity with cramp and delirium</td>
<td>5 mg</td>
<td>0.0075 mg</td>
<td>0.022 µl</td>
</tr>
<tr>
<td><em>Bellis perennis</em> (daisy)</td>
<td>Dislocations, contusions, sensation of soreness in the abdominal wall/cavity, exudative processes, resorption of edema</td>
<td>100 mg</td>
<td>0.06 mg</td>
<td>0.011 µl</td>
</tr>
<tr>
<td><em>Calendula officinalis</em> (calendula)</td>
<td>Slowly healing wounds, promotes granulation, analgetic</td>
<td>450 mg</td>
<td>0.15 mg</td>
<td>0.022 µl</td>
</tr>
<tr>
<td><em>Chamomilla (Matricaria) recutita</em> (chamomile)</td>
<td>Anti-inflammatory; stimulates granulation, promotes healing in difficulty healing wounds and ulcers, fistulae, hematomas, mastitis, interstitial, aphthous stomatitis, conditions of restlessness and excitation, disorders of dentition, arthritis, glandular swellings</td>
<td>150 mg</td>
<td>0.024 mg</td>
<td>0.0022 µl</td>
</tr>
<tr>
<td><em>Echinacea angustifolia</em> (narrow-leaved cone flower)</td>
<td>Increase in the neoplasticum defenses; inflammation of all kinds and localizations, septic processes, hyalurondase inhibiting, anti-inflammatory action</td>
<td>150 mg</td>
<td>0.06 mg</td>
<td>0.0055 µl</td>
</tr>
<tr>
<td><em>Echinacea purpurea</em> (purple cone flower)</td>
<td>Increase in the neoplasticum defenses; inflammation of all kinds and localizations, septic processes, hyalurondase inhibiting, anti-inflammatory action</td>
<td>150 mg</td>
<td>0.06 mg</td>
<td>0.0055 µl</td>
</tr>
<tr>
<td><em>Hamamelis virginiana</em> (witch hazel)</td>
<td>Purulent oedema, varicose veins, (thrombo-) phlebitis, crural ulcers, hematomas, venous hemorrhages, anti-inflammatory, analgetic</td>
<td>450 mg</td>
<td>0.15 mg</td>
<td>0.022 µl</td>
</tr>
<tr>
<td><em>Calcium sulphate</em> (homeopathic name: “Hepar sulfuris”)</td>
<td>Tendency to suppuration, especially on the skin and lymph glands (lymph nodes, pyoderma, pannus, phlyenema), tubular abscesses, cholangitis, hemorrhoids, urinary disorders, hypersensitivity to cold and draughts</td>
<td>0.0000025 mg</td>
<td>0.0000003 mg</td>
<td>0.00000022 µl</td>
</tr>
<tr>
<td><em>Hypericum perforatum</em> (St. John’s wort)</td>
<td>Neural and cerebral injuries, e.g. commotio cerebrarum, neural pain upon or after injuries hemostatic</td>
<td>0.000009 mg</td>
<td>0.03 mg</td>
<td>0.0066 µl</td>
</tr>
<tr>
<td><em>Mercurio-amidonitrat</em> (homeopathic name: “Mercurius solubilis trammel”)</td>
<td>Suppurations, abscesses, gingivitis, stomatitis, nasopharyngeal catarrh, colds of the sinuses, cholangitis, shrinking action on edematous conditions</td>
<td>0.000000004 mg</td>
<td>0.000000003 mg</td>
<td>0.00000011 µl</td>
</tr>
<tr>
<td><em>Symphytum officinale</em> (comfrey)</td>
<td>To accelerate callus formation in fractures periostitis, causalgia, disorders arising from amputation stump contusions</td>
<td>0.01 mg</td>
<td>0.000000024 mg</td>
<td>0.00000022 µl</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ointment</th>
<th>Tablets</th>
<th>Ampoules for injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier substances</td>
<td>Citrussyn alcohol, paraffin, 12.5% alcohol</td>
<td>6 mg lactose, 1.5 mg Mg stearate</td>
</tr>
</tbody>
</table>
Mechanism of Action of Traumeel®

Traumeel® inhibits pro-inflammatory mediators (IL-1β, TNF-α and IL-8) in both resting and active immune cells (Singer, Amit-Kohn, Weiss, Rosenblum, Maoz, Samuels, Lukasiewicz, Freedman, Paltiel, Itzchaki, Niska and Oberbaum, 2010). Additionally, components in Traumeel® have been shown to raise the levels of the anti-inflammatory cytokine, TGF-β. Fibroblasts are also stimulated resulting in regeneration of the extracellular matrix. The product is also non-cytotoxic to leukocytes, platelets and endothelial cells ensuring that their defensive function is maintained during the treatment phase. The mode of action of Traumeel® differs from other anti-inflammatories (non-steroidal anti-inflammatory drugs (NSAIDs), other COX-2 inhibitors and corticosteroids) in that it is inflammatory-regulating (Biologische Heilmittel Heel GmbH, 2006). Additionally, it is better tolerated and has fewer side effects than these drugs (Biologische Heilmittel Heel GmbH, 2009). Refer to Figure 2.16 for a diagrammatic representation of the mechanism of action of Traumeel®.

Figure 2.16: Mechanism of action of Traumeel® (Heel USA, 2008)

It is also proposed that the multiple constituents of Traumeel® have a synergistic effect, especially in light of the fact that small quantities of the constituents produce by observation, such strong effects. Some of the remedies in Traumeel® are regarded as
having anti-inflammatory properties (Atropa Belladonna, Aconitum napellus, Mercurius solubilis, Hepar sulphuris, and Chamomilla recutita), mucoprotective properties (Calendula officinalis and Hamamelis virginiana), antihaemorrhagic properties (Arnica montana, Calendula officinalis, Hamamelis virginiana, and Achillea milefolium) and immunostimulatory properties (Echinacea angustifolia and Echinacea purpurea) (Oberbaum, Yaniv, Ben-Gal, Stein, Ben-Zvi, Freedman, Branski, 2001).

**Indications for Usage of Traumeel®**

The following indications are listed as part of the Biotherapeutic Index (2006) for Traumeel® drops, tablets and injection solution (Biologische Heilmittel Heel GmbH, 2006):

- **Inflammatory musculoskeletal conditions:**
  - Traumatic:
    - Blunt trauma
    - Sprains
    - Dislocations
    - Contusions
    - Infracutaneous effusion and haemarthrosis
    - Fractures
    - Post-traumatic and post-operative oedema and swelling of soft tissue
  - Degenerative joint disease (with an inflammatory component) in the hip, knee and small joints of the body as well as spondylosis with or without discogenic disease.
  - Inflammatory and periarticular inflammatory processes (with a degenerative component) in the musculoskeletal system (tenovaginitis, epicondyilitis, tendinitis, styloiditis, bursitis, scapulohumeral periarthritism, rotator cuff syndrome).

- **Non-musculoskeletal indications include:**
  - Cutaneous disorders
- Eczema
- Fistular suppurations
- Neurodermatitis
- Lichen planus
- Paradontosis
- Intertrigo
  - Infective processes
    - Acute and chronic otitis media
    - Sinusitis
    - Carbuncles
    - Furuncles
    - Paradontosis
    - Mastitis
    - Sudoriparous abscesses
  - Acute cerebral concussion and contusion

Related Research

A broad evidence base exists supporting the use of Traumeel® in various indications. Usages are classified into musculoskeletal and non-musculoskeletal (e.g. asthma, dentistry, post-surgery, pediatric). For the purposes of this study, a literature review of the musculoskeletal usages of Traumeel® follows:

A randomised controlled trial conducted by Orizola and Vargus (2007) demonstrated that Traumeel® is an effective and safe alternative to diclofenac in the treatment of non-traumatic tendinous pain in elite athletes. Results of this study demonstrated that the Traumeel® group showed the greatest mean pain reduction (measured using the Visual Analog Scale).

In a study designed by Birnesser, Oberbaum, Klein and Weiser (2004), Traumeel® was compared to non-steroidal anti-inflammatories (NSAIDs) in the symptomatic treatment of epicondylitis. Over a two week period, 184 patients were treated symptomatically with
either Traumeel® or NSAIDs. After evaluation of subjective and objective data, results indicated that Traumeel® showed statistical superiority over NSAIDs in connection with both joint extensibility and torsional mobility measurements. Drawn from the study, was a further conclusion that Traumeel® is a well tolerated alternative to NSAIDs.

With reference to wide traumatic, inflammatory and degenerative conditions, Traumeel® has also shown good to very good efficiency in a multi-center, prospective study conducted by Zenner and Weiser (1997). Further evidence became manifest at the conclusion of the study that there were no significant restrictions in combining other medications with Traumeel®.

Böhmer and Ambrus (1992) showed in a randomised, double-blind study that Traumeel® is more effective than placebo in the treatment of sports injuries. This conclusion was drawn following the results of statistical analysis which demonstrated a proportional superiority of Traumeel® over placebo: greater reduction in the circumference of the affected body part as recorded upon the conclusion of the study, greater reduction in skin temperature between the affected and unaffected body part, greater reduction in pain and greater restoration of muscle power.

Zenner and Metelmann (1994) showed, in a homeopathic ointment surveillance survey conducted on 3422 patients, that post-marketing results verified a high tolerability to Traumeel® ointment and that it qualifies as a form of low-risk therapy for various disorders and injuries. The most frequent condition treated in this trial was acute sprains.

Recently, the “Traumeel® Clinical Summaries” review document, outlining the evidence base for Traumeel®, was prepared by Garkavi, de Vega San Román, Kahn, Speed and Wolfarth (2010). This review favourably supports the above evidence, summarising their analysis by stating that randomised controlled studies reveal Traumeel® to be superior in effectiveness to placebo, and as effective as diclofenac in treating musculoskeletal pain and dysfunction. Furthermore, the review goes on to show that in observational cohort studies, Traumeel® is comparable to conventional therapies. With particular relevance to this study involving a chronic musculoskeletal disorder, the above conclusions in the
review document correspond to those of Birnesser, Oberbaum, Klein and Weiser (2004) who showed that Traumeel® is an effective and well tolerated means of intervention in the treatment of chronic musculoskeletal pain and dysfunction.

**Traumeel® Safety Profile**

As indicated on the Traumeel® Injection Solution information page produced by Heel, there are no known adverse renal, hepatic, gastrointestinal, central nervous system or cardiovascular effects (Heel, 2003). Additionally, there are no known drug interactions, drug/laboratory test interactions or teratogenic effects of the Injectable Traumeel® Solution (Heel, 2003).

In a study performed to evaluate the clinical safety of Traumeel® in healthy subjects, (by measuring changes in complete blood count, liver profile, serum chemistry, coagulation time, bleeding time and the presence of blood in the stool) it was found that Traumeel® is both safe and well tolerated (Arora, Harris and Scherer, 2000). Among the adverse events reported in this study were “stomach discomfort, headache, diarrhea, dizziness, nausea, insomnia, and arm/leg pain.” These symptoms were transient and resolved without intervention despite continued use of Traumeel®.

Within the last decade, a study was conducted by Ludwig and Weiser (2001) to evaluate the various usages, efficacy and tolerability of Traumeel® among pediatric patients. Of the 157 children evaluated, it was found that there were no adverse effects to the use of Traumeel®. Subjective reporting by patients indicated (standalone or in combination with other medication) consistent tolerance ratings to Traumeel® of “good” or “excellent.”

From several studies, it has become manifest that Traumeel® shows a tolerance in preference to, or in conjunction with other forms of medication: As indicated previously, a study conducted by Birnesser, Oberbaum, Klein and Weiser (2004) showed a tolerance superiority of Traumeel® over NSAIDs. Similar evidence for the safety of Traumeel® from Zenner and Weiser's multi-center, prospective study (1997) showed that no significant restrictions existed in combining Traumeel® with other medications.
More recently, the “Traumeel® Clinical Summaries” review document (Garkavi, de Vega San Román, Kahn, Speed and Wolfarth, 2010), concluded that "safety studies have indicated that Traumeel® is unlikely to interfere with antimicrobial first defenses, the normal homeostatic process, kidney function or liver function." The review also affirms the “good tolerability” and “very few adverse effects” of Traumeel® observed in post-marketing surveillance. They affirm that Traumeel® appears to show a greater tolerability than conventional treatment.
CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter is a systematic analysis of the design of the study, participant recruitment procedure, and treatment protocol. A description of the assessments performed, types of measurements used and subsequent data analysis is given. The chapter concludes with ethical considerations.

3.2. Study Design

3.2.1. Comparative study

3.2.2. Participant recruitment

Advertisements (Appendix A) were placed within the University of Johannesburg Day Clinic, and around the University of Johannesburg campus. Any individual presenting to the University of Johannesburg Chiropractic Day Clinic with mechanical low back pain was considered a potential candidate for the study.

3.2.3. Sample selection and size

Thirty participants were both informed of the nature of the study as well as screened according to the inclusion and exclusion criteria. They were required to read and sign the study-specific information and consent form (Appendix B). The participants were equally divided into two groups of fifteen each.

3.2.4. Inclusion criteria

Inclusion criteria for prospective participants included:

...
Chronic mechanical low back pain (symptoms persist for more than 2 weeks) (Segen, 2002) with confirmation by a positive result in one or both of the following orthopaedic tests: Yeoman's Test or Kemp's Test (Walsh, 1998) (Appendix C)

- Males and/or females between the ages of 18 and 45
- The presence of at least one lumbar spine and/or sacroiliac joint restriction (viz. lumbar spine and/or sacroiliac joint dysfunction with or without associated myofascial pain) which was confirmed by motion palpation
- Participants were required to provide signed consent on the information and consent form (Appendix B).

3.2.5. Exclusion criteria

Exclusion criteria for prospective participants included:

- Contraindications to lumbar and/or sacroiliac spinal manipulation (Appendix D)
- Contraindications to Traumeel® (Appendix E)
- Any other condition that may have mimicked the signs and symptoms of mechanical low back pain
- Participation in other forms of treatment (during the duration of the study) which may have interfered with the study, including other manual therapies or analgesic and anti-inflammatory medication.

3.2.6. Participant placement

Participants were stratified in number and gender between two groups of equal size (15 participants each).

3.3. Treatment Approach

3.3.1. First consultation

The first consultation included the completion of the following forms: the signing of the study-specific information and consent form (Appendix B) and completion of two subjective
data forms: a Numerical Pain Rating Scale (NPRS) (Appendix F) as well as an Oswestry Low Back Pain and Disability Questionnaire (Appendix G). Subjective data was recorded on the participants' data sheet (Appendix H).

A case history (Appendix I), physical examination (Appendix J) and lumbar spine and pelvis regional examination (Appendix K) were then completed. A SOAP note (Appendix L) was completed prior to treatment.

As part of the examination, mechanical low back pain was confirmed with a positive result in one or both of the following orthopaedic tests: Yeoman's Test or Kemp's Test (Walsh, 1998).

Objective measurements were also gathered, which included: lumbar spine range of motion (flexion, extension, lateral flexion and rotation) which was measured by the researcher using a digital inclinometer and recorded on the participants' data sheet (Appendix H).

Treatment was then applied according to the participants' allocated group:

- The first group received spinal manipulation to restricted lumbar spine and/or sacroiliac joints followed by the administration of subcutaneous parenteral Traumeel® by a supervised homeopathic student or registered homeopathic practitioner at the University of Johannesburg Day Clinic
- The second group received spinal manipulation to restricted lumbar spine and/or sacroiliac joints.

3.3.2. Follow-up consultations

- Participants were requested, at the beginning of the 4th and 7th visits, to complete two subjective data forms: a Numerical Pain Rating Scale (NPRS) (Appendix F) as well as an Oswestry Low Back Pain and Disability Questionnaire (Appendix G)
Lumbar spine range of motion (flexion, extension, lateral flexion and rotation) was measured by the researcher using a digital inclinometer at the beginning of the 4th and 7th visits.

Following data collection, participants were reassessed.

A SOAP note was completed prior to treatment.

Treatment was then applied according to the participants’ allocated group.

The final (7th) consultation was used for data collection alone, with no application of treatment.

A total of 6 treatments (including the first visit) took place over a maximum 3 week period.

3.4. Subjective Measurements

3.4.1. Numerical Pain Rating Scale

The Numerical Pain Rating Scale (NPRS) is a patient-completed 11-point pain scale. Eleven blocks are used where the participant chose the block with the description most accurately corresponding to the perception of their pain and disability at a given point in time. Ratings of the Scale are between 0 (no pain) and 10 (worst possible pain), with mild pain being represented by a lower number (such as 3) and severe pain represented by a higher number (7 or higher) (McCaffery and Pasero, 1999).

The Scale was developed by Downie, Leatham, Rhind, Wright, Branco and Anderson (1978) who showed that an 11-point pain scale has better performance than both a 4-point or Visual Analog Scale. The Scale has been shown to be reliable and valid (Jensen and McFarland, 1993) as well as responsive in a comparison study between three pain scales (Bolton and Wilkinson, 1998).

3.4.2. Oswestry Low Back Pain and Disability Questionnaire

The Oswestry Low Back Pain and Disability Questionnaire (ODQ) is designed to assess the effect of low back pain on daily activities. There are a total of 10 questions, with 6
possible answers per question. Each question has a maximum score of 5 and a minimum score of 0. The points per section are then tallied up to get a final score out of a possible fifty points (Fairbank and Pynsent, 2000).

If more than one option per section was selected, the worst of the options was selected. Nine out of ten sections were calculated if any section was left out.

Score interpretation for the ODQ (Fairbank and Pynsent, 2000):

- 0 – 10: Minimal disability
- 11 – 20: Moderate disability
- 21 – 30: Severe disability
- 31 – 40: Crippled
- 41 – 50: Bed-bound or exaggerating symptoms

Jayson (1992) showed that the ODQ has both sensitivity, as well as internal consistency. In a study performed by Fisher and Johnston (1997), it was found that the ODQ reliably measures the index of disability in patients who have been suffering from chronic pain. In a recent study, Astfalck, O’Sullivan, Straker, Smith, Burnett, Caneiro and Dankaerts (2010) affirm that the ODQ is both reliable and valid in the evaluation of chronic low back pain and disability in both adults as well as adolescents. A critical comparative study by Rocchi, Sisti, Benedetti, Valentini, Bellagamba and Federici (2005) demonstrated that of nine self-administered questionnaires, the ODQ is among the top two recommended to be used in the psychometric assessment of low back pain and disability, since it has the most reliable, valid and responsive characteristics.

3.5. Objective Measurements

3.5.1. Digital Inclinometer

A portable, hand held digital inclinometer (which has a LCD which displays its position) was used to assess lumbar ranges of motion in active flexion, extension, lateral flexion,
and rotation. Measurements for all ranges of motion were recorded at the L5-S1 and T12-L1 interspaces (Saunders, 1997). Range of motion values were noted and recorded in degrees (on the participants' data sheet – Appendix H). Once collated, results were then tabulated for comparison and statistical analysis.

Waddell, Somerville, Henderson and Newton (1992) investigated physical impairment in patients with chronic low back pain and showed that the single inclinometry technique is reliable. Prushansky, Deryi and Jabarreens (2010) showed that range of motion measurements based on digital inclinometry are both valid and reproducible.

**Lumbar spine flexion and extension**

1. The participant was asked to stand erect
2. The researcher identified the T12-L1 interspace
3. The digital inclinometer was placed at the T12-L1 interspace (Saunders, 1997)
4. The digital inclinometer was zeroed before range of motion was tested
5. The participant was asked to laterally flex maximally to the left or right, while maintaining knee extension
6. Measurements were recorded at the end range of lateral flexion
7. The digital inclinometer was then placed at the L5-S1 interspace (Saunders, 1997)
8. The digital inclinometer was zeroed before range of motion was tested
9. The participant was asked to laterally flex maximally to the left or right, while maintaining knee extension
10. Measurements were recorded at the end range of lateral flexion.

To determine the value of end range of lumbar spine lateral flexion, the values at the L5-S1 interspace were subtracted from the values at the T12-L1 interspace.
**Lumbar spine lateral flexion**

1. The participant was instructed to stand erect and then to flex forward at the hips, ensuring the lumbar spine was as horizontal as possible. This method isolated lumbar spine rotation and excluded rotation at the hips.
2. In this forward flexed position the researcher identified the T12-L1 interspace.
3. The digital inclinometer was placed at the T12-L1 interspace (Saunders, 1997).
4. The digital inclinometer was zeroed before range of motion was tested.
5. The participant was instructed to rotate maximally to the left or right, while maintaining knee extension.
6. Measurements were recorded at maximal rotation.
7. The digital inclinometer was then placed at the L5-S1 interspace (Saunders, 1997).
8. The digital inclinometer was zeroed before range of motion was tested.
9. The participant was instructed to rotate maximally to the left or right, while maintaining knee extension.
10. Measurements were recorded at maximal rotation.

To determine end range of lumbar spine rotation, the values at the L5-S1 interspace were subtracted from the values at the T12-L1 interspace.

**Lumbar spine rotation**

1. The participant was instructed to stand erect. To isolate lumbar spine rotation and exclude rotation at the hips, the participant was instructed to flex forward at the hips, ensuring the lumbar spine was as horizontal as possible.
2. In this forward flexed position the researcher identified the T12-L1 interspace.
3. The digital inclinometer was placed at the T12-L1 interspace (Saunders, 1997) and zeroed before range of motion was tested.
4. The participant was instructed to rotate maximally to the left or right, whilst maintaining knee extension.
5. Measurements were recorded at maximal rotation, bilaterally.
6. The digital inclinometer was then placed at the L5-S1 interspace (Saunders, 1997) and zeroed before range of motion was tested.

7. The participant was instructed to rotate maximally to the left or right, whilst maintaining knee extension.

8. Measurements were recorded at maximal rotation, bilaterally.

To determine end range of lumbar spine rotation, the values at the L5-S1 interspace were subtracted from the values at the T12-L1 interspace.

3.6. Data Analysis

Subjective and objective data was collected by the researcher over the study period and analysed by a statistician. The two sets of data upon which data analysis occurred were: objective readings taken by researcher, as well as subjective readings obtained from the Numerical Pain Rating Scales and Oswestry Low Back Pain and Disability Questionnaires completed by the participants.

A comparative analysis was made of the following data (which was collected on the first, fourth and seventh consultations): average (mean) lumbar range of motion, Numerical Pain Rating Scale and Oswestry Low Back Pain and Disability Questionnaire values. A paired sample t-test was used in the intragroup analysis to determine if there was a statistically significant change in the recorded data over time, from the first to the seventh consultation. By comparing data taken on the fourth visit with that taken on the first visit and the data taken on the seventh consultation with that taken on the first visit, the paired sample t-test helped to determine the stage at which the statistically significant change occurred. A statistically significant change in recorded data between group one and group two (recorded on the first, fourth and seventh consultation) was investigated by means of an intergroup analysis involving the use of an independent sample t-test. This method of analysis made it possible to determine if either of the two treatment protocols was preferential.
3.7. Ethical Considerations

All participants that qualified for this particular study were requested to read and sign the study-specific information and consent form. The form outlined the names of the researcher, purpose of the study and benefits of partaking in the study, participant assessment and treatment procedure. Any risks, benefits and discomforts pertaining to the treatments involved were also explained and that the participant’s safety would be ensured (prevention of harm). The information and consent form also explained that the participant’s privacy would be protected as only the doctor, patient and clinician would be in the treatment room and that anonymity would be ensured as the patient information will be converted into data and therefore would not be traceable back to the individual. The form also stated that standard doctor/patient confidentiality would be adhered to at all times 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. Should the participant have any further questions, these would be explained by the researcher; whose contact details were made available. The participants were then required to sign the information and consent form, signifying that they understood all that was required of them for this particular study. Results of the study would be made available on request.

With regards to this particular study, the risks, benefits and discomforts included those associated with lumbar spine and pelvic manipulation as well as the administration of Traumeel®. Furthermore, initial aggravation of symptoms following consultations and rare hypersensitivity reactions to Traumeel® were possible responses to treatment. However, potential benefits may have involved a decrease in the severity of the presenting symptoms over the course of the study.

Participants were to be referred if necessary.
CHAPTER FOUR: RESULTS

4.1 Introduction

The results obtained during the course of the clinical trial are presented in this chapter. All participants presented with mechanical low back pain and were divided into two groups of fifteen participants each. The first group received a combination of lumbar and/or pelvic manipulation in conjunction with subcutaneous parenteral Traumeel®. The second group received lumbar and/or spinal manipulation alone. The results obtained from both groups were compared. Due to the small sample groups which the statistical data represents, no assumptions can be made about the population as a whole. The probability level (p-value) was set at 0.05, with results therefore being statistically significant (at a 95% confidence interval) if p < 0.05.

The following analyses were performed:

1. Demographic data: age and gender distribution for group 1 and group 2.
2. Subjective measurements: Numerical Pain Rating Scale and Oswestry Low Back Pain and Disability Questionnaire
3. Objective measurements: Lumbar spine range of motion (ROM), including flexion, extension, lateral flexion (right and left) and rotation (right and left).

4.2. Demographic Data

4.2.1. Age distribution

Participants in group 1 ranged between the ages of 21 and 42 years of age, with a mean age of 26.87 years. Participants in group 2 ranged between the ages of 18 and 42 years, with a mean age of 24.93 years. The youngest participant was 18 years of age; the oldest participant was 42 years of age with the mean age for the entire study being 25.90 years.

The t-test was used to compare participant ages, with no statistically significant differences between the groups being found \( p = 0.376 \), indicating inter-group age comparability.
4.2.2. Gender distribution

Group 1 consisted of 7 males and 8 females (1:1.14 ratio) and group 2 consisted of 6 males and 9 females (1:1.5 ratio). A chi-square test was used to compare the gender distribution of participants, with no statistical difference being found between groups (\( p = 0.465 \)) indicating inter-group gender comparability.

4.3. Subjective Data Analysis

4.3.1. Numerical Pain Rating Scale

![Figure 4.1: Bar graph comparing mean Numerical Pain Rating Scale values](image)

Intragroup analysis of Numerical Pain Rating Scale

**Group 1:** It may be seen from Figure 4.1 that the mean NPRS value for group 1 was **5.47** at the first consultation, **3.13** at the fourth consultation and **1.73** at the seventh consultation. This indicates an overall decrease in mean NPRS values by **68.37%**. Comparative intragroup analysis was performed using a paired samples t-test:
In comparing the mean NPRS values of the fourth consultation with the first consultation, a statistically significant difference was found \( (p = 0.005) \)

In comparing the mean NPRS values of the seventh consultation with the first consultation, a statistically significant difference was found \( (p = 0.001) \)

In comparing the mean NPRS values of the seventh consultation with the fourth consultation, a statistically significant difference was found \( (p = 0.004) \).

**Group 2:** It may be seen from Figure 4.1 that the mean NPRS value for group 2 was 4.47 at the first consultation, 2.13 at the fourth consultation and 1.00 at the seventh consultation. This indicates an overall decrease in mean NPRS values by 77.63%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean NPRS values of the fourth consultation with the first consultation, a statistically significant difference was found \( (p = 0.001) \)
- In comparing the mean NPRS values of the seventh consultation with the first consultation, a statistically significant difference was found \( (p = 0.001) \)
- In comparing the mean NPRS values of the seventh consultation with the fourth consultation, a statistically significant difference was found \( (p = 0.003) \).

**Intergroup analysis of Numerical Pain Rating Scale**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean NPRS values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:

- In comparing the mean NPRS values of the first consultation (5.47 and 4.47 respectively), no statistically significant difference was found between group 1 and group 2 \( (p = 0.199) \)
- In comparing the mean NPRS values of the fourth consultation (3.13 and 2.13 respectively), no statistically significant difference was found between group 1 and group 2 \( (p = 0.075) \)
• In comparing the mean NPRS values of the seventh consultation (1.73 and 1.00 respectively), no statistically significant difference was found between group 1 and group 2 (p = 0.066).

4.3.2. Oswestry Low Back Pain and Disability Questionnaire

Intragroup analysis of Oswestry Low Back Pain and Disability Questionnaire

Group 1: It may be seen from Figure 4.2 that the mean Oswestry Low Back Pain and Disability Questionnaire value for group 1 was 7.25 at the first consultation, 3.20 at the fourth consultation and 1.55 at the seventh consultation. This indicates an overall decrease in mean Oswestry Low Back Pain and Disability Questionnaire values by 78.62%. Comparative intragroup analysis was performed using a paired samples t-test:

• In comparing the mean Oswestry Low Back Pain and Disability Questionnaire values of the fourth consultation with the first consultation, a statistically significant difference was found (p = 0.002)
In comparing the Oswestry Low Back Pain and Disability Questionnaire values of the seventh consultation with the first consultation, a statistically significant difference was found \( (p = 0.001) \). In comparing the Oswestry Low Back Pain and Disability Questionnaire values of the seventh consultation with the fourth consultation, a statistically significant difference was found \( (p = 0.003) \).

**Group 2:** It may be seen from Figure 4.2 that the mean Oswestry Low Back Pain and Disability Questionnaire value for group 2 was 6.53 at the first consultation, 3.30 at the fourth consultation and 2.33 at the seventh consultation. This indicates an overall decrease in Oswestry Low Back Pain and Disability Questionnaire values by 64.32%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean Oswestry Low Back Pain and Disability Questionnaire values of the fourth consultation with the first consultation, a statistically significant difference was found \( (p = 0.005) \).
- In comparing the Oswestry Low Back Pain and Disability Questionnaire values of the seventh consultation with the first consultation, a statistically significant difference was found \( (p = 0.002) \).
- In comparing the Oswestry Low Back Pain and Disability Questionnaire values of the seventh consultation with the fourth consultation, a statistically significant difference was found \( (p = 0.017) \).

**Intergroup analysis of Oswestry Low Back Pain and Disability Questionnaire**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean Oswestry Low Back Pain and Disability Questionnaire values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:
• In comparing the mean Oswestry Low Back Pain and Disability Questionnaire values of the first consultation (7.25 and 6.53 respectively), no statistically significant difference was found between group 1 and group 2 ($p = 0.607$)

• In comparing the mean Oswestry Low Back Pain and Disability Questionnaire values of the fourth consultation (3.20 and 3.30 respectively), no statistically significant difference was found between group 1 and group 2 ($p = 0.929$)

• In comparing the mean Oswestry Low Back Pain and Disability Questionnaire values of the seventh consultation (1.55 and 2.33 respectively), no statistically significant difference was found between group 1 and group 2 ($p = 0.360$).

4.4. Objective Data Analysis

4.4.1. Lumbar spine range of motion

Lumbar spine flexion

![Bar graph comparing mean flexion values of the lumbar spine](image)

Figure 4.3: Bar graph comparing mean flexion values of the lumbar spine
Intragroup analysis of lumbar spine flexion

**Group 1:** It may be seen from Figure 4.3 that the mean flexion for group 1 was \(50.60^\circ\) at the first consultation, \(48.40^\circ\) at the fourth consultation and \(52.47^\circ\) at the seventh consultation. This indicates an overall increase in flexion by 3.56%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean flexion values of the fourth consultation with the first consultation, no statistically significant difference was found \((p = 0.206)\)
- In comparing the mean flexion values of the seventh consultation with the first consultation, no statistically significant difference was found \((p = 0.470)\)
- In comparing the mean flexion values of the seventh consultation with the fourth consultation, no statistically significant difference was found \((p = 0.068)\).

**Group 2:** It may be seen from Figure 4.3 that the mean flexion for group 2 was \(48.80^\circ\) at the first consultation, \(51.73^\circ\) at the fourth consultation and \(47.67^\circ\) at the seventh consultation. This indicates an overall decrease in flexion values by 2.37%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean flexion values of the fourth consultation with the first consultation, no statistically significant difference was found \((p = 0.294)\)
- In comparing the mean flexion values of the seventh consultation with the first consultation, no statistically significant difference was found \((p = 0.477)\)
- In comparing the mean flexion values of the seventh consultation with the fourth consultation, no statistically significant difference was found \((p = 0.495)\).

**Intergroup analysis of lumbar spine flexion**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean flexion values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:
• In comparing the mean flexion values of the first consultation (50.60° and 48.80° respectively), no statistically significant difference was found between group 1 and group 2 (p = 0.593)

• In comparing the mean flexion values of the fourth consultation (48.40° and 51.73° respectively), no statistically significant difference was found between group 1 and group 2 (p = 0.422)

• In comparing the mean flexion values of the seventh consultation (52.47° and 47.67° respectively), no statistically significant difference was found between group 1 and group 2 (p = 0.345).

Lumbar spine extension

![Bar graph comparing mean extension values of the lumbar spine](image)

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

Intragroup analysis of lumbar spine extension

**Group 1**: It may be seen from Figure 4.4 that the mean extension for group 1 was **16.40°** at the first consultation, **17.00°** at the fourth consultation and **16.73°** at the seventh consultation. This indicates an overall increase in extension by **1.97%**. Comparative intragroup analysis was performed using a paired samples t-test:
In comparing the mean extension values of the fourth consultation with the first consultation, no statistically significant difference was found \( (p = 0.944) \)

In comparing the mean extension values of the seventh consultation with the first consultation, no statistically significant difference was found \( (p = 0.778) \)

In comparing the mean extension values of the seventh consultation with the fourth consultation, no statistically significant difference was found \( (p = 0.932) \).

**Group 2:** It may be seen from Figure 4.4 that the mean extension for group 2 was 21.87° at the first consultation, 20.87° at the fourth consultation and 22.67° at the seventh consultation. This indicates an overall increase in extension values by 3.53%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean extension values of the fourth consultation with the first consultation, no statistically significant difference was found \( (p = 0.609) \)
- In comparing the mean extension values of the seventh consultation with the first consultation, no statistically significant difference was found \( (p = 0.513) \)
- In comparing the mean extension values of the seventh consultation with the fourth consultation, no statistically significant difference was found \( (p = 0.753) \).

**Intergroup analysis of lumbar spine extension**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean extension values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:

- In comparing the mean extension values of the first consultation (16.40° and 21.87° respectively), no statistically significant difference was found between group 1 and group 2 \( (p = 0.136) \)
- In comparing the mean extension values of the fourth consultation (17.00° and 20.87° respectively), no statistically significant difference was found between group 1 and group 2 \( (p = 0.272) \)
In comparing the mean extension values of the seventh consultation (16.73° and 22.67° respectively), no statistically significant difference was found between group 1 and group 2 (p = 0.068).

**Lumbar spine left lateral flexion**

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

**Intragroup analysis of lumbar spine left lateral flexion**

**Group 1:** It may be seen from Figure 4.5 that the mean left lateral flexion for group 1 was 22.93° at the first consultation, 23.53° at the fourth consultation and 20.20° at the seventh consultation. This indicates an overall decrease in left lateral flexion by 13.51%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean left lateral flexion values of the fourth consultation with the first consultation, no statistically significant difference was found (p = 0.469)
- In comparing the mean left lateral flexion values of the seventh consultation with the first consultation, no statistically significant difference was found (p = 0.207)
• In comparing the mean left lateral flexion values of the seventh consultation with the fourth consultation, no statistically significant difference was found \(p = 0.073\).

**Group 2:** It may be seen from Figure 4.5 that the mean left lateral flexion for group 2 was 18.87° at the first consultation, 21.20° at the fourth consultation and 20.33° at the seventh consultation. This indicates an overall increase in left lateral flexion values by 7.18%. Comparative intragroup analysis was performed using a paired samples t-test:

• In comparing the mean left lateral flexion values of the fourth consultation with the first consultation, no statistically significant difference was found \(p = 0.372\)

• In comparing the mean left lateral flexion values of the seventh consultation with the first consultation, no statistically significant difference was found \(p = 0.593\)

• In comparing the mean left lateral flexion values of the seventh consultation with the fourth consultation, no statistically significant difference was found \(p = 1.00\).

**Intergroup analysis of lumbar spine left lateral flexion**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean left lateral flexion values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:

• In comparing the mean left lateral flexion values of the first consultation (22.93° and 18.87° respectively), a statistically significant difference was found between group 1 and group 2 \(p = 0.039\)

• In comparing the mean left lateral flexion values of the fourth consultation (23.53° and 21.20° respectively), no statistically significant difference was found between group 1 and group 2 \(p = 0.191\)

• In comparing the mean left lateral flexion values of the seventh consultation (20.20° and 20.33° respectively), no statistically significant difference was found between group 1 and group 2 \(p = 0.960\).
Figure 4.6: Bar graph comparing mean right lateral flexion values of the lumbar spine

Intragroup analysis of lumbar spine right lateral flexion

**Group 1:** It may be seen from Figure 4.6 that the mean right lateral flexion for group 1 was 22.40° at the first consultation, 23.20° at the fourth consultation and 20.53° at the seventh consultation. This indicates an overall decrease in right lateral flexion by 9.11%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean right lateral flexion values of the fourth consultation with the first consultation, no statistically significant difference was found (p = 0.776)
- In comparing the mean right lateral flexion values of the seventh consultation with the first consultation, no statistically significant difference was found (p = 0.490)
- In comparing the mean right lateral flexion values of the seventh consultation with the fourth consultation, no statistically significant difference was found (p = 0.093).

**Group 2:** It may be seen from Figure 4.6 that the mean right lateral flexion for group 2 was 19.00° at the first consultation, 20.60° at the fourth consultation and 21.33° at the seventh consultation.
consultation. This indicates an overall increase in right lateral flexion values by 10.92%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean right lateral flexion values of the fourth consultation with the first consultation, no statistically significant difference was found ($p = 0.623$)
- In comparing the mean right lateral flexion values of the seventh consultation with the first consultation, no statistically significant difference was found ($p = 0.232$)
- In comparing the mean right lateral flexion values of the seventh consultation with the fourth consultation, no statistically significant difference was found ($p = 0.683$).

**Intergroup analysis of lumbar spine right lateral flexion**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean right lateral flexion values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:

- In comparing the mean right lateral flexion values of the first consultation ($22.40^\circ$ and $19.00^\circ$ respectively), no statistically significant difference was found between group 1 and group 2 ($p = 0.110$)
- In comparing the mean right lateral flexion values of the fourth consultation ($23.20^\circ$ and $20.60^\circ$ respectively), no statistically significant difference was found between group 1 and group 2 ($p = 0.267$)
- In comparing the mean right lateral flexion values of the seventh consultation ($20.53^\circ$ and $21.33^\circ$ respectively), no statistically significant difference was found between group 1 and group 2 ($p = 0.721$).
Intragroup analysis of lumbar spine left rotation

Group 1: It may be seen from Figure 4.7 that the mean left rotation for group 1 was 13.00° at the first consultation, 12.93° at the fourth consultation and 15.33° at the seventh consultation. This indicates an overall increase in left rotation by 15.20%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean left rotation values of the fourth consultation with the first consultation, no statistically significant difference was found (p = 0.932)
- In comparing the mean left rotation values of the seventh consultation with the first consultation, a statistically significant difference was found (p = 0.040)
- In comparing the mean left rotation values of the seventh consultation with the fourth consultation, no statistically significant difference was found (p = 0.074).

Group 2: It may be seen from Figure 4.7 that the mean left rotation for group 2 was 13.27° at the first consultation, 15.93° at the fourth consultation and 13.67° at the seventh
consultation. This indicates an overall increase in left rotation values by 2.93%.
Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean left rotation values of the fourth consultation with the first consultation, no statistically significant difference was found \( p = 0.093 \)
- In comparing the mean left rotation values of the seventh consultation with the first consultation, no statistically significant difference was found \( p = 0.900 \)
- In comparing the mean left rotation values of the seventh consultation with the fourth consultation, no statistically significant difference was found \( p = 0.096 \).

**Intergroup analysis of lumbar spine left rotation**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean left rotation values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:

- In comparing the mean left rotation values of the first consultation \((13.00^\circ \text{ and } 13.27^\circ\) respectively), no statistically significant difference was found between group 1 and group 2 \( p = 0.865 \)
- In comparing the mean left rotation values of the fourth consultation \((12.93^\circ \text{ and } 15.93^\circ\) respectively), no statistically significant difference was found between group 1 and group 2 \( p = 0.137 \)
- In comparing the mean left rotation values of the seventh consultation \((15.33^\circ \text{ and } 13.67^\circ\) respectively), no statistically significant difference was found between group 1 and group 2 \( p = 0.403 \).
Lumbar spine right rotation

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

Intragroup analysis of lumbar spine right rotation

Group 1: It may be seen from Figure 4.8 that the mean right rotation for group 1 was 12.07° at the first consultation, 12.00° at the fourth consultation and 13.60° at the seventh consultation. This indicates an overall increase in right rotation by 11.25%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean right rotation values of the fourth consultation with the first consultation, no statistically significant difference was found (p = 0.832)
- In comparing the mean right rotation values of the seventh consultation with the first consultation, no statistically significant difference was found (p = 0.196)
- In comparing the mean right rotation values of the seventh consultation with the fourth consultation, no statistically significant difference was found (p = 0.232).

Group 2: It may be seen from Figure 4.8 that the mean right rotation for group 2 was 11.80° at the first consultation, 12.53° at the fourth consultation and 13.07° at the seventh
consultation. This indicates an overall increase in right rotation values by 9.72%. Comparative intragroup analysis was performed using a paired samples t-test:

- In comparing the mean right rotation values of the fourth consultation with the first consultation, no statistically significant difference was found \((p = 0.448)\)
- In comparing the mean right rotation values of the seventh consultation with the first consultation, no statistically significant difference was found \((p = 0.458)\)
- In comparing the mean right rotation values of the seventh consultation with the fourth consultation, no statistically significant difference was found \((p = 0.670)\).

**Intergroup analysis of lumbar spine right rotation**

Intergroup analysis was performed in the following manner: an independent samples t-test was utilised to compare the mean right rotation values between group 1 and group 2 at the first consultation, fourth consultation and seventh consultation:

- In comparing the mean right rotation values of the first consultation \((12.07^\circ \text{ and } 11.80^\circ \text{ respectively})\), no statistically significant difference was found between group 1 and group 2 \((p = 0.864)\)
- In comparing the mean right rotation values of the fourth consultation \((12.00^\circ \text{ and } 12.53^\circ \text{ respectively})\), no statistically significant difference was found between group 1 and group 2 \((p = 0.762)\)
- In comparing the mean right rotation values of the seventh consultation \((13.60^\circ \text{ and } 13.07^\circ \text{ respectively})\), no statistically significant difference was found between group 1 and group 2 \((p = 0.762)\).
CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter discusses the results of the clinical trial (as presented in chapter four). It further outlines possible explanations for the results by referring to literature discussed in chapter two as well as results obtained from other studies. Both the statistical significance as well as the clinical significance are discussed. Statistical significance denotes a result that is unlikely to have occurred by chance alone, but rather has a causative factor (Mosby’s Medical Dictionary, 2009). Clinical significance denotes a result that imparts a practical relevance which is not necessarily dependent on statistical significance (McGraw-Hill Concise Dictionary of Modern Medicine, 2002).

5.2. Demographic Data

Each group in the study was comprised of 15 participants each, with group 1 consisting of 7 males and 8 females (1:1.14 ratio) and group 2 consisting of 6 males and 9 females (1:1.5 ratio). Inter-group gender comparability was affirmed using a chi-square test.

The ages of the participants in group 1 ranged between 21 and 42 years of age, with a mean age of 26.87 years. The ages of participants in group 2 ranged between 18 and 42 years, with a mean age of 24.93 years. Inter-group age comparability was affirmed using a t-test.

The mean age for the entire study was 25.90 years which corresponds consistently with the results of a study which demonstrated that the incidence of chronic, impairing low back pain in adults over the age of 21 years is common, with an average prevalence of 10.2% (Freburger, Holmes, Agans, Jackman, Darter, Wallace, Castel, Kalsbeek and Carey, 2009). Another study by Louw, Morris and Grimmer-Somers (2007) showed a 62% lifetime prevalence of low back pain in adults over 20 years of age, which also corresponds to the average age of this study in which low back pain was encountered. These two studies demonstrate that the demographic spread (in terms of mean age) of patients suffering from
mechanical low back pain in the present study are consistent with what is observed in the general population.

5.3. Subjective Data

5.3.1. Numerical Pain Rating Scale

Clinical Analysis

As is observed from Figure 4.1, both group 1 and 2 demonstrated a clinically significant reduction in NPRS values. Mean NPRS values decreased by 68.37% in group 1, and by 77.63% in group 2. Group 2 therefore demonstrated the most clinically significant improvement over the course of the study.

Intragroup analysis

A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in NPRS values over time. It was revealed that both groups 1 and 2 demonstrated statistically significant changes over the course of the study.

Intergroup analysis

An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in NPRS values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was revealed that no statistically significant difference between groups 1 and 2 was found at the first consultation, fourth consultation or seventh consultation.
5.3.2. Oswestry Low Back Pain and Disability Index

Clinical analysis

As is observed from Figure 4.2, both group 1 and 2 demonstrated a clinically significant reduction in Oswestry Low Back Pain and Disability Index values. Mean Oswestry Low Back Pain and Disability Index values in group 1 decreased by 78.62% and by 64.32% in group 2. Group 1 therefore demonstrated the most clinically significant improvement over the course of the study.

Intragroup analysis

A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in Oswestry Low Back Pain and Disability Index values over time. It was revealed that both groups 1 and 2 demonstrated statistically significant changes over the course of the study.

Intergroup analysis

An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in Oswestry Low Back Pain and Disability Index values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was revealed that no statistically significant difference between groups 1 and 2 was found at the first consultation, fourth consultation or seventh consultation.

5.3.3 Outcomes of subjective data

Numerical Pain Rating Scale: As seen in chapter four, the mean NPRS values (and hence, participants' perception of pain) showed a substantial reduction during the course of the study. Notwithstanding this clinically significant finding, no statistically significant difference was found in the comparison between the mean NPRS values of group 1 and group 2.
Oswestry Low Back Pain and Disability Index: Mean Oswestry Low Back Pain and Disability Index values (and hence, participants' perception of disability due to pain) showed a substantial reduction during the course of the study. The initial mean Oswestry Low Back Pain and Disability Index value for group 1 (7.25) and group 2 (6.53) both fell within the upper limit of the “minimal disability” category as described in chapter three (Fairbank and Pynsent, 2000). At the end of the study, the mean values for group 1 (1.55) and group 2 (2.33) had dropped to the lower limit of the “minimal disability” category. Notwithstanding this clinically significant finding, no statistically significant difference was found in the comparison between the mean Oswestry Low Back Pain and Disability Index values of group 1 and group 2.

Both group 1 and group 2 revealed positive clinical and statistical changes over the course of the seven consultations. However, comparative analysis of group 1 and group 2 revealed that the participants' perceived reduction in pain, or disability due to pain, was not statistically significant. As neither treatment protocol shows a superiority with reference to pain perception and disability due to pain (intergroup analysis), the results carry a possible suggestion that chiropractic manipulation (common to both groups) is effective in ameliorating participant-rated pain and disability, in the case of chronic mechanical low back pain.

In a prospective cohort study of 68 patients with chronic low back pain, it was concluded that “medication-assisted manipulation appears to offer some patients increased improvement in low back pain and disability” (Kohlbeck, Haldeman, Hurwitz, and Dagenais, 2005). The study compared a group of patients treated with Medication-Assisted Manipulation (MAM) to a group treated with manipulation alone. The MAM group showed a statistical advantage over the manipulation-only group. The results of the present study (in which no statistical advantage of the combination group was demonstrated) do not conform to those of the Kohlbeck et al. (2005) study. A possible explanation for this is that the participants in the present study were suffering with chronic mechanical low back pain. Thus, the benefits of Traumeel®, which is primarily an “effective medication for acute injuries and inflammation of the musculoskeletal system” (Heel USA,
2008), may have been less apparent due to the chronicity of the patients’ presenting complaint.

Descarreaux, Blouin, Drolet, Papadimitriou, and Teasdale (2004), conducted a study to assess the efficacy of spinal manipulation in the treatment of chronic low back pain. It was concluded from this study that evidence exists supporting the use of spinal manipulation in the treatment of chronic low back pain with reference to patient-rated pain and disability. In view of the fact that the present study used spinal manipulation as a common treatment in both groups, the findings of the Descarreaux et al. (2004) study, support the findings of subjective clinical improvement as well as intragroup statistically significant changes (as seen in relevant reductions in NPRS and Oswestry Low Back Pain and Disability mean values).

In a local study by Van Aswegen, Yelverton and Pretorius (2001), which compared diversified chiropractic manipulative therapy and Traumeel® S, it was concluded that manipulative therapy does have an advantage over other forms of treatment in the initial stages of pain and disability management. This corresponds to the suggested conclusion to the present study that chiropractic manipulation (common to both groups) is effective in ameliorating participant-rated pain and disability, in the case of chronic mechanical low back pain.

Another local study by Arrandale, Moodley and Razlog (2005), compared oral Traumeel®, parenteral Traumeel® and chiropractic manipulation in the treatment of mechanical neck pain. No definite conclusion was drawn from the results, but it was suggested that oral and parenteral Traumeel® and chiropractic manipulation are effective in the treatment of posterior mechanical neck pain, producing both favourable subjective and objective results upon analysis. These results differ from the results of the present study (in that no clear conclusion about Traumeel® could be drawn). Nevertheless, the study does support the conclusion of the present study demonstrating the efficacy of chiropractic manipulation, and suggests that there is further scope for research involving mechanical musculoskeletal complaints and intervention with Traumeel®.
This suggestion is further supported by the results of another local study by Cape, Razlog and Palmer (2005) which compared parenteral and oral Traumeel® in the treatment of cervical facet syndrome. The study showed clinical improvement and statistically relevant changes after treatment with Traumeel®.

As previously demonstrated, a comprehensive understanding of the mechanisms by which spinal manipulation decreases pain and disability are still under discussion. Sources of mechanical pain are proposed to be removed, and analgesia stimulated, by means of spinal manipulation (Peterson and Bergmann, 2002). Gay, Bronfort, and Evans (2005) showed in a study that mechanoreceptor stimulation and segmental muscle stretching as a result of chiropractic manipulation has an analgesic effect.

As discussed previously, subcutaneous parenteral Traumeel® is indicated in the treatment of inflammatory musculoskeletal conditions and the relief of pain by acting on and optimising the whole process of recovery beginning with the inflammation cascade (Heel USA, 2008).

5.4. Objective Data

5.4.1. Lumbar spine range of motion

Lumbar spine flexion

Clinical analysis. As is observed from Figure 4.3, both group 1 and 2 demonstrated a marginal clinically significant change in mean lumbar spine flexion. Over the course of the study, mean flexion values increased by 3.56% in group 1 and decreased by 2.37% in group 2. Group 1 therefore demonstrated the most clinically significant improvement over the course of the study.

Intragroup analysis. A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in mean flexion values over time. It was revealed that both group 1 and group 2 demonstrated no statistically significant changes over the course of the study. This was determined by comparing values in the following
manner: mean flexion values of the fourth consultation with those of the first consultation, mean flexion values of the seventh consultation with those of the fourth consultation and mean flexion values of the seventh consultation with those of the first consultation.

**Intergroup analysis.** An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in mean flexion values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was revealed that no statistically significant difference between groups 1 and 2 was found at the first consultation, fourth consultation or seventh consultation.

**Lumbar spine extension**

**Clinical analysis.** As is observed from Figure 4.4, both group 1 and 2 demonstrated a marginal clinically significant change in mean lumbar spine extension. Over the course of the study, mean extension values increased by 1.97% in group 1 and increased by 3.53% in group 2. Group 2 therefore demonstrated the most clinically significant improvement over the course of the study.

**Intragroup analysis.** A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in mean extension values over time. It was revealed that both group 1 and group 2 demonstrated no statistically significant changes over the course of the study. This was determined by comparing values in the following manner: mean extension values of the fourth consultation with those of the first consultation, mean extension values of the seventh consultation with those of the fourth consultation and mean extension values of the seventh consultation with those of the first consultation.

**Intergroup analysis.** An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in mean extension values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was revealed that no statistically significant difference between groups 1 and 2 was found at the first consultation, fourth consultation or seventh consultation.
Lumbar spine left lateral flexion

Clinical analysis. As is observed from Figure 4.5, both group 1 and 2 demonstrated a clinically significant change in mean lumbar spine left lateral flexion. Over the course of the study, mean left lateral flexion values in group 1 decreased by 13.51% and increased by 7.18% in group 2. Group 2 therefore demonstrated the most clinically significant improvement over the course of the study.

Intragroup analysis. A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in mean left lateral flexion values over time. It was revealed that both group 1 and group 2 demonstrated no statistically significant changes over the course of the study. This was determined by comparing values in the following manner: mean left lateral flexion values of the fourth consultation with those of the first consultation, mean left lateral flexion values of the seventh consultation with those of the fourth consultation and mean left lateral flexion values of the seventh consultation with those of the first consultation.

Intergroup analysis. An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in mean left lateral flexion values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was revealed that no statistically significant difference between groups 1 and 2 was found at the fourth consultation and seventh consultation. However, a statistically significant difference was noted between group 1 and 2 at the first consultation.

Lumbar spine right lateral flexion

Clinical analysis. As is observed from Figure 4.6, both group 1 and 2 demonstrated a clinically significant change in mean lumbar spine right lateral flexion. Over the course of the study, mean right lateral flexion values in group 1 decreased by 9.11% and increased by 10.92% in group 2. Group 2 therefore demonstrated the most clinically significant improvement over the course of the study.
Intragroup analysis. A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in mean right lateral flexion values over time. It was revealed that both group 1 and group 2 demonstrated no statistically significant changes over the course of the study. This was determined by comparing values in the following manner: mean right lateral flexion values of the fourth consultation with those of the first consultation, mean right lateral flexion values of the seventh consultation with those of the fourth consultation and mean right lateral flexion values of the seventh consultation with those of the first consultation.

Intergroup analysis. An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in mean right lateral flexion values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was revealed that no statistically significant difference between groups 1 and 2 was found at the first consultation, fourth consultation or seventh consultation.

Lumbar spine left rotation

Clinical analysis. As is observed from Figure 4.7, both group 1 and 2 demonstrated a marginal clinically significant change in mean lumbar spine left rotation. Over the course of the study, mean left rotation values in group 1 increased by 15.20% and increased by 2.93% in group 2. Group 1 therefore demonstrated the most clinically significant improvement over the course of the study.

Intragroup analysis. A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in mean left rotation values over time. It was revealed that group 1 demonstrated statistically significant changes in left rotation over the course of the study.

In comparing mean left rotation readings recorded at the fourth consultation with those recorded at the first consultation, no statistically significant changes were noted in either group 1 or group 2. In comparing mean left rotation readings recorded at the seventh consultation with those recorded at the fourth consultation, no statistically significant
changes were noted in either group 1 or group 2. In comparing mean left rotation readings recorded at the seventh consultation with those recorded at the first consultation, a statistically significant change was noted in group 1. No statistically significant change, however, was noted in group 2.

**Intergroup analysis.** An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in mean left rotation values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was revealed that no statistically significant difference between groups 1 and 2 was found at the first consultation, fourth consultation or seventh consultation.

**Lumbar spine right rotation**

**Clinical analysis.** As is observed from Figure 4.8, both group 1 and 2 demonstrated a marginal clinically significant change in mean lumbar spine right rotation. Over the course of the study, mean right rotation values in group 1 increased by 11.25% and increased by 9.72% in group 2. Group 1 therefore demonstrated the most clinically significant improvement over the course of the study.

**Intragroup analysis.** A paired samples t-test was used to determine and reveal any statistically significant intragroup changes in mean right rotation values over time. It was revealed that both group 1 and group 2 demonstrated no statistically significant changes over the course of the study. This was determined by comparing values in the following manner: mean right rotation values of the fourth consultation with those of the first consultation, mean right rotation values of the seventh consultation with those of the fourth consultation and mean right rotation values of the seventh consultation with those of the first consultation.

**Intergroup analysis.** An independent samples t-test was used to determine and reveal any statistically significant intergroup changes in mean right rotation values between group 1 and 2 at the first consultation, fourth consultation and seventh consultation. It was
revealed that no statistically significant difference between groups 1 and 2 was found at the first consultation, fourth consultation or seventh consultation.

5.4.2. Outcomes of objective data

Clinical outcomes. Analysis of the percentage change in lumbar spine range of motion values revealed that both group 1 and group 2 demonstrated clinically significant changes in flexion, extension, lateral flexion and rotation. Group 1 showed the most clinically significant improvement in flexion, left rotation and right rotation. Group 2 showed the most clinically significant improvement in extension, left lateral flexion and right lateral flexion. Results therefore suggest that neither group demonstrated a clinically significant superiority in terms of lumbar spine range of motion.

A possible explanation for the increase in flexion in group 1, left and right lateral flexion in group 2 and in extension and left and right rotation in both group 1 and 2 is that, as previously discussed in chapter two, the chiropractic manipulation ameliorated movement-inhibiting muscle hypertonicity on a segmental level (Peterson and Bergmann, 2002). Furthermore, the chiropractic manipulation would have restored function to previously subluxated motion segments, and therefore would have allowed for positive clinical changes in range of motion. This is supported by a recent study performed by Cramer, Ross, Pocius, Cantu, Laptook, Fergus, Gregerson, Selby and Raju (2011) which concluded that the chiropractic adjustment positively improves a joint's degree of gapping and hence, its range of motion.

Conversely, marginal decreases were noted in flexion in group 2 and left and right lateral flexion in group 1. A possible explanation for the left lateral flexion variance between groups is that there was an outlier left lateral flexion value recorded on the seventh consultation with one of the patients in group 2. The value was a negative figure (due to recording error) and may have influenced the final clinical outcome.

Statistical outcomes. As seen in chapter four, all lumbar spine range of motion analyses (except for left rotation in group 1), demonstrated no significant statistical change over the course of the study. This lack of statistical significance may be due to the random
sampling variability of the study. Measures were taken however, to ensure that there was a consistent accuracy during all lumbar spine measurement collection. These measures included: ensuring that the digital inclinometer was correctly placed, and zeroed in the same manner before each reading as well as ensuring that participants maintained knee extension during measurement collection.

In a study performed by Essendrop, Maul, Läubli, Riihimäki and Schibye (2002), it was concluded that there remains “a considerable lack of information about the reproducibility of functional measures for the low back” and as a consequence, there is a lack of general agreement as to the recommended procedure in obtaining objective measurements from the low back. This lack of consensus is consistent with the lack of statistically significant intragroup and intergroup outcomes of range of motion measurements in this particular study. One exception to the Essendrop et al. (2002), study conclusion was given: tests in the sagittal plane were found to be reliable. Therefore, it is noteworthy that the change in left rotation in group 1 in the present study was statistically significant, since this correlates to the findings by Essendrop et al. (2002).

Had more consultations been included in the treatment protocol and had the study groups been larger, group 1 may have shown a statistically significant increase in flexion, extension, right lateral flexion and rotation; and group 2 may have shown a statistically significant increase in flexion, extension, lateral flexion and rotation. Increasing the sample size of a study increases the statistical sensitivity and power, therefore resulting in a greater chance of obtaining statistically relevant outcomes (Murphy and Myors, 2004).

The final intergroup analysis of groups 1 and 2 revealed that only on left lateral flexion, was a statistically significant difference noted. This difference, however, was only noted on the first consultation prior to treatment, and therefore carries smaller statistical and clinical relevance than if the statistical difference was noted on the fourth or seventh consultation. Given this finding, it is safe to suggest that spinal manipulation of the lumbar spine and/or pelvis in conjunction with subcutaneous parenteral Traumeel® does not have a synergistic effect and thus is not more effective than spinal manipulation alone in increasing lumbar spine range of motion in the treatment of chronic mechanical low back pain. This may be due to insufficient penetration of the Traumeel® into the deep anatomical structures of the
low back, or the chronicity of the participants' mechanical low back pain and its resilience in light of the acute indications of Traumeel® (Heel USA, 2008). Thus, conjunctive therapy may be more effective in the treatment of acute musculoskeletal conditions, given the fact that Traumeel® is indicated primarily for acute musculoskeletal conditions, not chronic conditions as in the case of this study (Biologische Heilmittel Heel GmbH, 2006).

The results of this study suggest that spinal manipulation is effective in increasing lumbar spine range of motion in patients suffering with chronic mechanical low back pain.

Numerous mechanisms by which spinal manipulation may increase range of motion have been meticulously discussed in the literature review of chapter two. Joint dysfunction, with concomitant muscular hypertonicity is associated with restriction of movement (Peterson and Bergmann, 2002). Additionally, several intra-articular sources of segmental subluxation and joint restriction have been proposed: intradiscal derangement, intercapsular adhesions and posterior joint derangement. Several extra-articular sources have also been proposed: periarticular soft tissue fibrosis and attenuation as well as segmental muscle spasm (Peterson and Bergmann, 2002). As noted in chapter two, spinal manipulation may be positively effective in addressing the above causes of joint dysfunction, with commonly associated cavitation and the end result of increased joint range of motion (Cramer, Ross, Pocius, Cantu, Laptook, Fergus, Gregerson, Selby and Raju, 2011).

Mechanoreceptor stimulation as well as segmental musculature stretching via chiropractic manipulation is proposed to reduce “hypertonicity and segmental analgesia” and thus result in muscle relaxation as well as improved biomechanics and range of motion (Gay, Bronfort, and Evans, 2005).
CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The aim of this comparative study was to compare the effect of lumbar spine and/or sacroiliac joint manipulation versus lumbar spine and/or sacroiliac joint manipulation in conjunction with subcutaneous parenteral Traumeel® in the treatment of chronic mechanical low back pain with reference to pain, disability and lumbar spine range of motion. These effects were based on digital inclinometer measurements of lumbar spine range of motion and results obtained from the Numerical Pain Rating Scale (NPRS) and Oswestry Low Back Pain and Disability Questionnaire.

When mean NPRS and Oswestry Low Back Pain and Disability Questionnaire values as well as lumbar spine range of motion values were compared between group 1 and group 2 at the first consultation, fourth consultation and at the seventh consultation, no statistically significant differences were found. This suggests that the spinal manipulation of the lumbar spine and/or pelvis in conjunction with subcutaneous parenteral Traumeel® does not have a synergistic effect and thus, as neither group is preferential (by demonstrating statistical outcome superiority), it is possible that chiropractic manipulation alone is effective in reducing pain and disability and increasing lumbar spine range of motion. Spinal manipulation is therefore a safe, cost-effective and non-invasive intervention therapy for the treatment of chronic mechanical low back pain. Based upon other studies as outlined in chapter five, it is suggested that while no clear conclusion about the efficacy of Traumeel® in the treatment of mechanical low back pain could be drawn from the results of the present study, there is still further scope for research involving mechanical musculoskeletal complaints and intervention with Traumeel®.

Upon review and analysis of the clinical findings and subjective and objective measurements, it is patent that the results of this study carry relevance for the chiropractic profession for four reasons: first, that the expected outcomes have been queried; second, that chiropractic manipulation is proposed to be a cost-effective form of treatment for chronic mechanical low back pain; third, in affirming and augmenting the current theoretical
paradigm relative to the connection between mechanical pain and the anatomical structures of the lumbar spine and pelvis; fourth, in supporting the widely accepted paradigm within the chiropractic profession relative to the primacy and centrality of spinal manipulation.

6.2. Recommendations

Improvement and validation of the initial results of this study may be achieved by further studies conducted according to the following recommendations:

- Three participant groups should be included in further research. One treatment group receiving spinal manipulation alone, another receiving subcutaneous parenteral Traumeel® alone, and the last group receiving a combination of spinal manipulation and subcutaneous parenteral Traumeel®. This will allow for a direct comparison between groups and provide further data to evaluate the favourability of combination treatment.
- Further research should involve participants suffering from acute mechanical low back pain. The benefits of treatment with Traumeel® may be more apparent in the case of an acute inflammatory condition, with reference to pain, disability and lumbar spine range of motion.
- A more extensive research study should be performed by including more participants, creating larger sample groups which will provide more information and will more accurately represent the general population.
- Future research should be conducted with participants falling within a smaller age bracket, in order to help determine a change, similarity or improvement in results.
- Further objective measurements such as a pressure algometer should be used to measure pain over the course of the study.
- In order to investigate the immediate and long term effects of treatment, objective and subjective readings should be taken both prior to and after consultations.
- In order to determine the long-term benefits of treatment, a followup consultation should be included a month after the final consultation.
The inclusion of cervical and thoracic spinal manipulation should be included in the treatment protocol, in addition to lumbar spine and pelvic manipulation. This is suggested in order to correct the whole clinical picture in connection with the kinesiopathology of low back pain.

Diversified chiropractic techniques were used to manipulate lumbar spine and pelvic joints. Further comparative studies should be performed to determine the efficacy of chiropractic diversified technique versus other techniques, such as Gonstead, Thompson drop-pieces, sacro-occipital technique.

With the consideration that myofascial pain and dysfunction forms a significant part of the clinical picture of low back pain, it is suggested that spinal manipulation be compared to other forms of myofascial therapy such as Biopuncture with Traumeel®, dry needling, or ischaemic compression of active myofascial trigger points.

Subcutaneous parenteral Traumeel® alone was used in the combination group. Further comparative studies should be performed to determine the efficacy of Traumeel® versus other Homeopathic medication such as Spascupreel®, Lymphomyosot® and Discus Compositum®.
REFERENCES


APPENDICES

APPENDIX A

Advertisement

Do you suffer from LOW BACK PAIN

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If you are between the ages of 18 and 45, you may be eligible to participate in a research study aimed at relieving your back pain. Treatment is voluntary, free of charge, and will take place under professional supervision at the University of Johannesburg Doornfontein Campus Clinic (Gate 7, Sherwell Road, Doornfontein)
For more information please contact David Peyton on 084 512 8356 / david@peyton.co.za
APPENDIX B

INFORMATION AND CONSENT FORM

DEPARTMENT OF CHIROPRACTIC

I, David Peyton, hereby invite you to participate in my research study. I am currently a Chiropractic student, completing my Masters Degree in Chiropractic at the Faculty of Health Sciences of the University of Johannesburg.

The aim of this study is to compare the effectiveness of subcutaneous parenteral Traumeel® combined with spinal manipulative therapy over a three-week period and spinal manipulative therapy alone in the treatment of chronic mechanical low back pain. Traumeel® is a safe, effective and well tolerated homeopathic preparation used in the treatment of various musculoskeletal ailments.

Group one (Test group) will receive lumbar spine and/or sacroiliac adjustment(s) over the restricted joint(s) together with the application of Traumeel®. Group two (Control group) will receive lumbar spine and/or sacroiliac adjustment(s) over the restricted joint(s). The Chiropractic adjustment involves the restoration of normal joint motion. Abnormal joint motion will be detected by the researcher via motion palpation. The Chiropractic adjustment is a safe, non-invasive treatment technique. The study will take place over a maximum span of three weeks, with participants receiving a total of six treatments.

The research study will take place at the University of Johannesburg Doornfontein Campus Chiropractic Day Clinic. Your privacy will be protected (treatment in a private room with only the doctor and/or student present), anonymity maintained (research data, analysis...
and preparation will maintain anonymity and you will not be able to be traced) and standard patient-doctor confidentiality will be upheld throughout the research process.

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. Treatment is free of charge, and will occur under the supervision of a qualified clinician. The benefit of participating in this study is that you may experience relief from your symptoms in terms of decreased pain, decreased stiffness and increased range of movement. Please note that a small risk of temporary exacerbation of symptoms does exist; however this is a normal response to the treatment, lasting only a few days. A small, in fact negligible, risk of a hypersensitivity reaction does exist after the administration of Traumeel®. A qualified nurse, homeopathic students, registered homeopathic practitioner(s) and appropriate medical equipment is readily available and emergency procedures are in place at the University of Johannesburg Day Clinic if such a reaction does occur. Results of this study will be made available to you on request.

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 procedures to be followed and have been 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 any 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.

<table>
<thead>
<tr>
<th>Role</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researcher: David Peyton</td>
<td>Cell: 084 512 8356</td>
</tr>
<tr>
<td>Supervisor: Dr C. Yelverton</td>
<td>Tel: (011) 559 6218</td>
</tr>
<tr>
<td>Co-supervisor: Dr N. Gower</td>
<td>Tel: (011) 559 6779</td>
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APPENDIX C

Orthopaedic tests

Yeoman's Test

In Yeoman’s Test, the patient lies prone. The pelvis is stabilised by means of the examiner’s contact hand applying pressure to the sacroiliac joint. Simultaneously, the examiner contacts the test leg above the knee and passively extends the thigh at the hip joint. A positive test is indicated by pain over the ipsilateral sacroiliac joint (Magee 2008).

Kemp’s Test

Kemp's Test is also known as the Quadrant Test. This orthopaedic test is designed to cause maximum narrowing of the intervertebral foramen and maximal stress on the facet joint to the side that is being tested. The patient is seated in an unsupported position with the examiner standing behind. A thumb contact is then placed over the facet joint being tested. Using the other hand, facilitating movement, the examiner passively extends, laterally flexes, and rotates the participant to one side. Thumb pressure and movement is continued until the end range of motion or the reproduction of symptoms (Magee, 2008). The test is then repeated at each facet joint of the same side and then the opposite side of the lumbar spine. A positive test is indicated by local pain over the facet joint (beneath thumb pressure). Radiating pain going down the leg is also a positive for Kemp’s Test (Morris, 2005).
APPENDIX D

Contra-Indications to Spinal Manipulation (Gatterman, 2005).

1. Vascular complications
   - Vertebral-basilar insufficiency
   - Atherosclerosis of major blood vessels
   - Aneurysms

2. Tumours
   - Lung
   - Thyroid
   - Prostate
   - Breast
   - Bone

3. Bone infections
   - Tuberculosis
   - Bacterial infection (osteomyelitis)

4. Traumatic injuries
   - Fractures
   - Joint instability or hypermobility
   - Severe sprains or strains
   - Unstable spondylolisthesis

5. Arthritis
   - Ankylosing spondylitis
   - Rheumatoid arthritis
   - Psoriatic arthritis
   - Reiter’s syndrome
   - Osteoarthritis (unstable or late stage)
6. Psychological considerations
   - Malingering
   - Hysteria
   - Hypochondriasis
   - Pain intolerance

7. Metabolic disorders
   - Clotting disorders
   - Osteopenia (osteoporosis, osteomalacia)

8. Neurological complications
   - Sacral nerve root involvement from medial or massive disc protrusion
   - Disc lesions (advancing neurological deficits)
   - Space-occupying lesions
APPENDIX E

Contra-Indications to Traumeel® (Heel, 2003)

Hypersensitivity to the active substances or to the excipients, or to the botanicals of the Compositae (Asteraceae) family. Traumeel® Injection Solution ingredients of the Compositae family are: Arnica montana, radix (mountain amica), Calendula officinalis (marigold), Millefolium (milfoil), Chamomilla (chamomile), Bellis perennis (daisy), Echinacea angustifolia (narrow-lead cone flower), Echinacea purpurea (purple cone flower).
APPENDIX F

Numerical Pain Rating Scale (McCaffery and Pasero, 1999)

Place a mark on the pain scale below that represents your pain at this point in time. On a scale of 0 to 10, 0 means “no pain” and 10 means the “worst possible pain”. The middle of the scale describes “moderate pain”. A two or three rating would be “mild pain” and a rating of seven or higher would indicate “severe pain”.

Name of patient: _____________________

Date: ________________

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APPENDIX G

Oswestry Low Back Pain and Disability Questionnaire (Fairbank and Pynsent, 2000)

Date: _____________________   Name of patient: _____________________

PLEASE READ

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

SECTION 1: PAIN INTENSITY

☐ I can tolerate the pain I have without having to use pain killers.
☐ The pain is bad but I manage without taking pain killers.
☐ Pain killers give complete relief from pain.
☐ Pain killers give moderate relief from pain.
☐ Pain killers give very little relief from pain.
☐ Pain killers have no effect on the pain.

SECTION 2: PERSONAL CARE (WASHING, DRESSING ETC.)

☐ I can look after myself normally without causing extra pain.
☐ I can look after myself normally but it causes extra pain.
☐ It is painful to look after myself and I am slow and careful.
☐ I need some help but manage most of my personal care.
☐ I need help every day in most aspects of self-care.
☐ I do not get dressed; I wash with difficulty; and I stay in bed.

SECTION 6: STANDING (REMEMBER, STANDING IS NOT WALKING.)

☐ I can stand as long as I want without extra pain.
☐ I can stand as long as I want but it gives me extra pain.
☐ Pain prevents me from standing for more than 1 hour.
☐ Pain prevents me from standing for more than 30 minutes.
☐ Pain prevents me from standing for more than 10 minutes.
☐ Pain prevents me from standing at all.

SECTION 7: SLEEPING

☐ Pain does not prevent me from sleeping well.
☐ I can sleep well only by taking tablets.
☐ Even when I take tablets I have less than 6 hours sleep.
☐ Even when I take tablets I have less than 4 hours sleep.
☐ Even when I take tablets I have less than 2 hours of sleep.
☐ Pain prevents me from sleeping at all.
SECTION 3: LIFTING

☐ I can lift heavy weights without extra pain.
☐ I can lift heavy weights but it gives extra pain.
☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned (e.g. on a table).
☐ Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned.
☐ I can lift only very light weights.
☐ I cannot lift or carry anything at all.

SECTION 8: SEX LIFE

☐ My sex life is normal and causes no extra pain.
☐ My sex life is normal but causes some extra pain.
☐ My sex life is nearly normal but is very painful.
☐ My sex life is severely restricted by pain.
☐ My sex life is nearly absent because of pain.
☐ Pain prevents any sex life at all.

SECTION 4: WALKING

☐ I can walk as far as I wish.
☐ Pain prevents me walking more than 1 km.
☐ Pain prevents me walking more than 0.5 km.
☐ Pain prevents me walking more than 0.25 km.
☐ I can only walk using a stick or crutches.
☐ I am in bed or in a chair most of every day.

SECTION 9: SOCIAL LIFE

☐ My social life is normal and gives me no extra pain.
☐ My social life is normal but increases the degree of pain.
☐ Pain has no significant effect on my social life apart from limiting energetic interests (dancing, etc).
☐ Pain has restricted my social life and I do not go out as often.
☐ Pain has restricted my social life to my home.
☐ I have no social life because of pain.

SECTION 5: SITTING

☐ I can sit in any chair as long as I like.
☐ I can only sit in my favorite chair as long as I like.
☐ Pain prevents me sitting more than 1 hour.
☐ Pain prevents me from sitting more than 30 minutes.
☐ Pain prevents me from sitting more than 10 minutes.
☐ Pain prevents me from sitting at all.

SECTION 10: TRAVELING

☐ I can travel anywhere without extra pain.
☐ I can travel anywhere but it gives me extra pain.
☐ Pain is bad but I manage journeys over 2 hours.
☐ Pain restricts me to journeys of less than 1 hour.
☐ Pain restricts me to short necessary journeys under 30 minutes.
☐ Pain prevents me from traveling except to the doctor or hospital.
APPENDIX H

Participant Data Sheet

Patient name: ____________________________

Date: ________________________________

NPRS (10): __________________________

Oswestry score (50): _________________

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APPENDIX I

Case History

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

CASE HISTORY

Date: ________________

Patient: ___________________ File No: ____________

Age: _______ Sex: _______ Occupation: ______________________

Student: _______________ Signature: ______________________

FOR CLINICIAN’S USE ONLY

Initial visit clinician: _______________ Signature:_____________

Case History: ______________________________________________

_________________________________________________________

Examination:

Previous: UJ               Current: UJ

Other

Other

X-ray Studies:

Previous: UJ               Current: UJ

Other

Other

Clinical Path. Lab:

Previous: UJ               Current: UJ

Other

Other

Case status:
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 J

Pertinent Physical Examination

Student Name: ______________________  Signature: ______________________
Doctor Name: ______________________  Signature: ______________________

Patient Information:
Name: ______________________          Occupation: ____________________
Age: ______________________            Sex: ______________________      

Vitals:
Height: ______________________         Weights: ______________________
Pulse Rate: ______________________    Respiratory Rate:________________
Blood Pressure: ____________________

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APPENDIX K

Lumbar Spine and Pelvis Regional Examination

STANDING

BODY TYPE
POSTURE
OBSERVATION: -

Muscle Tone
Bony + Soft Tissue Contours
Skin
Scars
Discolouration
Step deformity

SPECIAL TESTS

Schober’s Test
Spinous Percussion
Treadmill
Minor’s Sign
Quick Test
Trendelenburg Test
RANGE OF MOTION

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

/ = Pain free limitation  // = Painful limitation

6. GAIT
- Rhythm, pendulousness
- On Toes (S1)
- On Heels (L4, 5)
- Halt 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 Manoeuvre
### 2. MOTION PALPATION

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### C. SUPINE

01. OBSERVATION

- Hair, Skin, Nails
- Fasciculations

02. PULSES

- Femoral
- Popliteal
- Dorsalis Pedis
- Posterior Tibial

### 3. MUSCLE CIRCUMFERENCE

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### 5. ABDOMINAL EXAMINATION

- Observation
- Abdominal Reflexes
- Auscultation Abdomen and Groin
- Palpation Abdomen and Groin
## NEUROLOGICAL EXAMINATION

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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 L

**SOAP Note**

**CHIROPRACTIC DAY CLINIC**

**SOAP NOTE:**

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