The Relative Effectiveness of Kinesio® Taping Methods as an Adjunct to a Single Sacroiliac Joint Manipulation in the Treatment of Chronic Sacroiliac Joint Syndrome.

By

Quintin Hardus De Beer

Dissertation submitted in partial compliance with the requirements for the Master's

Degree in Technology: Chiropractic

Durban University of Technology

I, Quintin Hardus de Beer, do declare that this dissertation is representative of my own work in both conception and execution (except where acknowledgements indicate to the contrary)

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Quintin Hardus de Beer Date

Approved for Final Submission

_____ _____

Dr Jones, M. Dip C; M. Med Sci Date

DEDICATION

I count it a privilege to dedicate this work to:

My Heavenly Father, Jesus Christ, who is my joy and strength. With Him anything can be accomplished!

Dad and Mom, your love, support and encouragement over the years have meant so much to me. I am forever grateful to you for giving me the means to making my dreams a reality. You truly mean everything to me. Thank you.

My sister, Lana, thank you too for your love and support. You may not have had the same opportunity as I have had but I know you will be just as successful in life. I have conquered my mountain, but you will conquer many more!

My Uncle Dave and Aunt Inez, I cannot thank you enough for the time I could spend living with you and learning from you. You loved me as your own in your home, I will forever be grateful. Thank you for the love, support, advice and encouragement you gave me.

My Uncle Johan, Aunt Jenny and family, words cannot express the love and thankfulness I have in my heart for you. Thank you for your sacrifice and support in my studies. It really means so much to me.

Paps and Mams, you have blown me away with your love, encouragement and guidance. I appreciate your kindness with all my heart. You too mean everything to me. Thank you.

Bibi, my beautiful Wife, no words can describe how thankful I am to have such an amazing person as my lifelong-companion. Your love, encouragement and advice have been the wind in my sails. You are so wonderful, truly an inspiration! Thank you for always uplifting me to the best I can be, and for helping me to get there. You are everything to me. It is an honour to dedicate this work, this blood, sweat and tears, to you. Ich liebe dich mit meine ganzes hertz, du bist meine ein und alles für immer und ewig!

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr. Andrew Jones, for all the long hours and dedication that went into guiding me through the research process. Thank you for your enthusiasm, encouragement, assistance and amazing work ethic.

To my friends and class mates: without the good times none of this would have been possible. Thank you for all the laughs, support when times were tough and making the years fly by. I wish you all well in your future endeavours and I am proud to be your colleague.

To Pat, Linda and Mrs Drake for all their effort, assistance and patience throughout my final years of studies.

To Dr Korporaal: thank you for your assistance despite the piles of work on your desk.

To Dr Hammond: for your patience and service in working with the statistics of this study.

To Dr Varahalajulu, Dr Henry and Dr Butt: thank you for your advice and assistance.

To the attending clinicians: thank you for your patience, assistance, guidance and expertise during my clinic years.

To Dr White: thank you for introducing me to the Chiropractic profession.

To Dr Kidson: thank you for your input into my clinical knowledge. In the short time that I spent with you I learnt a lot from you and your experience.

To my 60 research participants: thank you for your time, patience and willingness to participate in this study.

ABSTRACT

The lifetime incidence of low back pain is between 48% to 79% in South Africa. Globally, chronic Sacroiliac Joint Syndrome occurs in 13% to 63% of the world's population. Therefore, chronic Sacroiliac Joint Syndrome is a significant health problem that has the potential to have a major impact on quality of life.

Chronic Sacroiliac Joint Syndrome is described as an alteration in normal motion or mechanics. The Sacroiliac Joint fibrous capsule contributes to proprioceptive and nociceptive output, which may be exacerbated when the joint is in a dysfunctional state.

Chronic Sacroiliac Joint Syndrome may be effectively treated by spinal manipulative therapy. Spinal manipulative therapy is professed to have four therapeutic effects – mechanical correction, pain reducing effects, circulatory increase and neurobiologic effects. Similarly, Kinesio Tex® Tape therapy is professed to have comparable therapeutic effects – circulatory increase, pain reduction and stimulation of proprioceptive systems.

Spinal manipulative therapy and Kinesio Tex® Tape therapy may, therefore, have similar therapeutic effects which, if used in adjunction, may produce enhanced therapeutic effects and accelerated results regarding reduction of symptoms in patients with chronic Sacroiliac Joint Syndrome.

This investigation aimed to determine whether Kinesio® Taping methods would have any relative effect on the Sacroiliac Joint, and whether it would be appropriate to use as an adjunct to spinal manipulative therapy in the treatment of chronic Sacroiliac Joint Syndrome.

The study was a prospective stratified clinical trial with three intervention groups, twenty participants in each (n = 60). All participants were 18-50 years of age and suffering from chronic Sacroiliac Joint Syndrome. Subjective measurements included the Numerical Rating Scale and Oswestry Low Back Pain Disability Index. Objective

measurements included the Algometer Scores. Numerical Rating Scale and Algometer measurements were taken before and immediately after treatment at the first consultation and at the second consultation. Oswestry Low Back Pain Disability Index measurements were taken at the first and second consultation. Group One underwent spinal manipulative therapy alone, Group Two underwent Kinesio Tex® Tape therapy alone and Group Three underwent both spinal manipulative therapy and Kinesio Tex® Tape therapy in combination.

Comparisons were made using the Unpaired and Paired t-tests. The results for the Inter-group analyses suggested that most comparisons were statistically insignificant ($p \geq 0.05$) which indicated that all treatment groups appeared to improve to a similar degree. The results for the Intra-group analyses suggested that most comparisons were statistically significant ($p < 0.05$) which indicated that Kinesio Tex® Tape therapy was effective as an adjunct to spinal manipulative therapy, however not statistically more or less effective that spinal manipulative therapy or Kinesio Tex® Tape therapy alone.

In conclusion, it was found that some differences did occur, however these differences were not sufficient enough to conclude that one treatment was more effective than the other.

Further research with a larger sample size, more frequent treatments and follow-ups, a more homogenous stratification of age, ethnic group, gender, side of diagnosis and categorizing participant occupation is needed in order for the power of the study to be amplified and, therefore, any results would carry more weight.

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LIST OF ABBREVIATIONS

SIJ	– Sacroiliac Joint
SIJ's	– Sacroiliac Joints
LFJ	- Lumbar Facet Joint
SMT	– Spinal manipulative therapy
LBP	– Low Back Pain
NRS-101	– Numerical Rating Scale
ODI	– Oswestry Low Back Pain Disability Index
AROM	- Active range of motion
DUT	- Durban University of Technology

LIST OF DEFINITIONS

Afferent

Carrying inward to a central organ or section, as nerves that conduct impulses from the periphery of the body to the brain or spinal cord (Tortora and Derrickson, 2006).

Ankylosis

Severe or complete loss of movement at a joint (Tortora and Derrickson, 2006).

Aponeurosis

A broad, flat layer of connective tissue (Tortora and Derrickson, 2006).

Chronic

Symptomatic evidence for a period of six weeks or longer (Morris, 2006).

Exudate

The loss of protein-rich fluid into perivascular space (Kumar, Abbas, Fausto, Mitchell, 2007).

Fibrocartilage

The strongest type of collagen, it consists of chondrocytes scattered among collagen fiber. An example of fibrocartilage is the intervertebral discs in the spine (Tortora and Derrickson, 2006).

Hilton's law

The nerves supplying a joint also supply the muscles moving the joint or the skin covering their distal attachments (Moore and Dalley, 2006).

Hyaline Cartilage

The most abundant cartilage in the body, it provides flexibility and support and reduces friction and absorbs shock at joints. It is the weakest type of collagen (Tortora and Derrickson, 2006).

Inflammation

A protective response intended to eliminate the initial cause of cell injury (Kumar *et al.,* 2007).

Manipulation

Physical maneuvers designed to induce joint motion through thrust techniques, intended to treat disorders of the neuromusculoskeletal system by improving joint alignment, range of motion and quality of movement (Bergmann, Peterson and Lawrence, 1993).

Mesenchymal Cells

Embryonic connective tissue cells derived from mesoderm (Tortora and Derrickson, 2006).

Nociception

Sensation of painful stimuli resulting from physical or chemical damage to tissue (Tortora and Derrickson, 2006).

Oedema

Increased fluid in the interstitial tissue spaces (Kumar *et al.,* 2007).

Prone

Lying face downwards (Thompson, 1994).

Proprioception

The nonvisual perception of the movements and position of the body, awareness of the precise position of body parts (Tortora and Derrickson, 2006).

Substantia Gelatinosa

A region in the brain which receives portions of afferents (sensation) from myelinated and unmyelinated fibers that are associated with nociception (Crossman and Neary, 2000).

Supine

Lying face upward (Thompson, 1994).

Syndesmosis

A fibrous joint in which there is a greater distance between the articulating bones and more fibrous connective tissue than in a suture, which is a fibrous joint composed of a thin layer of dense fibrous connective tissue (Tortora and Derrickson, 2006).

Synovial Joint

A joint which has a cavity that is united to the connective tissue of the articular capsule which contains synovial fluid that lubricates joints and nourishes articular cartilage (Tortora and Derrickson, 2006).

Zygapophyseal Joint

Also known as facet joints, occurring between the articular processes of two adjacent spinal vertebrae (Moore and Dalley, 2006).

CHAPTER ONE

Introduction

1.1 The Problem and its Setting

The Sacroiliac Joints (SIJ's) have been recognised as moving, weight bearing synovial joints that display the same distinguishing joint dysfunction which may afflict other diarthrodial joints (Gatterman, 2005). The SIJ's are strong, weight bearing synovial articulations and are covered by a fibrous capsule attached closely to both articular margins (Standring, 2008; Moore and Dalley, 2006). It is one of the most stable joints in the body, and supports the weight of the trunk (Standring, 2008). In addition, according to Morris (2006), the Sacroiliac Joint (SIJ) fibrous capsule contributes to proprioceptive and nociceptive output, which may be exacerbated when the joint is in a dysfunctional state. Chronic SIJ Syndrome is described by Haldeman (2005) as an alteration in normal motion or mechanics that describes either hypermobility or hypomobility (Haldeman, 2005). Also, Kirkaldy-Willis and Bernard (1999) describe vasoconstriction following minor trauma to the SIJ's (due to torsional strain, chronic repetitive shear or torsional forces) to lead to oedema, accumulation of metabolites and therefore pain.

Van der Meulen (1997) found the lifetime incidence of low back pain (LBP) amongst a sample of 1000 Black South Africans to be 57, 6% (n = 576). A similar study done by Docrat (1999) found it to be 78, 2% in a sample of 500 Indian South Africans (n = 391), and 76, 6% in a sample of 500 Coloured South Africans (n = 383). Dyer (2012) found the lifetime incidence of LBP in a sample of 600 White South Africans to be 48% (n = 288). These studies did not specify which percentage of those people with LBP had SIJ Syndrome as the principal cause of their pain. Hansen and Helm (2003) describes studies (USA) that showed that the sacroiliac joint contributed to low back and lower extremity pain in two to 10% of patients. Dreyfuss and Dreyer (2004), report that lower

back and buttock pain is caused by the SIJ in approximately 15% of the world's population.

According to Slipman, Whyte, Chow, Chou, Lenrow and Ellen (2001) and Hansen and Helm (2003) repetitive acute trauma, torsional strain, chronic repetitive shear or torsional forces to the sacroiliac joint can all be causative factors in chronic SIJ Syndrome. Aggravating factors of chronic SIJ syndrome include weight bearing on the affected side with standing or walking, flexion in the standing position with knees fully extended and the Valsalva manoeuvre (Slipman *et al.,* 2001; Hansen and Helm, 2003).

Spinal manipulative therapy (SMT) for chronic SIJ Syndrome is professed to have four therapeutic effects - mechanical correction, pain reducing effects, circulatory increase and neurobiologic effects (Bergmann, Peterson and Lawrence, 1993; Walter, David and Philip, 1999; Pickar, 2002). Kirkaldy-Willis and Bernard (1999) state that in SIJ Syndrome the patient nearly always has reduced movement of the SIJ, as well as pain in the joint. SMT often restores the joint movement and relieves the pain (Kirkaldy-Willis and Bernard, 1999). SMT is designed to induce joint motion through either non-thrust (mobilization) or thrust manipulative techniques (Bergmann, Peterson and Lawrence, 1993). Haldeman (2005) suggests that chronic SIJ Syndrome may be effectively treated by SMT and Gatterman (2005) describes SMT as a treatment of choice for patients suffering from chronic SIJ Syndrome.

Kinesio Tex® Tape therapy is proposed to have the following therapeutic functions/effects: improvement of lymphatic and blood flow through enhanced lymphatic drainage (Constantinou and Brown, 2010), unloading of painful and inflamed tissue (Constantinou and Brown, 2010), pain reduction and correction of posture (Friedman, 2007). With respect to chronic SIJ Syndrome, the Kinesio Taping® Method may assist in reduction of joint pain (Kase, Wallis and Kase, 2003). It can be used during all phases of injury (acute, sub-acute, chronic), in rehabilitation, and can be used also as preventative prophylaxis and aiding the body to homeostasis (Illes, 2009). One case

study (*n* = 4) showed that it may decrease subjective pain and oedema (Szczegielniak, Luniewski, Bogacz, Krajczy and Sliwinski, 2007); and another (*n* = 15) showed that it may decrease soft tissue inflammation, aid in postural alignment and provide proprioceptive feedback to achieve and maintain preferred joint alignment (Jaraczewsca and Long, 2006). Jaraczewsca and Long (2006) also comment that Kinesio Tex® Tape may have an effect on sensorimotor and proprioceptive systems.

Therefore there is some evidence that demonstrates that Kinesio Tex® Tape therapy may be an effective treatment modality in aiding SMT in the treatment of chronic SIJ Syndrome as the therapeutic effects of Kinesio Tex® Tape therapy may enhance those of SMT (including aiding/stimulating joint proprioception, pain reducing effects, increasing circulation and decreasing inflammation), and if used in combination for chronic SIJ Syndrome, one may see more prompt recovery by patients as Kinesio Tex® Tape (and therefore its therapeutic effects) can be applied to an individual for 72 hours. Upon review of the related literature it appears that there is a paucity of published studies assessing the clinical effectiveness of Kinesio Tex® Tape therapy. For the purposes of this study, the reason that one treatment intervention (as opposed to 4-6 treatments) was selected was because similar studies in Bisset (2003) and Morgan (2005) found that one SMT resulted in statistically significant findings for up to three weeks.

Since the Kinesio Taping® Method is considered an easy-to-use modality which allows the patient to receive the therapeutic benefits for up to 72 hours (Kase, Wallis and Kase, 2003), the Kinesio Taping® Method was the modality used in the treatment of chronic SIJ Syndrome in this study with the aim to determine the effectiveness of Kinesio Tex® Taping as an adjunct to SMT.

1.2 Aim/Purpose of the Study

The aim of this study was to determine whether the Kinesio Taping® Method would have any relative effect on the SIJ and accompanying symptoms caused by chronic dysfunction, and whether it would be appropriate to use as an adjunct to SMT in the treatment of chronic SIJ Syndrome.

1.3 Objectives and Null Hypotheses of the Study

- **Objective One**

  The First Objective was to determine the clinical effectiveness of one SMT treatment on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data.

  Null Hypothesis One

  There would be no statistically significant difference in terms of subjective and objective clinical data regarding the clinical effectiveness of one SMT treatment on patients with chronic SIJ Syndrome.

- **Objective Two**

  The Second Objective was to determine the clinical effectiveness of one application of Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data.

Null Hypothesis Two

There would be no statistically significant difference in terms of subjective and objective clinical data regarding the clinical effectiveness of one application of Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome.

- **Objective Three**

The Third Objective was to determine the clinical effectiveness of one SMT in combination with Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data.

Null Hypothesis Three

There would be no statistically significant difference in terms of subjective and objective clinical data regarding the clinical effectiveness of one SMT in combination with Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome.

- **Objective Four**

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data.

Null Hypothesis Four

There would be no statistically significant difference in terms of subjective and objective clinical data between the groups before and/or after the interventions.

1.4 Rationale

- To clinically assess the effectiveness of the use of the Kinesio Taping® Method as a treatment modality for chronic SIJ Syndrome.
- Practitioners may be able to incorporate the Kinesio Taping® Method into their treatment protocol should the Kinesio Taping® Method be shown to be an effective treatment modality.
- Should the Kinesio Taping® Method be shown to be effective, it would provide a viable alternative to patients with chronic SIJ Syndrome that exhibit contraindications to SMT or who would prefer not to be treated with SMT.

1.5 Benefits of the Study

The outcomes of this study were to establish whether a potentially new treatment modality would be shown to be effective in the treatment of chronic SIJ Syndrome. This could, therefore, increase the number of effective treatment modalities available to the practitioner in the treatment of chronic SIJ Syndrome. This is especially important as it may serve to decrease the number of visits that a patient might need in order for symptoms to be resolved.

1.6 The Inherent Limitations of the Study

The inherent limitations of the study were:

- The small sample group (n = 60) increases the chances of a type II error occurring. This number was further subdivided, which may reduce the power of the research findings.

- There is more than one Kinesio Taping® Method for SIJ Syndrome and LBP due to Lumbar Facet Joint (LFJ) Syndrome. The method used in this study was the

most appropriate for chronic SIJ Syndrome (Kase, Wallis and Kase, 2003). These methods have, to the researchers knowledge and due to a paucity of information on the subject, not yet been tested against other studies.

- There was no comparison to other athletic tape or taping protocols in this study.

- The patient's honesty in answering the various feedback forms.

1.7 Conclusion

The results of this study would be important in confirming the effectiveness of the Kinesio Taping® Method in relation to SMT in the treatment of chronic SIJ Syndrome. This would, therefore, increase the number of effective treatment modalities available to the practitioner in the treatment of chronic SIJ Syndrome.

CHAPTER TWO

Literature Review

2.1 Introduction

The following chapter aims to create a clear understanding regarding the incidence and prevalence, diagnosis and treatment of SIJ Syndrome, as well as outlining the anatomy and biomechanics of the SIJ and its dysfunction. Further emphasis will be dedicated to Kinesio Tex® Tape therapy and the theories and principles surrounding the use of the Kinesio Taping® Method in treating SIJ Syndrome. This chapter furthermore discusses the literature surrounding SIJ Syndrome and the two treatment modalities utilized in this study, namely SMT and the Kinesio Taping® Method.

2.2 Incidence of Chronic Sacroiliac Joint Syndrome

In addition to the local studies regarding incidence and prevalence of LBP, internationally Slipman et al., (2001) describes that the epidemiology of sacroiliac joint pain has been reported to present with right sided symptoms in 45% of cases, left sided symptoms in 35%, and bilaterally in 20%. Table 2.1 describes other international studies and findings regarding incidence and prevalence.

Table 2.1 Incidence of SIJ Syndrome in international studies:

Author	**Percentage**
Hansen and Helm (2003)	22,5 - 62,8
Weksler, Velan, Semionov, Gurevitch, Klein, Rozentsveig and Rudich, (2007)	13 - 30
Zelle, Gruen, Brown and George, (2005)	10 - 25
Standring (2008)	15
Dreyfuss and Dreyer (2004)	15
Laslett (2008)	13

It can be noted from Table 2.1 that chronic SIJ Syndrome is a common condition globally. Locally, as has been discussed in Chapter One, the lifetime incidence of LBP of selected samples was 48% – 78.2%, and as mentioned previously it is not known what percentage of these samples had chronic SIJ Syndrome as the principle cause of LBP. However these global and local statistics are somewhat comparable.

2.3 Development and Morphology of the Sacroiliac Joint

2.3.1 Fetal

According to Haldeman (2005), the SIJ forms at about the tenth to twelfth week of gestation in humans. The joint surfaces are smooth and flat at this stage, which allows the joint to be manipulated in a gliding manner in all directions. The sacral and iliac sides of the joints develop differently from the time the joint space develops. A cover of smooth, clear hyaline cartilage remains on the sacral side of the joint after endochondral ossification of the sacrum. A thin layer of mesenchymal cells cover the joint surface on the already ossified ilium. The covering of the iliac side of the joint appears dull and striated, and the bone beneath shows through (Haldeman, 2005).

2.3.2 Infant

The joint retains its planar configuration after birth (Haldeman, 2005) and the surfaces of the joint remain nearly flat in infants (Standring, 2008). The sacral surface is covered by a layer of hyaline cartilage. Columns of cartilage cells develop beneath the thin layer of mesenchymal cells on the iliac side. These columns of cells eventually expand and replace the mesenchymal cells to become the cartilage cover for the iliac side of the joint, which appears to be a thin layer of fibrocartilage. However, biochemical analysis has identified type II collagen on both the sacral and iliac sides of the SIJ. Type I collagen, typical of fibrocartilage, is not present even though the joint surface looks like fibrocartilage. The cartilage on the iliac side of the joint is more friable, like fibrocartilage (Haldeman, 2005).

2.3.3 Child

As the child begins to walk, the shape and topography of the SIJ's begin to change. The overall surface shape of the joint changes from planar to a complex form of angles (Haldeman, 2005).

2.3.4 Adolescent

During the rapid weight gain of puberty, the rate of change of the SIJ's topography accelerates. A central crescent-shaped ridge forms along the entire length of the iliac surface. On the sacral surface a corresponding depression develops in the hyaline cartilage layer (Haldeman, 2005). This configuration resembles a tram rail and guides movement. The ridge-and-groove topography limits movement to a posterosuperior-anteroinferior nodding along the crest of the interdigitation with a center of rotation posterior to S2 (Haldeman, 2005).

2.3.5 Adult

The tram rail configuration within the SIJ surfaces, as well as a thickening joint capsule, restrict movement to a subtle forward and backward "nodding" between the ilium and the sacrum. With age, the surface irregularities of the SIJ become more pronounced (Haldeman, 2005), often markedly so, and are sometimes "undulant" (Standring, 2008). By 35 to 40 years of age, the size and number of elevations and depressions continue to develop and each joint is left with a unique surface topography. The topography of the adult SIJ is highly variable among individuals and from left to right sides within the same individual. Usually the SIJ's demonstrate changes consistent with osteoarthritis on the iliac side of the joint (Haldeman, 2005), which is hyaline in type, as confirmed by the presence of type II collagen (Standring, 2008). Rough spots and fibrous plaques develop on the iliac surface of the joint while the sacral surface remains smooth. Later the cartilage cover on the iliac side becomes thinner, with areas of erosion and sclerosis of the underlying bone. Arthrosis on the iliac side of the SIJ may start occurring from the age of 40 years (Haldeman, 2005) as the iliac side of the joint is the side with a thinner hyaline cartilage cover (Standring, 2008). Early changes associated with osteoarthritis usually aren't seen on the sacral side of the joint until the fourth or fifth decade. The reason for this is that the sacral surface is covered by hyaline cartilage which is 2 to 3 times thicker (Hansen and Helm, 2003) anteriorly than posteriorly in adults. The surface irregularities that occur on the sacral joint surface are less marked than on the iliac side, the cartilage remains thick, and the subchondral bone retains its normal appearance (Haldeman, 2005).

2.3.6 Past middle age

Fibrous adhesions within the SIJ become common after 40 years of age (Haldeman, 2005), and are even more common among the elderly. In the elderly, intaarticular fibrous adhesions, joint space narrowing, and periarticular osteophyte interdigitations may restrict joint movement. Joint surface erosions, often down to the surface of the

subchondral bone with sclerosis of subchondral bone, are common on the iliac side of the joint. However, true bony ankylosis is rare in the absence of joint disease such as ankylosing spondylitis (Haldeman, 2005). According to Kirkaldy-Willis and Bernard (1999) after the sixth decade fibrous adhesions develop in the SIJ.

2.4 Anatomy of the Sacroiliac Joint

2.4.1 Bony anatomy

Hansen and Helm (2003) states that the SIJ is a synovial (diarthrodial) joint with a capsule, and synovial fluid. Standring (2008) agrees by saying the sacroiliac joint is a synovial articulation between the sacral and iliac auricular surfaces (Standring, 2008). Hansen and Helm (2003) also describes the sacroiliac joint as an auricular shaped joint with two arms. The short arm is positioned posteriorly and cephalic in contrast to the long arm which is oriented posterolaterally and caudally (Hansen and Helm, 2003). According to Moore and Dalley (2006), the SIJ consists of an anterior synovial joint (between the aforementioned ear-shaped auricular surfaces, covered with articular cartilage) and a posterior syndesmosis (between the tuberosities of the sacrum and ilium). The curvatures and intrinsic joint surface irregularities, greater in males, are reciprocal: restricting movements and contributing to the considerable strength of the joint in transmitting weight from the vertebral column to the lower limbs (Standring, 2008). The fibrous joint capsule is attached close to both articular margins (Standring, 2008). Anteriorly, the sacroiliac joint is well-defined and a small amount of synovial fluid is produced here (Standring, 2008). Posteriorly, the joint is suspended by multiple ligaments (Hansen and Helm, 2003).

2.4.2 Ligaments of the Sacroiliac Joint

While mainly a bony structure, the sacroiliac joint is supported by ligaments and muscles (Standring, 2008). The fibers of the sacroiliac joint capsule blend anteriorly and

posteriorly with numerous ligaments (Hansen and Helm, 2003). Hansen and Helm also states that while the posterior capsule of the sacroiliac joint frequently possesses multiple vents and tears, the anterior capsule is well formed and uniformed (Hansen and Helm, 2003). The ligaments of the sacroiliac joint are the anterior sacroiliac, posterior sacroiliac, iliolumbar, sacrotuberous and sacrospinous ligaments (Standring, 2008).

The anterior sacroiliac ligament (Figure 2.1), merely a thickening of the anteroinferior capsule (Moore and Dalley, 2006), is particularly well developed near the posterior inferior iliac spine, where it connects the third sacral segment to the lateral side of the preauricular sulcus (Standring, 2008).

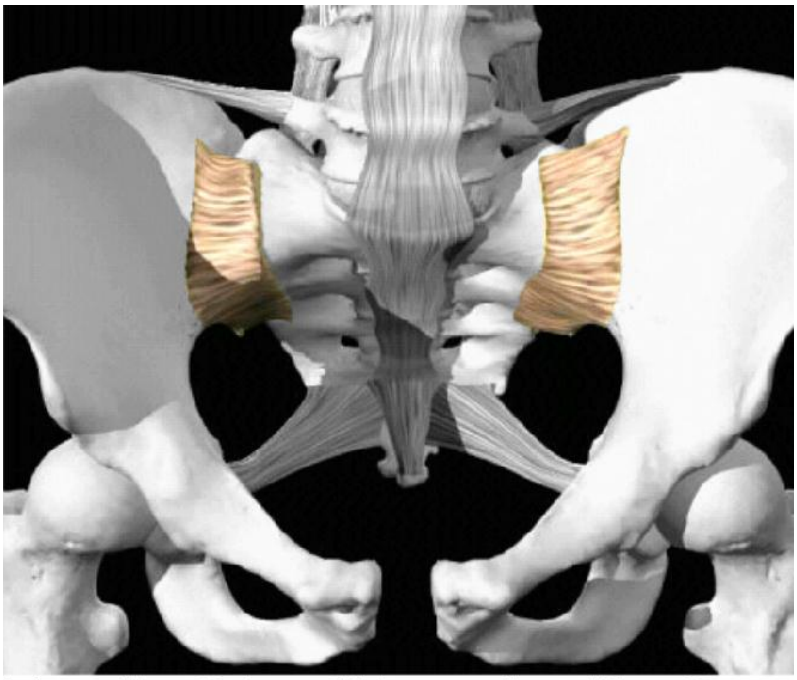


Figure 2.1 Anterior Sacroiliac Ligament.

The interosseous sacroiliac ligament lies deep between the sacral and ilial tuberosities. The ligament is the primary structure involved in transferring the truncal weight (from the axial skeleton) to the ilia of the appendicular skeleton (Moore and Dalley, 2006).

The posterior sacroiliac ligament (Figure 2.2) is a posterior external continuation of the interosseous ligament. The fibers of the posterior sacroiliac and interosseous ligaments run obliquely upward from the sacrum, which causes axial weight to pull the ilia inwards (medially) so that the sacrum is compressed between them, locking the irregular but congruent surfaces of the SIJ's together (Moore and Dalley, 2006).

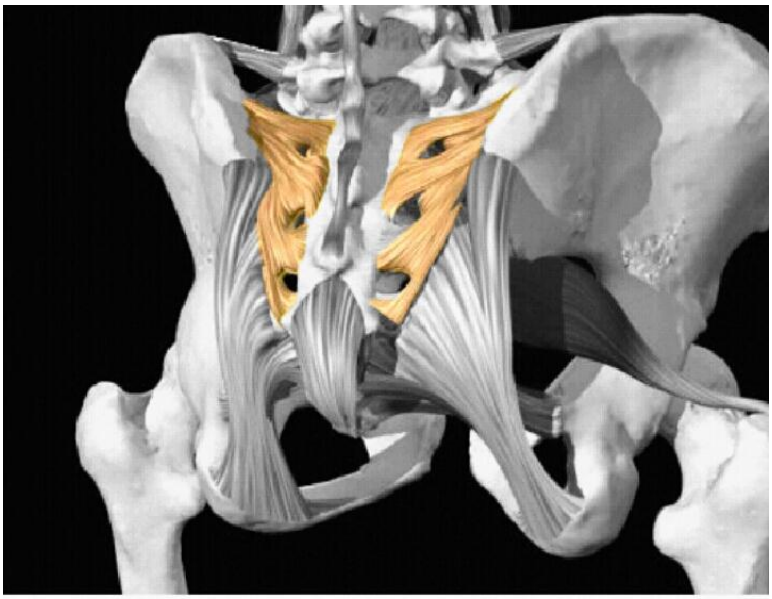


Figure 2.2 Posterior Sacroiliac Ligament (Moore and Dalley, 2006).

The iliolumbar ligament (Figure 2.3) is attached to the fifth lumbar transverse process. It is attached to the pelvis by two main bands as it diverges laterally. A lower band passes from the inferior aspect of the fifth lumbar transverse process and the body of the fifth lumbar vertebra across the anterior sacroiliac ligament to reach the posterior boundary of the iliac fossa. An upper band passes to the iliac crest anterior to the sacroiliac joint, and is continuous above with the anterior layer of the thoracolumbar fascia. In neonates and children the iliolumbar "ligament" is muscular - the muscle is gradually replaced by ligament up to the fifth decade of life (Standring, 2008).

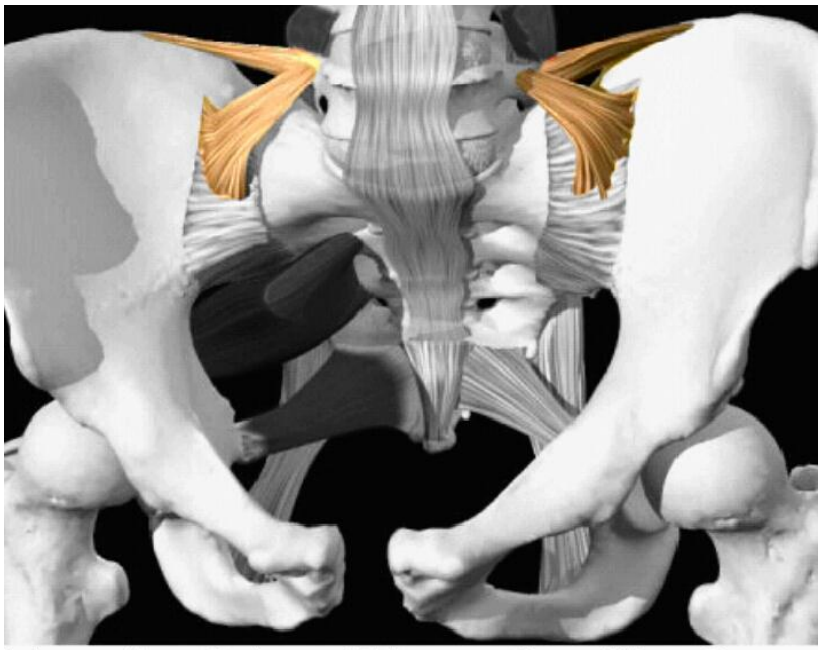


Figure 2.3 Iliolumbar Ligament (Moore and Dalley, 2006).

The sacrotuberous ligament (Figure 2.4) is attached by its broad base to the posterior superior iliac spine, the posterior sacroiliac ligaments (with which it is partially blended), to the lower transverse sacral tubercles and the lateral margins of the lower sacrum and upper coccyx. Its oblique fibres descend laterally, uniting to form a narrow band that widens again below and is attached to the ischial tuberosity. It then spreads along the ischial ramus as the falciform process. The lowest fibres of the gluteus maximus are attached to the posterior surface of the ligament; the superficial fibres of the lower part of the ligament continue into the tendon of biceps femoris (Standring, 2008).

The thin, triangular sacrospinous ligament (Figure 2.4) extends from the ischial spine to the lateral margins of the sacrum and coccyx anterior to the sacrotuberous ligament, with which it blends in part. Its anterior surface is in fact the coccygeus muscle, i.e. muscle and ligament are contiguous. The sacrospinous ligament is often regarded as a degenerative part of coccygeus (Standring, 2008).

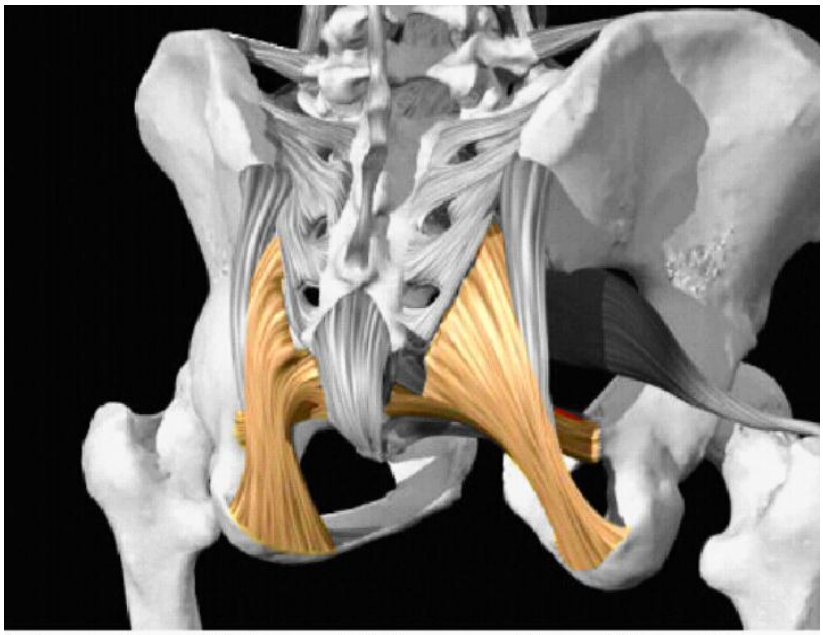


Figure 2.4 Sacrotuberous (superficial) and Sacrospinous (deep) Ligaments (Moore and Dalley, 2006).

2.4.3 Factors maintaining stability

Muscular activation assists in providing control of locomotion and body posture and provides stability of the SIJ and lumbar spine (Hansen and Helm, 2003; Shearar, 2003). The reciprocal irregularity of the joint surfaces allows little movement. The tendency for the sacrum to be forced downwards by the trunk is resisted by the strong posterior ligaments, while the iliolumbar ligaments help to resist displacement of the fifth lumbar vertebra over the sacrum. The sacrotuberous and the sacrospinous ligaments oppose upward tilting of the lower part of the sacrum when downward thrust is applied at its upper end (Standring, 2008).

2.4.4 Muscles of the Sacroiliac Joint

Gluteus maximus is the largest and most superficial muscle of the sacroiliac joint. It is a broad, thick quadrilateral mass, which, with its overlying adipose fascia, forms the buttock (Standring, 2008). It arises from the posterior gluteal line of the ilium, including the crest, immediately above and behind it; from the aponeurosis of the erector spinae; the dorsal surface of the lower part of the sacrum and the side of the coccyx; the sacrotuberous ligament; and the fascia which covers gluteus medius (Standring, 2008). The fibres descend laterally; the upper part of the muscle, together with the superficial fibres of the lower part ends in a thick tendinous lamina which passes lateral to the greater trochanter and is attached to the iliotibial tract of the fascia lata (Standring, 2008). The deeper fibres of the lower part of the muscle are attached to the gluteal tuberosity between vastus lateralis and adductor magnus. Acting from the pelvis, it can extend the flexed thigh and bring it in line with the trunk. Acting from its distal attachment, it may prevent the forward momentum of the trunk from producing flexion at the supporting hip during bipedal gait (Standring, 2008). It acts with the hamstrings in raising the trunk after stooping, by rotating the pelvis backwards on the head of the femur. It is intermittently active in the walking cycle and in climbing stairs. Its upper fibres are active during strong abduction of the thigh (Moore and Dalley, 2006).

Gluteus medius is a broad, thick muscle. It arises from the outer surface of the ilium between the iliac crest and posterior gluteal line above, and the anterior gluteal line below, and also from the strong fascia superficial to its upper part. The fibres converge to a flat tendon that attaches to a ridge that slants downwards and forwards on the lateral surface of the greater trochanter (Standring, 2008).

Gluteus minimus lies deep to gluteus medius. The fan-shaped muscle arises from the outer surface of the ilium between the anterior and inferior gluteal lines, and from behind, the margin of the greater sciatic notch (Standring, 2008). The fibres converge below to the deep surface of an aponeurosis that ends in a tendon which is attached to

an anterolateral ridge on the greater trochanter and contributes an expansion to the capsule of the hip joint (Standring, 2008). Both gluteus medius and minimus, acting from the pelvis, abduct the thigh, and their anterior fibres rotate it medially. Acting from the femur, these muscles play an essential part in maintaining the trunk upright when the foot of the opposite side is raised from the ground in walking and running (Standring, 2008).

Piriformis occupies a central position in the buttock, where it lies in the same plane as gluteus medius. It arises from the anterior surface of the sacrum by three digitations, which are attached to the portions of bone between the pelvic sacral foramina, and to the grooves leading from the foramina (Standring, 2008). It also arises from the gluteal surface of the ilium near the posterior superior iliac spine, from the capsule of the adjacent SIJ, and sometimes from the upper part of the pelvic surface of the sacrotuberous ligament (Standring, 2008). The muscle passes out of the pelvis through the greater sciatic foramen, which it substantially fills. It inserts into the medial side of the upper border of the greater trochanter of the femur via a rounded tendon, but is often partially blended with the common tendon of obturator internus and the gemelli (Standring, 2008). It rotates the extended thigh laterally, but abducts the flexed thigh (Standring, 2008).

2.4.5 Innervation of the Sacroiliac Joint

According to Hansen and Helm (2003), many attempts have been made to define innervation of the anterior and posterior elements of the sacroiliac joint, but the actual nerve supply to the joint remains unclear (Slipman *et al.,* 2001; Hansen and Helm, 2003; Huijbreghts, 2004). The SIJ has a rich nociceptive innervation (Weksler *et al.,* 2007). Nerve fibres ramify within the joint capsule and adjoining ligaments, and obtained histologic samples of capsule ligamentous tissue reveal that the synovial joint is innervated, but the source is uncertain (Hansen and Helm, 2003). It is thought that the joint probably receives branches from the anterior and posterior rami of the first two

sacral spinal nerves (the anterior portion receives innervation from the posterior rami of the L2-S2 roots (Weksler *et al.,* 2007)), and from the superior gluteal nerve, and there may also be contributions from the obturator nerve and the lumbosacral trunk. It would appear that Hilton's law is not readily applicable to this joint (Standring, 2008). Additionally, Hansen and Helm (2003) reports that the nerve fibres in the joint capsule are most likely derived from the dorsal rami of S1-3. The poor characterization of innervation is a likely source of confusion during the examination and is responsible for the varied referred pain patterns (Hansen and Helm, 2003) discussed under Section 2.5 of this chapter.

2.5 Biomechanics of the Sacroiliac Joint

According to Haldeman (2005) it is known that movement occurs in the sacroiliac joints, however, the shape of the SIJ, the irregular interlocking surface topography, and the strong dense ligaments render the SIJ stable and capable of only a small range of movement (Haldeman, 2005). According to Slipman *et al.,* (2001), the SIJ possesses motion that likely does not occur around a single fixed axis. Slipman *et al.,* (2001) also reports that several types of motion in the SIJ exists, such as gliding, rotation, tilting, nodding, and translation. Although the precise model of SIJ motion remains unclear, the predominant motion appears to be x-axis rotation with some z-axis translation (Slipman *et al.,* 2001). The supporting ligaments surrounding the SIJ influence movement: the interosseous ligament resists the anterior and lateral displacement of the ilia and the sacrotuberous ligament functions to decrease the anterior rotation of the sacrum relative to the ilia (nutation) (Slipman *et al.,* 2001). Conversely, the sacroiliac ligament has been found to decrease posterior rotation of the sacrum relative to the ilia (counternutation) (Slipman *et al.,* 2001). Motion of the SIJ is usually limited to one to three degrees of rotation and 1.6mm of translation, with 90 percent of rotation occurring along the x-axis (Slipman *et al.,* 2001). The SIJ is surrounded by some of the largest and most powerful muscles of the body, but none of these muscles have direct influence on joint motion (Slipman *et al.,* 2001), but rather the muscles and ligaments act to maintain the integrity

of the SIJ (Slipman *et al.,* 2001). The SIJ's and symphysis pubis function as a "shock absorber" to transmit and dissipate loads and forces between the lower limbs and the trunk (Haldeman, 2005). The term "friction joint" has been used to describe the function of the SIJ (Haldeman, 2005). Forces of the lower extremities are transmitted to the trunk through the sacrum (Slipman *et al.,* 2001). The SIJ is capable of withstanding six times as much medial directed force and seven times as much lateral bending force than a lumbar motion segment (Slipman *et al.,* 2001). According to Moore and Dalley (2006), upon weight bearing, the upper sacrum is forced downward and anteriorly, wedging into the ilia. However, rotation of the superior sacrum is counterbalanced by the strong sacrotuberous and sacrospinous ligaments that anchor the inferior end of the sacrum to the ischium, preventing its superior and posterior rotation (Moore and Dalley, 2006). By allowing only slight upward movement of the inferior end of the sacrum relative to the hip bones, resilience is provided to the sacroiliac region when the vertebral column sustains sudden increases in force or weight (Moore and Dalley, 2006).

2.6 The Sacroiliac Syndrome

Chronic SIJ dysfunction is described by Haldeman (2005) as an alteration in normal motion or mechanics that describes either hypermobility or hypomobility (Haldeman, 2005). In addition, according to Morris (2006), the SIJ fibrous capsule contributes to proprioceptive and nociceptive output, which may be exacerbated when the joint is in a dysfunctional state. Kirkaldy-Willis and Bernard (1999), Slipman *et al.,* (2001) and Huijbregts (2004) believe the symptoms of SIJ Syndrome include LBP, pain over the posterior aspect of the sacroiliac joint that varies in its degree of severity, with associated referred pain to the groin, and pain over the greater trochanter, down the back of the thigh to the knee, and occasionally down the lateral or posterior calf to the ankle, foot and toes. The diffuseness of the sacroiliac joint pain referral zones may arise for several reasons: the joint's innervation is highly variable and complex (Slipman *et al.,* 2001; Hansen and Helm, 2003; Huijbreghts, 2004); pain may be somatically referred from other primary osseous and ligamentous nociceptors such as the zygapophyseal

joint and disc (Slipman *et al.,* 2001); adjacent structures such as the piriformis muscle, sciatic nerve, and L5 nerve root, may be affected by intrinsic joint pathology and become active nociceptors (Slipman *et al.,* 2001); and pain referral patterns may be dependent on the distinct locations of injury within the sacroiliac joint (Slipman *et al.,* 2001; Hansen and Helm, 2003). Although chronic SIJ Syndrome and LBP due to LFJ Syndrome are often associated (Montomery and Haak, 1999), there exist differences in presentation which distinguish them from one another. Table 2.2 describes the differences in clinical features between chronic SIJ Syndrome and LFJ Syndrome:

Table 2.2 Differences in presentation of chronic SIJ Syndrome and LFJ Syndrome

Chronic SIJ Syndrome	**Lumbar Facet Joint (LFJ) Syndrome**
Pain pattern over the SIJ/s (Huijbreghts, 2004)	Pain pattern over the facet joints (Kirkaldy-Willis, 1992)
Pain referral down to the groin, pain over the greater trochanter, down the back of the thigh to the knee, and occasionally down the lateral or posterior calf to the ankle, foot and toes (Huijbreghts, 2004)	Pain distal to the knee is rarely associated with LFJ Syndrome; upper facet joint pain refers to the flank, hip and lateral thigh; lower facet joint pain refers to the posterior thigh only; sometimes pain may be referred to the groin (van Kleef, Vanelderen, Cohen, Lataster, Van Zundert and Mekhail, 2010)
More often unilateral pain (Kleef *et al*., 2010)	More often bilateral pain (Kleef *et al*., 2010)

2.7 Diagnosis and Tests of Chronic Sacroiliac Joint Syndrome

In the clinical situation, a diagnosis of SIJ Syndrome is not made based on the results of an isolated history item or active range of motion (AROM) tests (Huijbregts, 2004). Huijbregts (2004) also states that the result of an isolated special test or even the results of a cluster of special tests in isolation is not used to establish a diagnosis of SIJ

Syndrome. Instead, a clinical diagnosis of SIJ Syndrome will be the result of a comprehensive examination consisting of a history, AROM tests, and special tests within the framework of a clinical reasoning process (Huijbregts, 2004). No single SIJ pain provocation test may be used to definitively diagnose SIJ Syndrome, however, the use of multi-test regimens has been advocated as reliable and valid in diagnosing SIJ Syndrome (Huijbregts, 2004). According to Slpiman (2001), an array of SIJ examination maneuvers have been described in the medical, osteopathic, physiotherapy and chiropractic literature designed to either provoke SIJ pain or detect aberrant motion. Broadhurst and Bond (1998) reported a sensitivity range of 77 to 87% when three provocative SIJ maneuvers are positive. Slipman *et al.,* (2001) demonstrated a positive predictive value of 60% in diagnosing SIJ Syndrome in patients with three positive provocative SIJ tests. Several studies indicate that out of a cluster of five orthopaedic tests which indicate chronic SIJ Syndrome, at least three positive tests are found to be reliable in diagnosing chronic SIJ Syndrome (Szadek, van der Wurff, van Tulder, Zuurmond and Perez, 2009; Van der Wurff, Buijs and Groen, 2006; Robinson, Brox, Robinson, Bjelland, Solem and Telje, 2007; Huijbreghts, 2004; Hansen and Helm, 2003). The five specific provocative tests with the most references throughout the literature, have the most interexaminer reliability and used most often in SIJ diagnosis are the Thigh Thrust (Posterior Shear) Test (Huijbregts, 2004), the Yeoman's Test (Kirkaldy-Willis and Bernard, 1999), the Patrick Faber Test (Huijbregts, 2004; Kirkaldy-Willis and Bernard, 1999), the Gaenslen's Test (Kirkaldy-Willis and Bernard, 1999) and the Sacroiliac Compression Test (Huijbregts, 2004). The procedures for these tests are discussed below:

- <u>The Thigh Thrust (Posterior Shear) Test</u>

  This test is performed with the patient in the supine position. The hip and knee of the side to be tested is flexed and slightly adducted, and direct posterior shear pressure is applied through the axis of the femur into the sacrum with the examiners one hand under the SIJ. Pain in the SIJ is

indicative of SIJ Syndrome (Laslett and Williams, 1994; Thompson, 2002; Moodley, 2002; Bisset, 2003; Shearar, 2003; Huijbregts, 2004; Matkovich, 2004; Morgan, 2005).

- The Yeomans Test

This test is performed with the patient in the prone position. The hip of the side to be tested is extended, and direct pressure is applied over the posterior superior iliac spine (SIJ margin) on the same side. Pain in the SIJ is indicative of SIJ Syndrome (Kirkaldy-Willis and Bernard, 1999; Thompson, 2002; Moodley, 2002; Bisset, 2003; Shearar, 2003; Matkovich, 2004; Morgan, 2005).

- The Patrick Faber Test

This test is performed with the patient in the supine position. The limb to be examined is placed into a figure-four position with the ipsilateral ankle resting across the contra-lateral thigh, proximal to the knee joint. Downward pressure is applied by the examiner on the ipsilateral knee with one hand while providing counter-pressure with the other hand on the contra lateral anterior superior iliac spine. This manoeuvre stresses the sacroiliac joint on the side being tested, and posterior hip pain is indicative of SIJ Syndrome (Reider, 1999; Kirkaldy-Willis and Bernard, 1999; Thompson, 2002; Moodley, 2002; Bisset, 2003; Shearar, 2003; Huijbregts, 2004; Matkovich, 2004; Morgan, 2005).

- The Gaenslen Test

This test is performed with the patient in the supine position with his/her buttock on the side being tested projecting over the edge of the examination

bed. The patient is instructed to draw both knees up to his/her chest while the examiner stabilizes the patient. The ipsilateral thigh is guided to hang off the side of the table, which results in full extension of the hip. This manoeuvre stresses the ipsilateral sacroiliac joint. Pain in the sacroiliac joint suggests SIJ Syndrome (Reider, 1999; Kirkaldy-Willis and Bernard, 1999; Thompson, 2002; Moodley, 2002; Bisset, 2003; Shearar, 2003; Matkovich, 2004; Morgan, 2005).

- The Sacroiliac Compression Test

This test is performed with the patient in the lateral decubitis position. The examiner applies pressure over the iliac crest, which results in compression of the pelvis (and therefore the SIJ's) against the examination table. Pain localised to either of the SIJ's is indicative of SIJ Syndrome (Reider, 1999; Huijbregts, 2004).

Additionally, Huijbregts (2004) states that using a criterion of three of five provocation tests to diagnose SIJ Syndrome produces substantial interrater agreement at a clinically useful range. Therefore a diagnosis of SIJ Syndrome can be made from three or more of the five tests being positive. In addition, measurements regarding the patient's pain can be used in order to diagnose SIJ Syndrome and to assess for changes in patient's pain. These include:

2.7.1 The Numerical Rating Scale (NRS - 101) (Appendix D)

A printed version of a standard 0-100 numeric rating scale, where a zero rating is described as having "no pain" and a rating of 100 is described as "pain as bad as it could be", can be used (Miro, Castarlenas and Huguet 2009). The NRS-101 has been shown to be reliable, valid and highly responsive (Ferreira-Valente, Pais-Ribeiro and

Jensen 2011) and can be used to help show the percentage decrease of patients subjective pain over time.

2.7.2 The Oswestry Low Back Pain Disability Index (ODI) (Appendix E)

The ODI remains a valid, vigorous and worthwhile outcome measure (Fairbank and Pynsent, 2000) and can therefore be used to measure the change in the patient's condition over time. The accepted target population for the ODI is acute, sub-acute, and chronic back pain patient groups (Fairbank, Couper, Davies and O'Brien 2008).

2.7.3 The Algometer (Appendix F)

The examiner may achieve highly reliable scores with the use of an algometer as an objective measurement tool, and it may be considered a valid measure of subjective pain and a suitable, convenient method of monitoring treatment effects (Potter, McCarthy and Oldham, 2008; Kinser, Sands and Stone, 2009). The algometer can therefore be used to assess pressure and pain threshold over the SIJ surface just medial to the posterior superior iliac spine (Thompson, 2002). Additionally, in a study by Paungmali (2003) it was reported that an electric algometer was found to yield reliable measurements and it had strong discriminating validity between treatment groups (Paungmali, O'leary, Souvlis and Vicenzino, 2003).

2.8 Treatment of Chronic Sacroiliac Joint Syndrome

There is a paucity of information on the treatment available for chronic SIJ Syndrome and LBP. LBP due to LFJ Syndrome and SIJ Syndrome are associated with each other (Montgomery and Haak, 1999) as LBP is a clinical feature of SIJ Syndrome (Huijbreghts, 2004). The following treatment modalities are common in clinical practice.

2.8.1 Low Back Orthotics

According to Lusardi and Nielsen (2000) the primary goal of an orthosis in the management of LBP is to decrease pain. Most designs accomplish this by limiting motion in the lumbar spine and by providing greater abdominal support. Optimal lumbar posture has been identified as an important contributor to reduction of pain. An orthosis that supports the lumbar spine in optimal posture may be an effective conservative treatment modality for LBP (Lusardi and Nielsen, 2000). Sacroiliac corsets support only the SIJ (Lusardi and Nielsen, 2000). With end points inferior to the waist and superior to the pubis, these garments encompass the pelvis but not the lower trunk. Sacroiliac corsets increase intra-abdominal pressure only slightly and are best used for mild SIJ Syndrome (Lusardi and Nielsen, 2000). An example of this is a Groovi-SI-Belt (Bell-Jenje, unknown date). Harrison, Harrison and Trovanovich (1997) reports that the use of foot orthotics in the treatment of chronic SIJ Syndrome levels the sacral base, and therefore normalises SIJ function. The use of orthotics in the treatment of SIJ Syndrome has been widely investigated but there have been no prospective studies performed to evaluate their effectiveness (Slipman *et al.,* 2001; Hansen and Helm, 2003). However, clinicians often correct leg length discrepancies of greater than 1cm as such inequalities have been described as altering normal SIJ function (Slipman *et al.,* 2001; Hansen and Helm, 2003). However, according to Mooney, Pozos, Vleeming, Gulick and Swenski (2001) orthotic devices are often not well tolerated (Mooney *et al*., 2001).

2.8.2 Physiotherapy

According to Slipman *et al.,* (2001) and Hansen and Helm (2003) physiotherapy strategies should emphasize pelvic stabilization, restoration of postural and dynamic muscle imbalances, and correction of gait abnormalities (Slipman *et al.,* 2001; Hansen and Helm 2003). Certain truncal and lower extremity muscles have a tendency to tighten and weaken as a result of SIJ pathology. Therefore a physical therapy program that concentrates on stretching tight musculature and strengthening weak muscles

becomes a key element in treatment of SIJS (Slipman *et al.,* 2001; Hansen and Helm 2003). As symptoms are controlled, therapy should be advanced to activity-specific stabilization exercises to incorporate return to the patients occupational, sporting, and/or non-occupational activities (Slipman *et al.,* 2001; Hansen and Helm 2003). For SIJ Syndrome, passive and active movements stimulate the tissues to adapt to the proper lines of stress, to modulate pain and to provide proprioceptive input (Hertling and Kessler, 2006). Education, in the form of ergonomic counseling and correction of habitual working stresses and sitting postures is the most important aspect of treatment (Hertling and Kessler, 2006).

2.8.3 Surgery

According to Slipman *et al.,* (2001) and Hansen and Helm (2003), surgery is not indicated for patients with acute SIJ Syndrome, but may be an option for those suffering with intractable pain. This is done by SIJ fusion (Slipman *et al.,* 2001; Hansen and Helm, 2003). However, SIJ fusion is an extreme form of stabilization with an unavoidable rate of failure and complications (Mooney *et al.,* 2001).

2.8.4 Acupuncture

Acupuncture refers to the insertion of a solid needle into any part of the human body for disease prevention, therapy or maintenance of health (Savigny *et al*., 2009). According to Yi (2009) sacroiliac acupuncture was developed by the Shanghai Research Institute of Acupuncture and Meridian from modern and traditional Chinese medical theories combined with clinical practice (Yi, 2009). Longbottom (2009) draws attention to the fascial tissue around the lumbosacral area where fascial restrictions may be treated with acupuncture using piston-like fanning techniques, which allows release of fascial tension, and therefore, deeper mobilization or further active stretching exercises (Longbottom, 2009). In another study by Longbottom (2009) on the treatment of chronic pelvic pain with acupuncture, a case study was done on a 68 year old male with chronic

lumbosacral pain. It was reported that acupuncture achieved gradual pain relief over several sessions, and the case study provided further support for the use of acupuncture in the treatment of chronic pelvic pain (Longbottom, 2009). This suggests that the use of acupuncture techniques for chronic SIJ Syndrome may be successful in relieving pain.

2.8.5 Interferential Current (IFC) Therapy

This is an electrical treatment that uses two medium frequency currents simultaneously, so that their paths cross (Savigny *et al.,* 2009). Where the current crosses, a beat frequency is generated which mimics low frequency stimulation (Savigny *et al*., 2009). In a systematic review done by Fuentes, Olivo, Magee and Gross (2010) on the effectiveness of IFC therapy in the management of musculoskeletal pain it was found that IFC as a supplement to another intervention seems to be more effective for reducing pain than that intervention alone, and IFC alone was not significantly better than any other therapy (Fuentes *et al*., 2010).

2.8.6 Exercise

Empirically, exercise has been an important aspect in the treatment of SIJ Syndrome (Slipman *et al.,* 2001). However, there are is a paucity of prospective trials that have evaluated the effect of aerobic exercise, stabilization exercises, or restoration of range of motion in SIJ Syndrome (Slipman *et al.,* 2001). One study by Mooney *et al.,* (2001) investigated the reciprocal relationship between the gluteus maximus muscle and the contralateral latissimus dorsi (two major muscles whose fascial connection traverses the SIJ) for treatment of sacroiliac pain. A reciprocal relationship was discovered in asymptomatic patients ($n = 15$), as well as the symptomatic group ($n = 15$), however the gluteus maximus was more active in the symptomatic group as opposed to the asymptomatic group (Mooney *et al.,* 2001). These findings demonstrate therapeutic implications to develop a rational exercise program for the treatment of SIJ Syndrome

(Mooney *et al.,* 2001). A case report on managing a 65 year old female patient with low back and sacroiliac pain with therapeutic exercise, describes symptomatic relief of the patient's pain in terms of subjective and objective measurements (Boyle, 2009).

2.8.7 Injection

According to Kirkaldy Willis and Bernard (1999) an injection of 0,25% bupivacaine into the overlying muscle, the posterior ligaments, and if possible, the sacroiliac joint can produce marked relief of pain. Given the irregular joint topography, direct joint injection may be difficult, and periarticular injections are easier to accomplish. Injections are often used as a diagnostic tool, where relief of symptoms following injection indicates a correct diagnosis (Slipman *et al.,* 2001).

2.8.8 Non Steroidal Anti-Inflammatory Drugs (NSAIDs) and Opiod Drugs

Kuijpers (2011) reports that NSAID's and opioids might be useful for short-term pain relief in patients with chronic SIJ Syndrome, but possible adverse effects such as abdominal pain, nausea and vomiting should be weighed up before deciding which medication to prescribe (Kuijpers *et al*., 2011).

2.8.9 Chiropractic Manipulation of the Sacroiliac Joints

Kirkaldy-Willis and Bernard (1999) state that the therapeutic effects of spinal manipulation are explained in terms of mechanical (physical) and neurophysiological (reflex) mechanisms. Much of this is gleaned from research into pain modulation and articular neurology (Melzack and Wall, 1965). Research published in the 1960's proposed a spinal gating mechanism for pain within the substantia gelatinosa of the dorsal horn of the spinal cord. This gate controls the central transmission of sensory information, including pain. Increased proprioceptive input to the gate can block the transmission of pain (Melzack and Wall, 1965). On the other hand, a lack of

proprioceptive input can facilitate the transmission of pain. The articular capsules of the spinal joints are densely populated with mechanoreceptors. These structures relay information about joint position and mobility through large myelinated fibers to the substantia gelatinosa of the dorsal horn (Melzack and Wall, 1965; Pickar, 2002). These proprioceptive impulses compete with transmission with impulses from the smaller unmyelinated pain fibers from adjacent tissues. An increase in proprioceptive input in the form of spinal mobility tends to narrow the gate and decrease the central transmission of pain from adjacent structures. According to Pickar (2002) non-harmful mechanical inputs travelling by means of large, myelinated A fiber neurons can prevent the response of dorsal horn neurons to nociceptive stimuli from C fibers (Pickar, 2002). Natural stimulation (i.e. increased proprioceptive input via motion) of A fibers has been shown to reduce chronic pain and increase pain threshold levels (Pickar, 2002). Thus, a therapy that induces articular motion will inhibit the transmission of nociceptive signals (Kirkaldy-Willis and Bernard, 1999). Local chronic SIJ Syndrome studies (Thompson, 2002; Moodley, 2002; Bisset, 2003; Shearar, 2003; Morgan, 2005) with sample sizes of 60, and Matkovich (2004) with a sample size of 30, all found SMT to have statistically significant results, indicating the effectiveness of SMT. In another study by Senna and Machaly (2011), who also had a sample size of 60, it was found that SMT was effective for the treatment of chronic non-specific LBP. A systematic review by Standaert, Fiedly, Erwin, Lee, Rechtine and Norvell (2011) reported that SMT is an effective form of therapy for those with chronic LBP.

2.8.9.1 Side Posture Sacroiliac Spinal Manipulative Therapy

This Chiropractic manipulation is done with the patient lying on their side with the dysfunctional SIJ uppermost. The doctor stands with a fencer stance angled approximately 45 degrees to the patient. The patient's upper thigh is flexed to between 60 and 80 degrees and a femur-to-femur contact is made. The doctor uses the hypothenar (pisiform) of the caudal hand and contacts just medial to the posterior superior iliac spine of the patient's side of SIJ dysfunction. The doctor's other hand

contacts the patient's upper shoulder and overlapping hand. The vector of the force required for the adjustment is directed from posterior to anterior and slightly inferior to superior through the SIJ (Bergmann, Peterson and Lawrence, 1993). This was the method of SMT used in this study as it is the most effective and commonly utilized method of SMT (Bisset, 2003; Bergmann, Peterson and Lawrence, 1993). Local studies on chronic SIJ Syndrome also adopted this method of SMT (Thompson, 2002; Moodley, 2002; Bisset, 2003; Shearar, 2003; Matkovich, 2004; Morgan, 2005). In a study carried out by Senna and Machaly (2011), the side posture method of SMT was also used, in which it was found to be effective.

2.8.9.2 Drop Piece Sacroiliac Spinal Manipulative Therapy

Another method of SMT for SIJ Syndrome is with the use of a drop piece chiropractic table. A maintained-contact technique is performed as follows: the doctor stands with a fencer stance at the ipsilateral side to the painful SIJ; the patient lies prone, with their anterior-superior iliac spine's over the edge of the drop piece. The contact point on the patient is the ipsilateral SIJ medial to the posterior-superior iliac spine; the contact point on the doctor is a re-inforced pisiform contact. The vector of the thrust is posterior to anterior and inferior to superior (Botha, 2005). In a study (n = 80) by Botha (2005) where the efficacy of the drop piece technique was observed in the treatment of chronic SIJ Syndrome, it was found that it was an effective treatment.

2.8.9.3 Traction Therapy

Two types of traction therapies exist: sustained static linear traction and intermittent flexion distraction, or Leander traction (Hicklin, 2010).

For Leander traction, the patient is positioned in the prone position, the iliac crest is even with the front edge of the pelvic cushion of the Leander traction chiropractic bed. The abdominal cushion is then released in order for the patient to attain his/her normal

lumbar lordosis, the ankle cushion is adjusted to touch the top of the instep of the foot. The contact point is over the affected joint, and at maximum depth of flexion distraction, the doctor hand applies a stabilizing force (Hicklin, 2010).

For sustained static linear traction, the patient is positioned supine on a linear traction device, which is either on a flat chiropractic bed or plinth, with a cushion under the knees in order for the lumbar spine to assume its normal curvature, which decreases the traction force required to stretch posterior tissues (Hicklin, 2010). Two canvas braces are then attached to the patient, one across the iliac crests (hip bones) and the other around the lower thoracic cage. Once the patient is comfortable, the traction force is slowly increased by a pump, starting from zero to 20% of the patients' body weight until the patient indicates that a 'pulling' feeling is felt. The traction is then increased to 35% of the patients' body weight. If this is tolerable by the patient, it is kept in this position for 10 minutes (Hicklin, 2010).

In Hicklin's (2010) study, a sample of 30 participants were used to test for the effectiveness of Leander (n = 15) and sustained static linear (n = 15) traction. The results indicated that both forms of traction were equally effective, in the treatment of LBP (Hicklin, 2010). However, there is a paucity of information on traction therapy for chronic SIJ Syndrome.

2.8.10 Therapeutic effects of Spinal Manipulative Therapy

Haldeman (2005) suggests that chronic SIJ Syndrome may effectively be treated by SMT and Gatterman (2005) describes SMT as a treatment of choice for patients suffering from chronic SIJ Syndrome. SMT for chronic SIJ Syndrome is professed to have four therapeutic effects - mechanical correction (range of motion), pain reducing effects, circulatory increase and neurobiologic (proprioceptive) effects (Bergmann, Peterson and Lawrence, 1993; Walter, David and Philip, 1999; Pickar, 2002; Marszalek, 2002; Thompson, 2002; Bisset, 2003):

1) Mechanical correction aims to reverse any soft tissue pathology and mechanical dysfunction associated with injuries of the neuromusculoskeletal system (Bergmann, Peterson and Lawrence, 1993). The soft tissue pathologies responsible for mechanical dysfunction, resulting in altered joint mechanics, include acute trauma, torsional strain, chronic repetitive shear or torsional forces, weight bearing on the affected side with standing or walking, flexion in the standing position with knees fully extended and the Valsalva manoeuvre (Slipman *et al.,* 2001; Hansen and Helm, 2003).

2) Pain reducing effects from SMT is well recognized and documented (Kirkaldy-Willis and Cassidy, 1985; Bergmann, Peterson and Lawrence, 1993; Pickar, 2002). The pain associated with mechanical dysfunction of the musculoskeletal system is due to physical deformation, inflammation or both (Mense and Prabhakar, 1986). Manual therapy (i.e. SMT) may reverse physical deformation and/or inflammation, and therefore, remove the source of pain as the structures are returned to normal function (Bergmann, Peterson and Lawrence, 1993).

3) Circulatory increase from SMT may be due to improved functional capacity of the musculoskeletal system, which in turn may lead to improved circulatory increase (Bergmann, Peterson and Lawrence, 1993).

4) Neurobiologic effects, also known as "stimulus-produced analgesia", from SMT may result in inhibiting the central transmission of pain (Bergmann, Peterson and Lawrence, 1993). It is suggested that SMT may produce enough force to activate superficial and deep somatic mechanoreceptors, proprioceptors and nociceptors (Bergmann, Peterson and Lawrence, 1993). As per Section 2.8.9, research on the spinal gating system by Melzack and Wall (1965) states that increased proprioceptive stimulation (by SMT) may block the transmission of pain. Additionally, according to Pickar (2002), biomechanical changes due to SMT are thought to have physiological consequences because of the effects on the inflow of sensory information to the central nervous system. Muscle spindle and Golgi tendon organ

afferents are stimulated by SMT (Pickar, 2002). Smaller-diameter sensory nerve fibers are usually activated, although this has not yet been demonstrated directly (Pickar, 2002).

2.8.11 Contraindications to Spinal Manipulative Therapy of the Sacroiliac Joints

According to Bergmann, Peterson and Lawrence (1993), SMT is contraindicated when the therapy may produce an injury, worsen an associated disorder, or delay appropriate curative or life-saving treatment. The majority of spinal manipulative complications arise from misdiagnosis and improper technique. Although the danger of injury from manipulation is low, it must be remembered that adjustments do carry some risk (Bergmann, Peterson and Lawrence, 1993). In nearly all situations injury can be avoided by sound diagnostic assessment and awareness of the complications and contraindications to manipulative therapy. A relative contraindication is one for which caution should be used or technique modification should be made, because complications may result. An absolute contraindication precludes manipulative therapy to the affected area. The most frequently described, yet rare, complication from spinal manipulative therapy in the SIJ is compression of the cauda equina by a midline disc herniation at the level of the third, fourth or fifth intervertebral disc (Bergmann, Peterson and Lawrence, 1993).

2.9 The Kinesio Taping® Method

2.9.1 Introduction to Kinesio Tex® Tape

Dr. Kenso Kase, a Japanese chiropractor, developed Kinesio Tex® Tape and the method used in its application, namely the Kinesio Taping® Method (Illes, 2009). Dr. Kase sought a healing technique which could help the body heal traumatized tissue. Unlike normal athletic tape, the aim was to develop something which had similar elastic properties as that of human skin and muscles (Kase, Wallis and Kase, 2003). Kinesio

Tex® Tape received worldwide exposure when it was used at the Seoul Olympics by Japanese athletes (Illes, 2009). This technique then spread to the United States and then to the 2004 Athens Olympics where it was used extensively to treat the athletes (Illes, 2009). Since then, its use has increased greatly despite limited research into its use, especially in a clinical setting (Shim, Lee and Lee, 2003; Jaraczewsca and Long, 2006; Yasukawa, 2006; Szczegielniak *et al.,* 2007; Thelen, Dauber and Stoneman, 2008).

2.9.2 Kinesio Taping® Method Concepts

The four major functions and effects of Kinesio Tex® Tape have been identified as (Illes, 2009):

- normalization of muscle function,
- improvement of lymphatic and blood flow,
- pain reduction and management and
- correction of posture.

A possible explanation for the treatment effects of the Kinesio Taping® Method may be the Gatterman and Goe (1990) and Mense (1991) models as referenced by Leach (2004). The models indicate that inflammation may be the cause of muscle pain, joint pain and joint dysfunction. The Kinesio Taping® Method may help to facilitate oedema resolution by raising the skin allowing for lymphatic drainage (Illes, 2009), and may also help to restore muscle function resulting in increased joint and muscle movement and thus further resolution of the inflammatory oedema through a mechanical effect (Kase, Wallis and Kase, 2003; Illes, 2009). Kinesio Tex® Tape may also help to reduce pain due to its proprioceptive effect through stimulation of the large pressure and touch nerve fibers (Kase, Wallis and Kase, 2003, Friedman, 2007; Illes, 2009).

2.9.3 Properties of Kinesio Tex® Tape

Kinesio Tex® Tape (50mm width) contains polymer elastic strands with 100% cotton fibers wrapped around them (Kase, Wallis and Kase, 2003). By design it stretches only lengthways and this is 55-60% of its resting length which may be comparable to the elastic properties of human skin, and these elastic qualities are effectual for 72-120 hours as the elastic polymers weaken after this (Kase, Wallis and Kase, 2003). The cotton permits evaporation of body moisture and it allows for quick drying. The thickness of Kinesio Tex® Tape is designed to imitate the thickness of the epidermis (Kase, Wallis and Kase, 2003). Patient's skin easily accommodates the sensory stimulation once the tape has been applied (after approximately 10 minutes the patient will barely notice that there is Kinesio Tex® Tape on their skin). The adhesive in the Kinesio Tex® Tape is 100% acrylic and is heat activated, which allows it to become more adherent to the skin the longer the tape is worn (Kase, Wallis and Kase, 2003). A wave-like acrylic pattern causes lifting of the skin, which fascilitates circulation, and creates areas in the Kinesio Tex® Tape from which moisture can escape, which allows for quick drying (Kase, Wallis and Kase, 2003). Importantly, the skin needs to be free of moisture or oils prior to application and notably there is no latex in the Kinesio Tex® Tape (Kase, Wallis and Kase, 2003). The Kinesio Tex® Tape's skin-like properties are due to the combination of its capability to stretch, its thickness and its adhesion (Kase, Wallis and Kase, 2003). Two factors are thought to contribute to the success of the Kinesio Taping® Method: Proper evaluation of the patient and application of the Kinesio Tex® Tape over the correct areas, and appropriate application of the Kinesio Taping® Method (Kase, Wallis and Kase, 2003).

2.9.4 Therapeutic effects of the Kinesio Taping® Method

According to Kase, Wallis and Kase (2003) and the Kinesio Taping® Association International, Kinesio Tex® Tape therapy is proposed to have the following therapeutic functions/effects:

1) Improvement of lymphatic and blood flow (through enhanced lymphatic drainage (Constantinou and Brown, 2010)). This was found in hemiplegia and stroke patients (*n* = 15) in which it was determined that they had improved functional use of the upper extremity. In this study it was shown that Kinesio Tex® Tape therapy may decrease soft tissue inflammation through improved lymphatic and blood flow (Jaraczewsca and Long, 2006). Another proposal for Kinesio Tex® Tape therapy improving circulation is that it creates more space between the layers of skin, fascia and soft tissues above the areas of pain and inflammation, and it may assist in the removal of oedema by directing exudates toward lymph ducts (Thelen, Dauber and Stoneman, 2008; Illes, 2009).

2) Pain reduction (Paoloni, Bernetti, Fratocchi, Mangone, Parrinello, Del Pilar Cooper, Sesto, Di Sante and Santilli 2011). It is theorized that the cutaneous stretch stimulation provided by Kinesio Tex® Tape therapy may interfere with the transmission of mechanical and painful stimuli (Paoloni *et al.,* 2011). Additionally, Kinesio Tex® Tape therapy may provide afferent stimuli which facilitate pain inhibitory mechanisms (Melzack and Wall, 1965) and pain reduction (Paoloni *et al.,* 2011).

3) Stimulation of sensorimotor and proprioceptive systems (Jaraczewsca and Long, 2006). Jaraczewsca and Long (2006) reported that the effects of proprioceptive feedback from Kinesio Tex® Tape therapy in achieving and maintaining preferred joint alignment benefits patients with hemiplegia that was a result of a stroke (Jaraczewsca and Long, 2006). According to Baker, Laiderman, Paunika, Simpson, and Weaver (2011), Kinesio Tex® Tape therapy allows the body to move normally as it reacts to the fascia of the body through biomechanical and proprioceptive mechanisms (Baker *et al.,* 2011). Additionally, according to Melzack and Wall (1965) proprioceptive stimulation decreases the transmission of pain (Section 2.8.9).

2.9.5 Adverse Reactions and Contraindications to Kinesio Tex® Tape Therapy

If a patient has sensitive skin, a small strip of Kinesio Tex® Tape should be applied to the skin to determine what the patients' response will be prior to its therapeutic use (Kase, Wallis and Kase, 2003). Contraindications that need to be assessed for and noted when Kinesio Tex® Tape is used include, but are not limited to:

- Open wounds, recently formed scars or recently irradiated skin;
- Allergies to certain adhesives - to determine if an allergy exists, test a piece of Kinesio Tex® Tape by applying it to the skin prior to its therapeutic application; and
- Skin irritation (e.g. redness, rash, itchiness).

2.10 Kinesio Tex® Tape Versus Athletic Tape

According to Constantinou and Brown (2010), athletic taping (elastic/rigid joint stability taping) may provide mechanical support for the SIJ and is only performed when SIJ support is needed. Athletic taping refers to 38mm width adhesive rigid tape, which is considered to be the most commonly used tape (Constantinou and Brown, 2010), as compared to Kinesio Tex® Tape, which is described in detail above under Section 2.9.3. Perrin (1995) states that the function of athletic taping is limited to prevention of injury/re-injury and/or to facilitate an injured athlete's return to competition. It may provide some proprioceptive stimulation by stimulating cutaneous nerve receptors and muscle or joint mechanoreceptors (Constantinou and Brown, 2010). It is also proposed that athletic taping may assist with controlling oedema through a compression (pump) effect (Constantinou and Brown, 2010), but in the case of low back/SIJ taping it may not have the same compressive effect on oedema as it would have around a swollen ankle or knee. Additionally, in a study done on the use of elastic adhesive tape to promote lymphatic flow in a rabbit hind leg it was shown that athletic tape may provide an increase in lymphatic blood flow only if complimented with exercise local to the area

being taped (Shim, Lee and Lee, 2003). Therefore, traditional athletic taping has limited capabilities with regards to the taping of the SIJ in relieving symptoms. The use of Kinesio Tex® Tape as opposed to traditional therapeutic athletic taping may more effectively and speedily aid patient recovery when associated with SMT for chronic SIJ Syndrome. According to Thelen, Dauber and Stoneman, (2008) Kinesio Tex® Tape therapy produced significant immediate improvement in pain free shoulder abduction in patients with shoulder pain, whereas athletic tape only produced a decrease in pain after 72 hours.

Using traditional athletic tape which has a different adhesive, is thicker, does not breathe and has dissimilar elastic qualities may not produce the same results as Kinesio Tex® Tape (Kase, Wallis and Kase, 2003). Constantinou and Brown (2010) states with regards to any form of taping that "several studies have concluded that tape as an adjunct to treatment of musculoskeletal conditions does effectively reduce pain" and with regards to Kinesio Tex® Tape therapy "more research into this system of taping is necessary before any conclusions regarding its benefit or superiority over other approaches to taping can be made."

2.11 Conclusion

In conclusion, due to the fact that chronic SIJ Syndrome is a common condition (Slipman *et al.,* 2001, Hansen and Helm 2003, Dreyfuss and Dreyer 2004, Zelle *et al.,* 2005, Weksler *et al.,* 2007, Standring 2008), and the therapeutic effects of both SMT and Kinesio Tex® Tape therapy may correlate, this study was designed to evaluate the use of Kinesio Tex® Tape therapy as an adjunctive therapy to SMT in a clinical setting.

CHAPTER THREE

Methodology

3.1 Introduction

The methodology followed an experimental procedure, which is described within this chapter. This includes the methods used in obtaining the subjective and objective clinical data from the study participants, as well as the methods used for statistical interpretation and presentation.

3.2 Materials and Method

3.2.1 The Data

The data collected for this study consisted of primary as well as secondary data.

3.2.1.1 The Primary Data

Primary data for inclusion into this study was obtained from the Durban University of Technology standardised forms: Case History (Appendix A), Physical Examination (Appendix B), Lumbar Regional Examination (Appendix C). Data of reported measures were obtained from subjective measures viz. NRS - 101 Questionnaire (Appendix D) and the ODI Questionnaire (Appendix E) and objective measures viz. the Algometer Form (Appendix F). These forms were not translated into isiZulu as a barrier in communication would have been established in telephonic or personal interaction and therefore such a participant would not have been included.

3.2.1.2 The Secondary Data

The secondary data was obtained during a search of related literature. This included journal articles, textbooks and the internet (using various search engines such as Google Scholar, Summit, EBSCO Host and Proquest).

3.3 Study Design and Protocol

3.3.1 The Study Design

A prospective stratified clinical trial with three intervention groups aimed at determining the relative effectiveness of the Kinesio Taping® Method as an adjunct to a single sacroiliac joint manipulation in the treatment of chronic Sacroiliac Joint Syndrome.
Based on this study design, this research was approved by the Faculty of Health Institutional Research and Ethics Committee (IREC 004/12)(Appendix G) indicating that the research protocol satisfied the ethical requirements set out by the Faculty of Health Institutional Research and Ethics Committee for such studies.

3.3.2 Sampling and Allocation of Participants

3.3.2.1 Advertisements (Appendix H)

This was done through advertisements being placed at the Durban University of Technology (DUT) Chiropractic Day Clinic, Durban University of Technology Campus, Durban University of Technology intranet, flyers, local newspapers (Appendix H) and through word of mouth.

3.3.2.2 Sampling Technique

A non-probability sampling technique was used to attract participants. No bias to ethnicity, religion or socio-economic standing was shown. This study was limited to include participants between the age of 18 and 50.

3.3.2.3 Sample size

The study was limited to 60 participants (20 in each group). This was determined by looking at previous chronic SIJ Syndrome studies which were performed at Durban University of Technology and which found statistically significant results. The sample sizes were comparable to this study (Thompson, 2002; Bisset, 2003; Shearar, 2003; Morgan, 2005).

3.3.2.4 Telephonic Interview

All persons who responded to the advertisements were screened by telephonic or personal interview by the researcher. The following questions were asked:

1. *Are you between the ages of 18 and 50?* The expected answer was "Yes" as the participants between the ages of 18 and 50 years of age were included into this study to avoid parental consent and the possibility of the development of fibrous ankylosis in the SIJ after the sixth decade (Kirkaldy-Willis and Burton, 1992) as well as concerns relating to osteoporosis.

2. *Do you currently have lower back pain?* The expected answer was "Yes" as the participant had to have been in a state of current LBP.

3. *Have you had the pain for more than 6 weeks?* The expected answer was "Yes" as "chronic" is defined by Morris (2006) as being pain for six weeks or longer.

4. *Do you have any of the following long term ailments ("Slipped Disc," bone tumours or infections, hip pathology, skin infections around the sacral area or*

open wounds around the sacral area)? The expected answer was "No" as any of the above conditions would exclude the participant from the study.

5. *Do you have any skin allergies?* The expected answer was "No" as the use of Kinesio Tex® tape over allergic and/or sensitive skin is contraindicated.

3.3.2.5 Sampling Allocation/Stratification

Twenty participants were allocated to each of the three groups with the allocation of the participants to each group occurring only after their inclusion into the study had been ascertained by assessment of the participant's compliance with the inclusion and exclusion criteria, as well as after a certain diagnosis of either SIJ Syndrome alone or both SIJ and Facet Joint Syndrome together had been made. The reason why LFJ Syndrome was considered if it was in association with chronic SIJ Syndrome and not if it was found to be the major causative factor in a participants LBP only was because LBP due to LFJ Syndrome is often related to and associated with chronic SIJ Syndrome (Montgomery and Haak, 1999), although two separate conditions (refer to Table 2.2). However, there may be circumstances in which chronic SIJ Syndrome exists in isolation as the main causative factor in a participants LBP. However, whether a participant was diagnosed with chronic SIJ Syndrome alone or in association with LFJ Syndrome, the participants were still considered to have chronic SIJ Syndrome, which included them into the study.

A diagnosis of LFJ syndrome is confirmed by using Kemps Test (Morris, 2006). Kemp's test uses the patients trunk as a lever, to induce tension, and as a compressive force. The test may be performed either seated or standing. In the seated position and with the patients arms crossed over the chest, the examiner uses one hand to stabilize the patients lumbosacral region on the side to be tested and the other arm to control the patient's upper body movement (Morris, 2006). The patient is then passively directed into flexion, rotation, lateral flexion and then finally extension. Depending on the patients response, axial compression may be applied in the fully extended and rotated position

to increase stress on the posterior joints (Morris, 2006). Radiating pain down the leg provoked anywhere along the arc of movement should be noted and the test should be discontinued at that point. Often patients will report dull or achy pain stemming from the lumbar spine that may be due to facet or extraspinal soft tissue irritation (Morris, 2006). The seated test is more provocative than the standing or supine counterparts (Morris, 2006). The differing diagnoses resulted in the participants being allocated and stratified to either of the treatment groups according to the number of similar presentations (SIJ Syndrome alone or both SIJ and Facet Joint Syndrome) already in the groups. This would prevent too many of similar presentations to be in one single group. Group one was treated with SMT of the SIJ's only. Group two was treated with Kinesio Tex® Tape therapy of the SIJ's only. Group three was treated by a combination of SMT and Kinesio Tex® Tape therapy of the SIJ's only. The researcher conducted the data collection.

3.3.3 Inclusion and Exclusion criteria of Participants

3.3.3.1 Inclusion Criteria

- The participant had to agree to and sign a consent form (participant had to give their informed consent: see Appendix I).
- Only participants between the ages of 18 and 50 years of age were included into this study to avoid parental consent and the possibility of the development of fibrous ankylosis in the SIJ after the sixth decade (Kirkaldy-Willis and Burton, 1992) as well as concerns relating to osteoporosis.
- The participant had to be experiencing chronic (overall duration on average of more than six weeks according to Morris, 2006) LBP (the pain had to be mechanical and uncomplicated in nature).
- The participant had to be suffering from chronic SIJ Syndrome as diagnosed by at least three positive tests out of the five specific orthopaedic sacroiliac provocation tests. Refer to Section 2.7 ("Diagnosis and Tests of Sacroiliac Joint Syndrome") in Chapter Two.

- Participants who had taken analgesic medication (e.g. Ibuprofen, Paracetamol) were included following a three day wash out period (Seth, 1999).

3.3.3.2 Exclusion Criteria

- Participants with absolute contra-indications to SMT (i.e. abdominal aortic aneurysm, disc prolapse, fractures, osteoporosis, dislocation, bone tumours and bone infections (Bergmann, Peterson and Lawrence, 1993)) and/or Kinesio Tex® Taping (malignancy, cellulitis, skin infections and open wounds, deep vein thrombosis, itching or increase in pain [Illes, 2009]) were excluded. This was determined during the Case History (Appendix A) and Physical Exam (Appendix B).
- Any participant with previously diagnosed organic (i.e. pathologic) LBP, or diagnosed upon history and physical examination at DUT with an organic cause of LBP and chronic SIJ Syndrome were excluded.
- Participants who have attended/been attending the DUT Chiropractic Day Clinic for treatment were not permitted into this study until a two week wash out period had taken place (this was according to the DUT Chiropractic Day Clinic protocol).
- Participants with LBP due to a history of trauma (e.g car accident) were excluded.
- Participants with clinical features of lumbar spine radiculopathy (LBP with associated leg pain, dermatomal sensory changes, motor weakness or loss and decreased deep tendon reflexes of corresponding muscles) were excluded (Gatterman, 2005).
- Participants were asked to refrain from any major physical activity or any activity that might aggravate their pain during the course of the study.
- Participants with a history of allergy to taping, plasters or bandages were excluded.

- If a participant had taken any non-steroidal anti-inflammatory drugs during the course of participation in the research, it would exclude that participant from the research.

3.3.4 Clinical Procedure

3.3.4.1 Telephonic/Personal Interview

Potential participants who responded to the adverts for this study were interviewed telephonically or in person and were asked questions in order to gauge the probability of acceptance into the research study. These questions are listed under Section 3.3.2.4. If the potential participant was likely to fit into the study, the first appointment was scheduled.

3.3.4.2 Consultations

At the initial consultation, the assessment and treatment protocol were clearly explained. All participants that were included in the study were required to read through and sign a Letter of Information and Informed Consent Form (Appendix I).

A total of 60 participants were evaluated. At the initial consultation a Case History (Appendix A), a Physical Examination (Appendix B) and a Lumbar Spine Regional examination (Appendix C) were performed. Screening for suitability of the study was done by applying the inclusion and exclusion criteria as delineated in Section 3.3.3.1. and Section 3.3.3.2. This study utilised purposive sampling, according to the participants' presenting diagnosis. Participants were diagnosed as having either SIJ Syndrome in isolation, or as having SIJ Syndrome and LFJ Syndrome in association. The participants were then purposively allocated into one of the three groups in order to have an equal spread of presentations in each group. In addition, feedback from the participants regarding LBP was obtained using: NRS - 101 (Appendix D) for subjective

pain intensity, the Oswestry Low Back Disability Index Questionnaire (Appendix E) for degree of subjective disability and the Algometer readings (Appendix F) for objective measures of the participants pain.

The second consultation occurred 72 hours after the initial consultation. The reason for this is that according to Kase, Wallis and Kase (2003), Kinesio Tex® Tape therapy may be therapeutically effective for a minimum of 72 hours, thus such a period of 72 hours was allowed for the effects of Kinesio Tex® Tape therapy to take place. This was managed by scheduling participants in a way that the follow-up appointments may be on day three after their initial consultation (initial consultation participants seen on a Monday, Tuesday and Friday had a follow-up consultation on Thursday, Friday and Monday respectively). Participants were informed of this arrangement at the initial telephonic/personal conversation, and clashing of appointments was avoided by making sure the participant could commit to such arrangements and were scheduled appropriately. Subjective and objective measurements were again taken at this consultation with no treatment. Participants still suffering of LBP symptoms after being involved in this study were appropriately referred to another on-duty chiropractic student for further care.

3.3.4.3 Skin Preparation for Kinesio Tex® Tape Application

The skin was cleaned with disinfectant alcohol swabs before the application of the Kinesio Tex® Tape to ensure it was free of lotions and oils. Anything limiting the ability of the acrylic to adhere (including hair), would have limited both the length of time of the Kinesio Tex® Tape's adherence, as well as the degree to which the tape would have been effective (Kase, Wallis and Kase, 2003). Two factors that determined the success in the use of Kinesio Tex® Tape are the proper evaluation of the participant's condition to ensure that the Kinesio Tex® Tape application is over the correct areas, and the correct application of the Kinesio Tex® Tape using the Kinesio Taping® Method (Kase, Wallis and Kase, 2003). Evaluation was done by the researcher only, using a Case

History (Appendix A), Physical Examination (Appendix B) and Lumbar Regional Examination (Appendix C) in order to ensure that the participant had chronic SIJ Syndrome. Correct application of the Kinesio Tex® Tape was done according to the protocol set out in the "Clinical Therapeutic Applications of the Kinesio Taping® Method" by Kase, Wallis and Kase (2003) and from skills learnt at the Kinesio Taping® Method course (Illes, 2009).

3.3.4.4 The Treatment

Group One was treated with SMT. A side posture sacroiliac roll was utilised as the preferred method of SMT (Bergmann, Peterson and Lawrence, 1993). This Chiropractic adjustment was done with the participant lying in the lateral decubitis position with the dysfunctional SIJ uppermost. The researcher stood with a fencer stance angled approximately 45 degrees to the participant. The participant's upper thigh was flexed to between 60 and 80 degrees and a femur-to-femur contact was made. The researcher used the hypothenar (pisiform) of the caudal hand and made contact just medial to the posterior superior iliac spine of the participant's side of SIJ dysfunction. The researchers cephalad hand made contact with the participant's upper shoulder and overlapping hand. The vector of the force required for the adjustment was directed from posterior to anterior and slightly inferior to superior through the SIJ (Bergmann, Peterson and Lawrence, 1993).

Group Two was treated with Kinesio Tex® Tape, using the Kinesio Taping® Method. The tape was applied as follows (Figure 3.1): Two pieces of tape were needed per SIJ. A fan strip technique (5 fan strips) was utilised by placing the base of the first strip approximately 5-7cm superior to the SIJ along the lumbar spine spinous processes with the participant in neutral spine (seated) position. The participant was then moved into forward flexion with rotation to the opposite side from the injured joint. The tails of the fan strip were angled at 45 degrees over the SIJ and ended near the superior aspect of the gluteus maximus, using very light to light tension (15-25% of available tension). The

second strip base was placed approximately 5-7cm inferior to the SIJ along the sacral spinous processes with the participant in neutral spine position. The participant was then flexed forward and rotated away from the injured joint and the tails of the fan strip were angled at 45 degrees over the SIJ and end near the superior aspect of the superior iliac spine. Glue activation (via frictional rubbing over the placed tape) was then performed before the participant moved in order for correct adhesion to the skin to occur (Kase, Wallis and Kase, 2003).

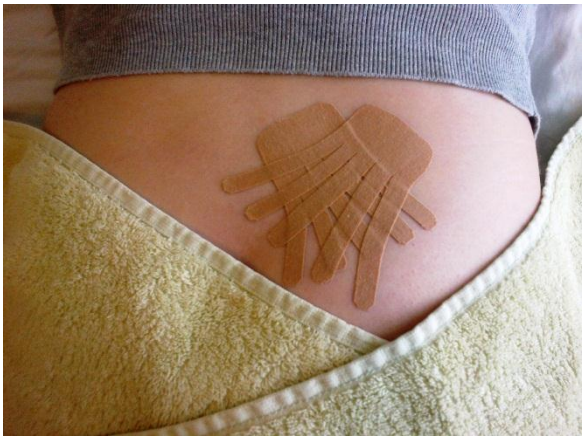


Figure 3.1. The fan strip technique over the right SIJ.

Group Three was treated with a combination both SMT and the Kinesio Taping® Method. The respective treatments in this group were the same as for Group One and Two. SMT was performed first, followed by application of the Kinesio Tex® Tape. The reason for this was because if the Kinesio Tex® Tape was applied before the SMT, the SMT might have disrupted the adhesion of the Kinesio Tex® Tape on the participants' skin over the SIJ.

It must be stressed that for the purposes of this study it was selected to utilize one treatment intervention as Morgan (2005) and Bisset (2003), in similar studies to the present study, found statistically significant results using one SMT for chronic SIJ Syndrome. Therefore, it could be reasoned that similar results would be seen in this study.

If at any stage the Kinesio Tex® Tape came off, the participant was required to contact the researcher immediately for a reapplication of the Kinesio Tex® Tape to ensure standardization in the treatment protocol.

3.3.4.5 Treatment Protocols

3.3.4.5.1 Spinal Manipulative Therapy Treatment Protocol

Table 3.1 Group One: SMT Alone

DAY OF CONSULTATION	TREATMENT	DATA COLLECTION
1	SMT	NRS-101 (before and after treatment), Oswestry Low Back Disability Index, Algometer (before and after treatment).
4	None	NRS-101, Oswestry Low Back Disability Index, Algometer.

3.3.4.5.2 Kinesio Taping® Method Treatment Protocol

Table 3.2 Group Two: Kinesio Tex® Tape Alone

DAY OF CONSULTATION	TREATMENT	DATA COLLECTION
1	Kinesio Taping® Method	NRS-101 (before and after treatment), Oswestry Low Back Disability Index, Algometer (before and after treatment).
4	None	NRS-101, Oswestry Low Back Disability Index, Algometer.

3.3.4.5.3 Combination Group Treatment Protocol

Table 3.3 Group Three: SMT and Kinesio Tex® Tape

DAY OF CONSULTATION	TREATMENT	DATA COLLECTION
1	SMT, Kinesio Taping® Method.	NRS-101 (before and after treatment), Oswestry Low Back Disability Index, Algometer (before and after treatment).
4	None	NRS-101, Oswestry Low Back Disability Index, Algometer.

3.4 Methods of Measurement

The measurement tools are discussed in greater detail within Chapter Two under Section 2.7. "Diagnosis and Tests of Sacroiliac Joint Syndrome". Refer to the previous description of the reliability and validity of these measurement tools. However, it will also be discussed further in this section:

3.4.1 The Subjective Data

Subjective data was collected at the initial (prior to and after treatment) and second consultations by the use of:

3.4.1.1 The Numerical Rating Scale (NRS - 101) (Appendix D)

Participants filled out the NRS-101 which had a scale in the form of a straight line from 0 - 100 ("no pain" - "worst pain") in order to rate the "Least Severe" pain, and another scale in the form of a straight line from 0 - 100 in order to rate "Most Severe" pain. These measurements were used to rate the pain intensity the participant felt before the treatment, immediately after the treatment and then at the follow-up consultation which was analysed separately for statistical significance.

3.4.1.2 The Oswestry Low Back Pain Disability Index (Appendix E)

For the purposes of this study, the ODI was used as a measure for chronic SIJ Syndrome as defined by Morris (2006) as being pain on average of more than six weeks. This questionnaire was filled out by the participant at the initial and follow-up consultation. It was used to calculate participants' percentage disability due to chronic SIJ Syndrome, and whether there were any changes in disability over the period of the study. The reason that this version was used in preference to the Revised ODI was because it remains a valid, vigorous and worthwhile outcome measure (Fairbank and Pynsent, 2000) and can therefore be used to measure the change in the patient's condition over time. Additionally, in the process of approving the proposal for this research the departments responsible for such approval did not approve the Revised ODI.

3.4.2 The Objective Data

Objective data was collected at the initial (prior to and after treatment) and second consultations by the use of:

3.4.2.1 The Algometer (Appendix F)

The Algometer used in this trial was the Wagner FDK20 Force Dial (Wagner Instruments, P.O. Box 1217, Greenwich, CT, 06836 USA, tel. 2038699861). The force readings were measured in kilograms per square centimetre. Measurements were taken by placing the Algometer on the SIJ margin medial to the posterior superior iliac spine. Participants were instructed to say "Now" at the point when pain could not be tolerated any longer as the pressure gradually increased. Higher Algometer readings (i.e. increased measures of kilograms per square centimeter) indicated that the participant could absorb increased levels of pressure and pain.

3.5 Statistical Analysis

The latest version of SPSS (21.0) was used for statistical analysis of the subjective and objective data and the results were presented in the form of bar graphs (with trend-line comparisons) and tables. The null hypothesis was accepted at the $p \geq 0.05$ level of significance, indicating statistically insignificant findings. The null hypothesis was rejected at the $p < 0.05$ level of significance, indicating statistically significant findings. Two subjective measurements were used, namely the ODI, the NRS-101 Questionnaire and the objective measurement tool used was the Algometer. The statistical significance ($p < 0,05$) of any improvements as a result of treatment was compared using the t-test (paired t-tests for intra-group analyses and unpaired t-tests for intergroup analyses).

3.5.1 The Unpaired t-Test (Intergroup)

The unpaired t-test was used to determine whether there was any difference between the three groups at the time of the first and second consultation. This test was used as the sample size was greater than or equal to 30 ($n \geq 30$).

3.5.2 The Paired t-Test (Intragroup)

The paired t-test was used to determine whether any improvement occurred within Group One, Two and Three. This was done before and after the treatment at the first consultation and the second consultation for the NRS-101 and the Algometer, and it was done before treatment at the first consultation and at the second consultation for the ODI Questionnaire. This test was used as the sample size was greater than or equal to 30 ($n \geq 30$). The results obtained from these tests were then used to establish whether there was any statistical difference between the three treatment groups, from which any discussions or conclusions were drawn up.

CHAPTER FOUR

Results

4.1 Introduction

The first part of this chapter contains the demographic data of all the participants included in the study. There were three groups of twenty participants in each, giving a total of sixty participants. The second part of this chapter contains the statistical analysis of the subjective and objective data obtained from the subjects. The subjective data consists of the Numerical Pain Rating Scale data and the Oswestry Disability Index data. The objective data consists of the measurements obtained from the Algometer. The results are tabulated to display the mean, standard deviation and probability value (*p*-value). The *p*-value is compared to the level of significance, which is set at $p = 0.05$. Probability values less than 0.05 were regarded as being statistically significant. Probability values equal-to or greater than 0.05 were regarded as being statistically insignificant.

There were a number of respondents who did not qualify to participate in this study. Two participants who had initially qualified for the study were excluded. The reason for exclusion was due to re-injury of the SIJ's between the two consultations and due to failure to attend the follow-up consultation respectively. There were five respondents who had met all the requirements from the telephonic interview but after the case history, physical and regional examinations did not qualify to participate in this study as the inclusion criteria of the study were not met. There were 9 respondents who at the point of the telephonic interview did not meet the requirements to participate in the study.

4.2 Criteria Governing the Admissibility of the Data

Only data from participants who met the research criteria stated previously was included. The subjective measurements were completed by each participant under the researcher's supervision and the objective measurements were taken by the researcher and used for analysis.

Key abbreviations used in the following tables:

Group One	SMT alone
Group Two	Kinesio Tex® Tape alone
Group Three	SMT and Kinesio Tex® Tape
"Least Severe"	The least severe pain intensity rating on the NRS-101 Questionnaire
"Most Severe"	The most severe pain intensity rating on the NRS-101 Questionnaire
"Bilateral"	The Algometer measurements of the participants who had bilateral SIJ involvement
"Left-Sided"	The Algometer measurements of the participants who had left sided SIJ involvement only
"Right-Sided"	The Algometer measurements of the participants who had right sided SIJ involvement only
S. D.	Standard Deviation
>/≥	Greater than/Greater than or equal-to
</≤	Less than/Less than or equal-to

4.3 Demographic Data

4.3.1 Age Distribution

Table 4.1 Age distribution within sample of 60 participants:

Age (in years)	Group One	Group Two	Group Three	Total %
18-20	0	1	1	3.33
21-30	14	15	16	75
31-40	4	3	2	15
41-50	2	1	1	6.67

The mean age of Group One is 27.35 years (SD = 7.89).

The mean age of Group Two is 25.45 years (SD = 6.06).

The mean age of Group Three is 25.55 years (SD = 7.17).

The mean age of all three groups is 26.12 years (SD = 7.01).

4.3.2 Gender distribution

Table 4.2 Gender distribution within sample of 60 participants:

Gender	Group One	Group Two	Group Three	Total %
Female	11	9	7	45
Male	9	11	13	55

4.3.3 Ethnic distribution

Table 4.3 Race distribution within sample of 60 participants:

Race	Group One	Group Two	Group Three	Total %
Black	9	12	13	56.67
Indian	1	2	1	6.67
Other	1	0	1	3.33
White	9	6	5	33.33

4.3.4 Occupation distribution

Table 4.4 Occupational distribution within sample of 60 participants:

Occupation	Group One	Group Two	Group Three	Total %
Information Technology	1	0	0	1.67
Student	13	13	15	68.33
Motivational Speaker	0	0	1	1.67
Chiropractor	0	1	1	3.33
Technician	1	2	0	5
Caterer	0	1	0	1.67
Textile and Fashion	0	1	0	1.67
General Manager	0	0	1	1.67
Consultant	0	0	1	1.67
Web Developer	1	0	0	1.67
Physiotherapist	0	0	1	1.67
Debtors Clerk	1	0	0	1.67
Design and Art Director	0	1	0	1.67
Business Mentor	0	1	0	1.67
Massage Therapist	1	0	0	1.67
Lecturer	1	0	0	1.67
Manager	1	0	0	1.67

4.3.5 Diagnosis distribution

Table 4.5 Distribution of left sided, right sided or bilateral SIJ Syndrome diagnoses within sample of 60 participants:

Diagnosis	Group One	Group Two	Group Three	Total %
Left	4	7	1	20
Right	4	4	5	21.67
Bilateral	12	9	14	58.33

4.3.6 Joint Involvement Distribution

Table 4.6 Distribution of the joints involved within sample of 60 participants:

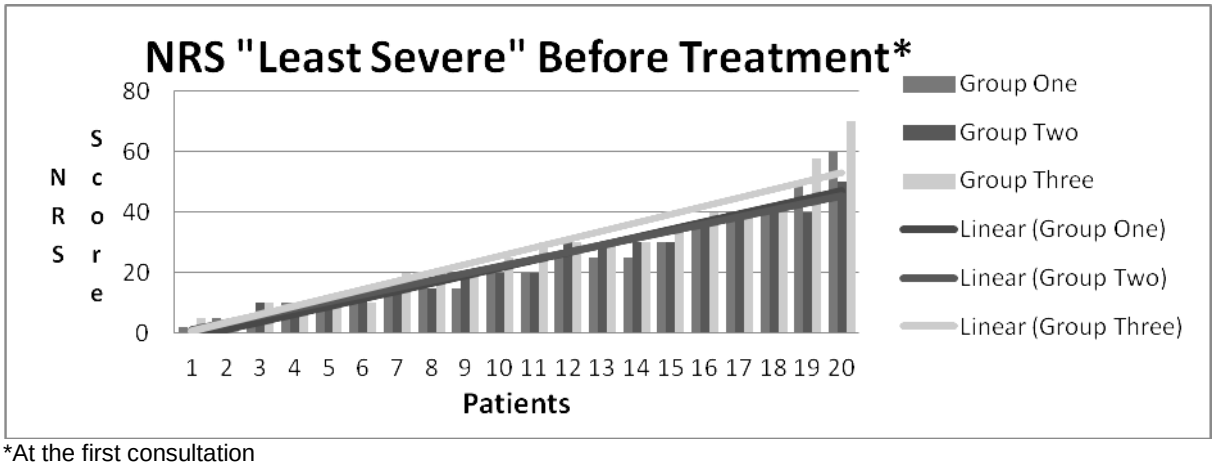
Joint	Group One	Group Two	Group Three	Total %
SIJ alone	7	7	6	33.33
SIJ and Lumbar Facet Joint	13	13	14	66.67

4.4 Results

4.4.1 Intergroup Analysis of the Subjective Measurements

4.4.1.1 Intergroup Analysis of the NRS-101 Scores

4.4.1.1.1a "Least Severe" NRS-101 Comparisons Between Group One, Two and Three Before Treatment at the First Consultation



*At the first consultation

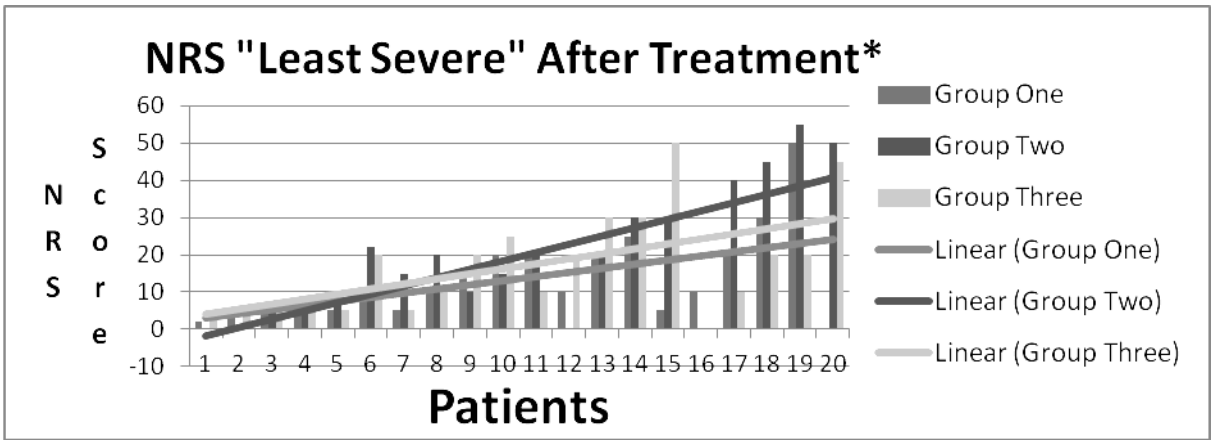
Figure 4.1: Trend-Line Comparison Before Treatment for the NRS-101 "Least Severe" Category Between Group One, Two and Three

Table 4.7 Comparison of the "Least Severe" NRS-101 data between Group One, Two and Three Before Treatment using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 22.9	+/- 15.7	0.95	+/- 23.2	+/- 14
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 22.9	+/- 15.7	0.44	+/- 26.9	+/- 17.3
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 23.2	+/- 14	0.05	+/- 26.9	+/- 17.3

The null hypothesis is accepted regarding the subjective findings for the "Least Severe" category of the NRS-101 between Group One and Two (p = 0.95), Group One and Three (p = 0.44) and Group Two and Three (p = 0.05), which indicates that there were no statistically significant differences between the three groups at the first consultation before treatment. This suggests that these three groups were similarly matched in terms of the "Least Severe" rating on the NRS-101 score before the treatment at the first consultation.

4.4.1.1.1b "Least Severe" NRS-101 Comparisons Between Group One, Two and Three After Treatment at the First Consultation



*At the first consultation

Figure 4.2: Trend-Line Comparison After Treatment for the NRS-101 "Least Severe" Category Between Group One, Two and Three

Table 4.8 Comparison of the "Least Severe" NRS-101 data between Group One, Two and Three After Treatment using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 13.6	+/- 11.9	0.2	+/- 19.6	+/- 17.2
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 13.6	+/- 11.9	0.41	+/- 17	+/- 13.8
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 19.6	+/- 17.2	0.6	+/- 17	+/- 13.8

The null hypothesis is accepted regarding the subjective findings for the "Least Severe" category of the NRS-101 between Group One and Two (p = 0.2), Group One and Three (p = 0.41) and Group Two and Three (p = 0.6), which indicates that there were no statistically significant differences between the three groups at the first consultation after treatment. This suggests that these three groups were similarly matched in terms of the "Least Severe" rating on the NRS-101 score after the treatment at the first consultation.

4.4.1.1.1c "Least Severe" NRS-101 Comparisons Between Group One, Two and Three at the Second Consultation

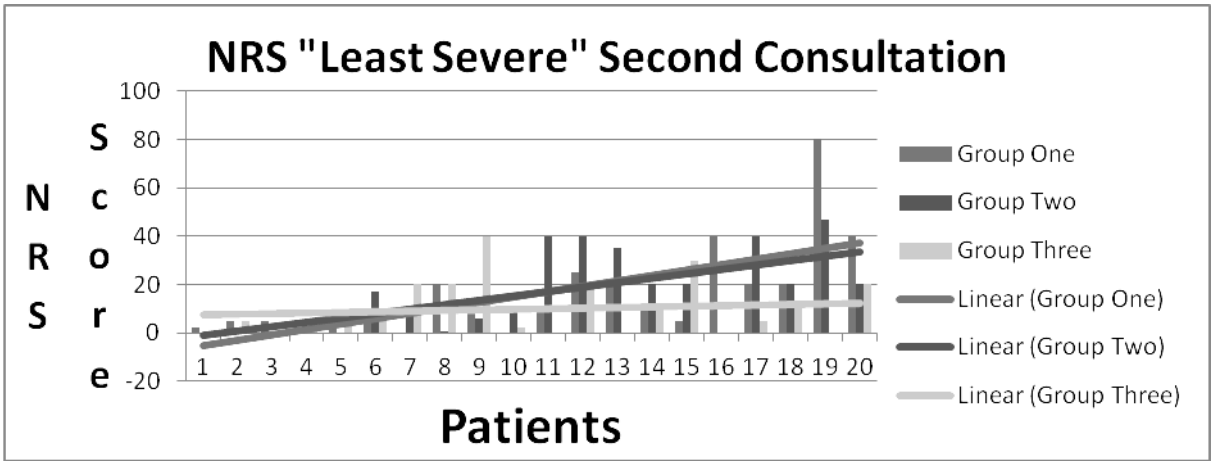


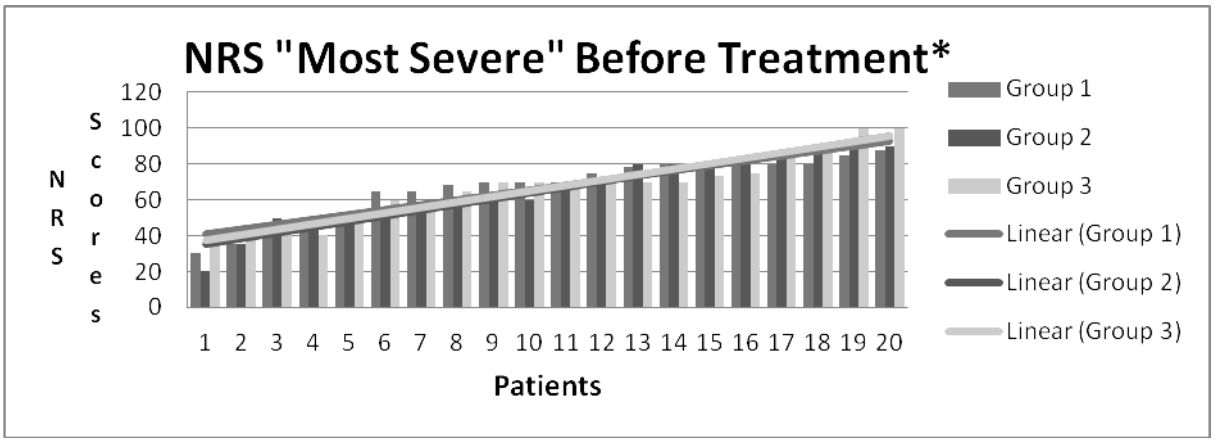
Figure 4.3: Trend-Line Comparison at the Second Consultation for the NRS-101 "Least Severe" Category Between Group One, Two and Three

Table 4.9 Comparison of the "Least Severe" NRS-101 data between Group One, Two and Three at the Second Consultation using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 16.1	+/- 19.3	0.98	+/- 16.2	+/- 16.3
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 16.1	+/- 19.3	0.24	+/- 10.1	+/- 11.4
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 16.2	+/- 16.3	0.18	+/- 10.1	+/- 11.4

The null hypothesis is accepted regarding the subjective findings for the "Least Severe" category of the NRS-101 between Group One and Two (p = 0.98), Group One and Three (p = 0.24) and Group Two and Three (p = 0.18), which indicates that there were no statistically significant differences between the three groups at the second consultation. This suggests that these three groups were similarly matched in terms of the "Least Severe" rating on the NRS-101 score at the second consultation.

4.4.1.1.2a "Most Severe" NRS-101 Comparisons Between Group One, Two and Three Before Treatment at the First Consultation



*At the first consultation

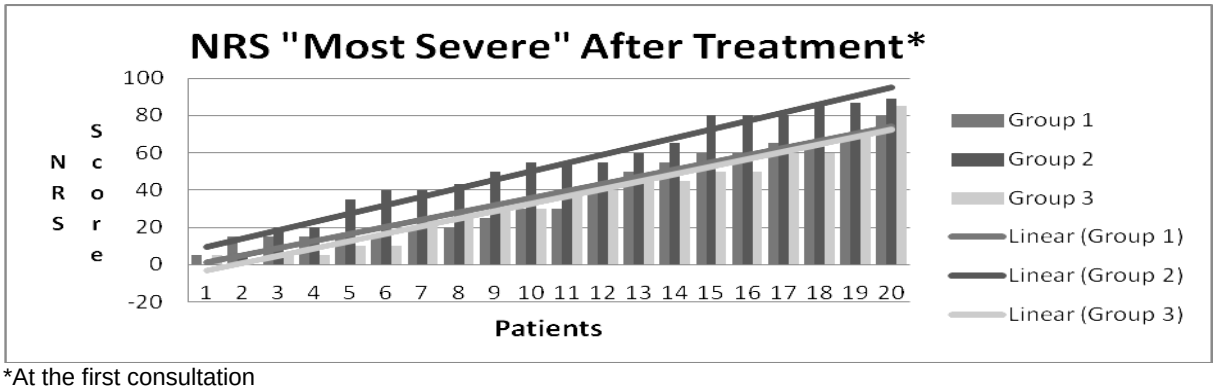
Figure 4.4: Trend-Line Comparison Before Treatment for the NRS-101 "Most Severe" Category Between Group One, Two and Three

Table 4.10 Comparison of the "Most Severe" NRS-101 data between Group One, Two and Three Before Treatment using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 66.95	+/- 17.1	0.76	+/- 65.15	+/- 19.4
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 66.95	+/- 17.1	0.96	+/- 66.65	+/- 18.9
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 65.15	+/- 19.4	0.81	+/- 66.65	+/- 18.9

The null hypothesis is accepted regarding the subjective findings for the "Most Severe" category of the NRS-101 between Group One and Two (p = 0.76), Group One and Three (p = 0.96) and Group Two and Three (p = 0.81), which indicates that there were no statistically significant differences between the three groups at the first consultation before treatment. This suggests that these three groups were similarly matched in terms of the "Most Severe" rating on the NRS-101 score before the treatment at the first consultation.

4.4.1.1.2b "Most Severe" NRS-101 Comparisons Between Group One, Two and Three After Treatment at the First Consultation



*At the first consultation

Figure 4.5: Trend-Line Comparison After Treatment for the NRS-101 "Most Severe" Category Between Group One, Two and Three

Table 4.11 Comparison of the "Most Severe" NRS-101 data between Group One, Two and Three After Treatment using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 37.5	+/- 23.3	0.07	+/- 52.2	+/- 27.1
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 37.5	+/- 23.3	0.72	+/- 34.75	+/- 24.1
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 52.2	+/- 27.1	0.04	+/- 34.75	+/- 24.1

The null hypothesis is accepted regarding the subjective findings for the "Most Severe" category of the NRS-101 between Group One and Two (p = 0.07) and Group One and Three (p = 0.72) which indicates that there were no statistically significant differences between Group One and Two, and Group One and Three at the first consultation after treatment. This suggests that these groups were similarly matched in terms of the "Most Severe" rating on the NRS-101 score before the treatment at the first consultation. However the null hypothesis is rejected regarding the subjective findings between Group Two and Three (p = 0.04), which indicates that there was a statistically significant difference between group two and three at the first consultation after treatment. This suggests that these two groups were not similarly matched in terms of the "Most Severe" rating on the NRS-101 score.

4.4.1.1.2c "Most Severe" NRS-101 Comparisons Between Group One, Two and Three at the Second Consultation

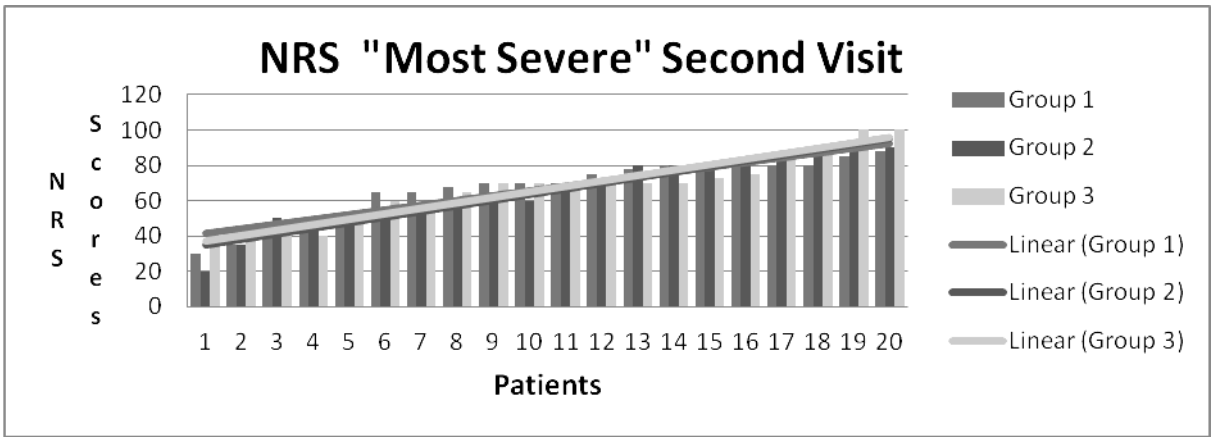


Figure 4.6: Trend-Line Comparison After Treatment for the NRS-101 "Most Severe" Category Between Group One, Two and Three

Table 4.12 Comparison of the "Most Severe" NRS-101 data between Group One, Two and Three at the Second Consultation using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 28.3	+/- 26.7	0.47	+/- 34.8	+/- 29.4
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 28.3	+/- 26.7	0.59	+/- 24.1	+/- 21.4
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 34.8	+/- 29.4	0.2	+/- 24.1	+/- 21.4

The null hypothesis is accepted regarding the subjective findings for the "Most Severe" category of the NRS-101 between Group One and Two (p = 0.47), Group One and Three (p = 0.59) and Group Two and Three (p = 0.2), which indicates that there were no statistically significant differences between the three groups at the second consultation. This suggests that these three groups were similarly matched in terms of the "Most Severe" rating on the NRS-101 score at the second consultation.

4.4.1.1.3a ODI Score Comparisons Between Group One, Two and Three at the First Consultation

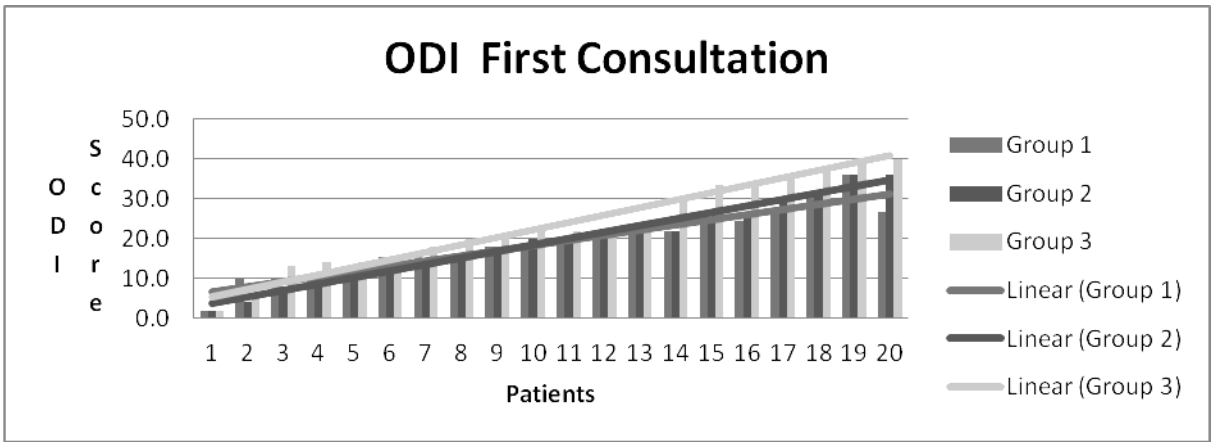


Figure 4.7: Trend-Line Comparison of the ODI Scores at the First Consultation Between Group One, Two and Three

Table 4.13 Comparison of the ODI Scores at the First Consultation Between Group One, Two and Three using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 19	+/- 7.96	0.91	+/- 19.3	+/- 9.7
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 19	+/- 7.96	0.19	+/- 23.1	+/- 11.15
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 19.3	+/- 9.7	0.25	+/- 23.1	+/- 11.15

The null hypothesis is accepted regarding the subjective findings for the ODI between Group One and Two (p = 0.91), Group One and Three (p = 0.19) and Group Two and Three (p = 0.25), which indicates that there were no statistically significant differences between the three groups at the first consultation. This suggests that these three groups were similarly matched in terms of the ODI score at the second consultation.

4.4.1.1.3b ODI Score Comparisons Between Group One, Two and Three at the Second Consultation

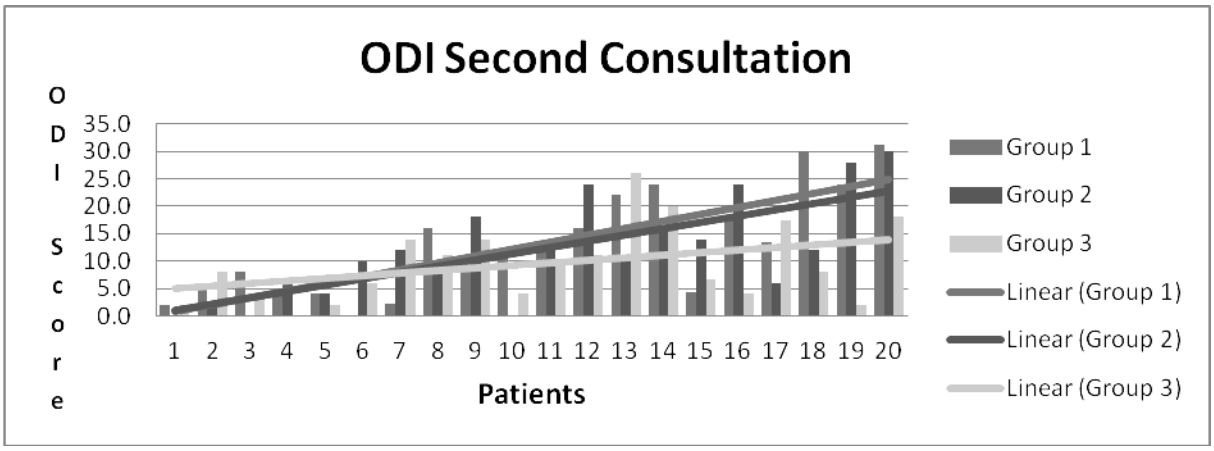


Figure 4.8: Trend-Line Comparison of the ODI Scores at the Second Consultation Between Group One, Two and Three

Table 4.14 Comparison of the ODI Scores at the Second Consultation Between Group One, Two and Three using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 12.9	+/- 9.5	0.75	+/- 11.9	+/- 9.23
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 12.9	+/- 9.5	0.2	+/- 9.4	+/- 7.03
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 11.9	+/- 9.23	0.34	+/- 9.4	+/- 7.03

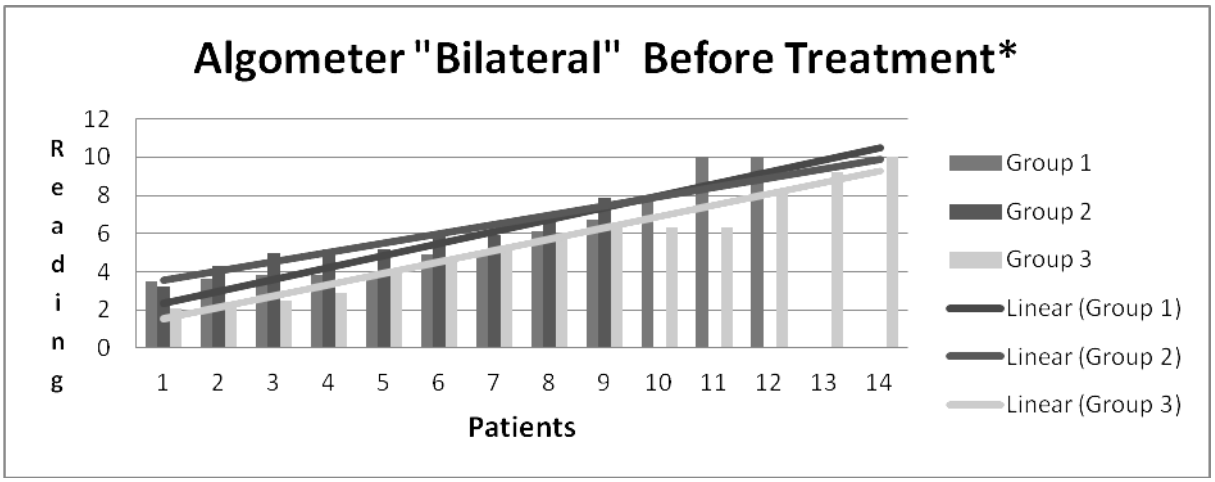
The null hypothesis is accepted regarding the subjective findings for the ODI between Group One and Two (p = 0.75), Group One and Three (p = 0.2) and Group Two and Three (p = 0.34), which indicates that there were no statistically significant differences between the three groups at the second consultation. This suggests that these three groups were similarly matched in terms of the ODI score at the second consultation.

4.4.2 Inter-group Analysis of the Objective Measurements

4.4.2.1 Inter-group Analysis of the Algometer Scores

Participants with either unilateral or bilateral SIJ Syndrome were accepted into this study. Algometer measurements were taken on both sides for participants with bilateral presentations, and not the most affected side alone. This means that the Algometer scores were taken either bilaterally, on the left side only or on the right side only, depending on the participants' presentation, which resulted in an unequal distribution of Algometer readings (i.e. the number of participants in each of the three treatment groups varied according to either the "Bilateral", "Left-Sided" or "Right-Sided" presentations). This applies to the intra-group analysis later in this chapter.

4.4.2.1.1a "Bilateral" Algometer Comparisons Between Group One, Two and Three Before Treatment at the First Consultation



*At the first consultation

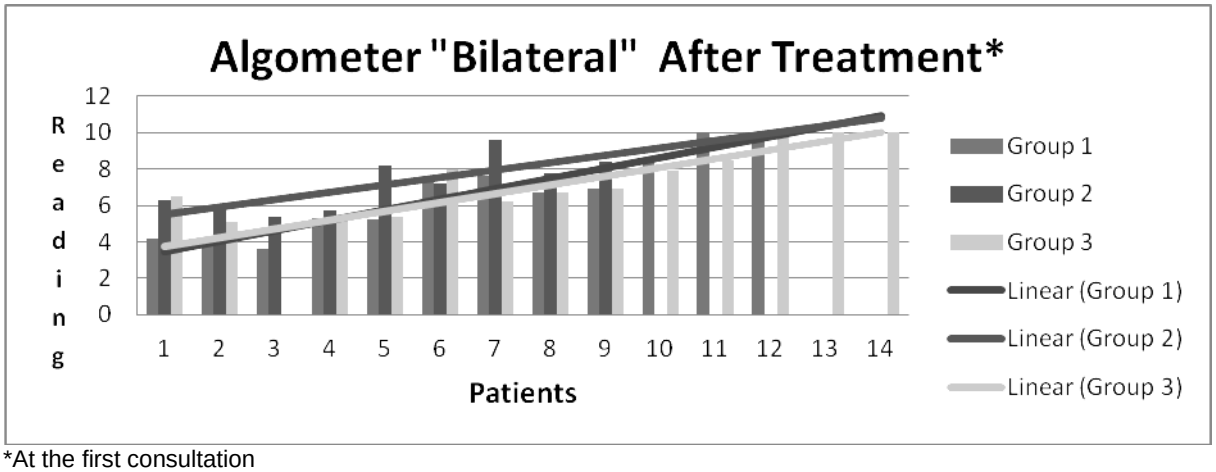
Figure 4.9: Trend-Line Comparison of the "Bilateral" Algometer Scores Before Treatment at the First Consultation Between Group One, Two and Three

Table 4.15 Comparison of the "Bilateral" Algometer Scores Between Group One, Two and Three Before Treatment at the First Consultation using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.78	+/- 2.42	0.76	+/- 5.51	+/- 1.39
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.78	+/- 2.42	0.71	+/- 5.41	+/- 2.55
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.51	+/- 1.39	0.91	+/- 5.41	+/- 2.55

The null hypothesis is accepted regarding the objective findings for the "Bilateral" Algometer scores between Group One and Two (p = 0.76), Group One and Three (p = 0.71) and Group Two and Three (p = 0.91), which indicates that there were no statistically significant differences between the three groups before treatment at the first consultation. This suggests that these three groups were similarly matched in terms of the "Bilateral" Algometer score before treatment at the first consultation.

4.4.2.1.1b "Bilateral" Algometer Comparisons Between Group One, Two and Three After Treatment at the First Consultation



*At the first consultation

Figure 4.10: Trend-Line Comparison of the "Bilateral" Algometer Scores After Treatment at the First Consultation Between Group One, Two and Three

Table 4.16 Comparison of the "Bilateral" Algometer Scores Between Group One, Two and Three After Treatment at the First Consultation using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.6	+/- 2.2	0.55	+/- 7.2	+/- 1.5
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.6	+/- 2.2	0.79	+/- 6.9	+/- 2.6
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.2	+/- 1.5	0.79	+/- 6.9	+/- 2.6

The null hypothesis is accepted regarding the objective findings for the "Bilateral" Algometer scores between Group One and Two (p = 0.55), Group One and Three (p = 0.79) and Group Two and Three (p = 0.79), which indicates that there were no statistically significant differences between the three groups after treatment at the first consultation. This suggests that these three groups were similarly matched in terms of the "Bilateral" Algometer score after treatment at the first consultation.

4.4.2.1.1c "Bilateral" Algometer Comparisons Between Group One, Two and Three at the Second Consultation

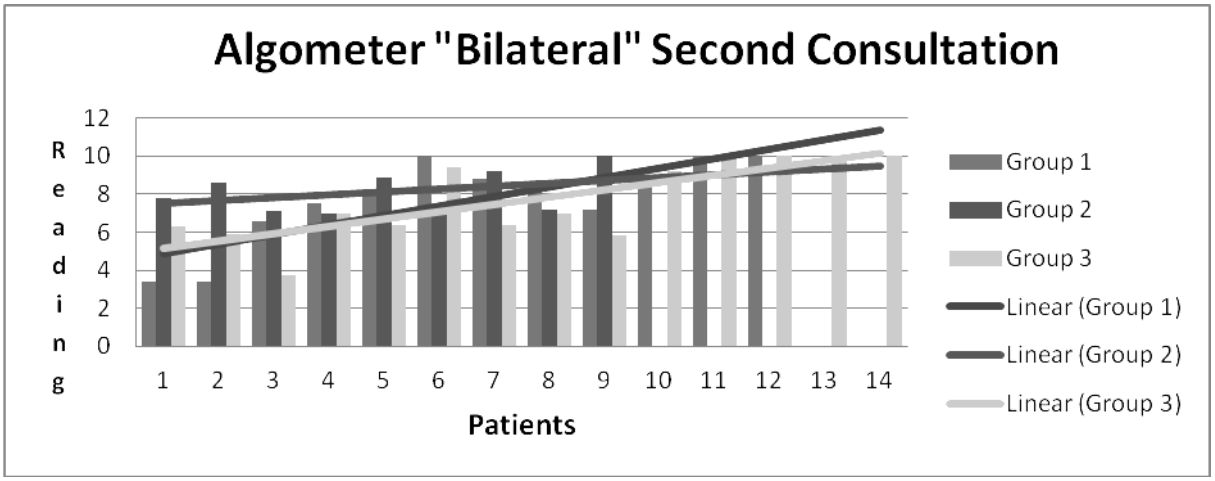


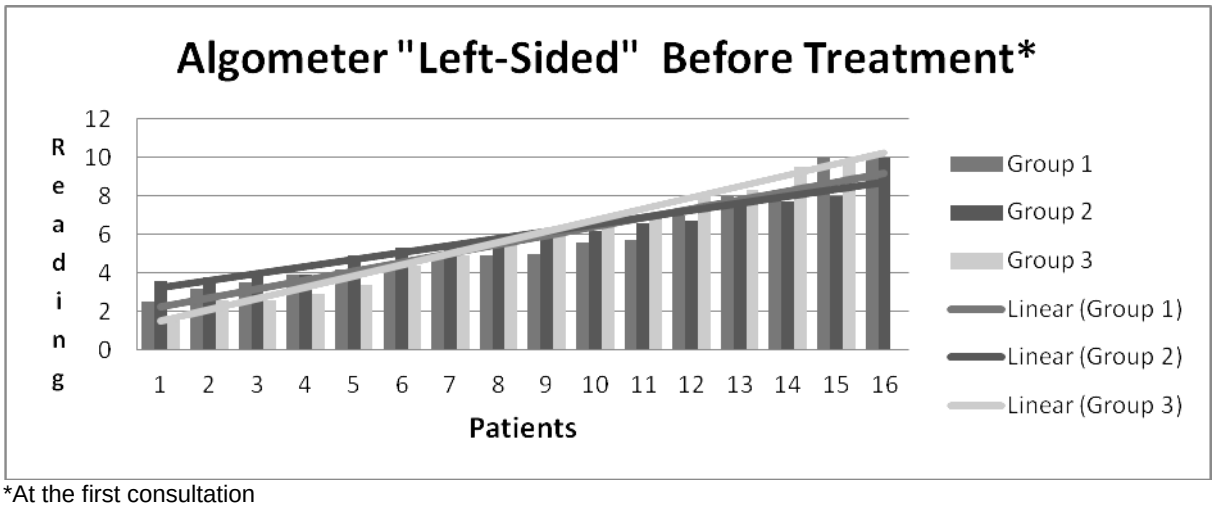
Figure 4.11: Trend-Line Comparison of the "Bilateral" Algometer Scores at the Second Consultation Between Group One, Two and Three

Table 4.17 Comparison of the "Bilateral" Algometer Scores Between Group One, Two and Three at the Second Consultation using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.6	+/- 2.3	0.53	+/- 8.1	+/- 1.1
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.6	+/- 2.3	0.98	+/- 7.7	+/- 2
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 8.1	+/- 1.1	0.49	+/- 7.7	+/- 2

The null hypothesis is accepted regarding the objective findings for the "Bilateral" Algometer scores between Group One and Two (p = 0.53), Group One and Three (p = 0.98) and Group Two and Three (p = 0.49), which indicates that there were no statistically significant differences between the three groups at the second consultation. This suggests that these three groups were similarly matched in terms of the "Bilateral" Algometer score at the second consultation.

4.4.2.1.2a "Left-Sided" Algometer Comparisons Between Group One, Two and Three Before Treatment at the First Consultation



*At the first consultation

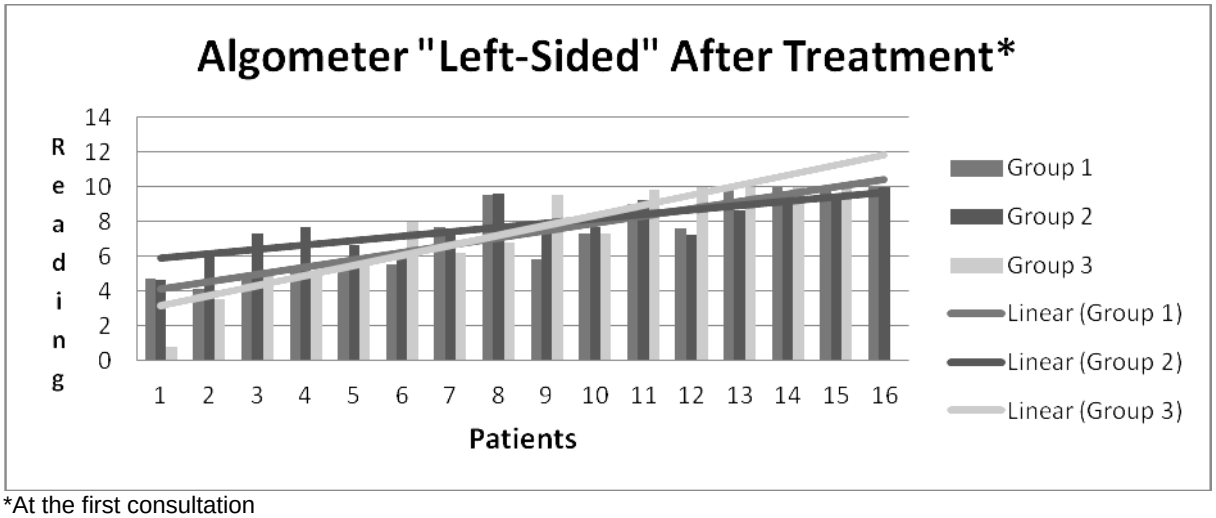
Figure 4.12: Trend-Line Comparison of the "Left-Sided" Algometer Scores Before Treatment at the First Consultation Between Group One, Two and Three

Table 4.18 Comparison of the "Left-Sided" Algometer Scores Between Group One, Two and Three Before Treatment at the First Consultation using the Unpaired t-Test

	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.7	+/- 2.3	0.71	+/- 5.6	+/- 1.8
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.7	+/- 2.3	0.9	+/- 5.6	+/- 2.6
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.6	+/- 1.8	0.64	+/- 5.6	+/- 2.6

The null hypothesis is accepted regarding the objective findings for the "Left-Sided" Algometer scores between Group One and Two (p = 0.71), Group One and Three (p = 0.9) and Group Two and Three (p = 0.64), which indicates that there were no statistically significant differences between the three groups before treatment at the first consultation. This suggests that these three groups were similarly matched in terms of the "Left-Sided" Algometer score before treatment at the first consultation.

4.4.2.1.2b "Left-Sided" Algometer Comparisons Between Group One, Two and Three After Treatment at the First Consultation



*At the first consultation

Figure 4.13: Trend-Line Comparison of the "Left-Sided" Algometer Scores After Treatment at the First Consultation Between Group One, Two and Three

Table 4.19 Comparison of the "Left-Sided" Algometer Scores Between Group One, Two and Three After Treatment at the First Consultation using the Unpaired t-Test

	Group One		***P*-value**	**TGroup Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.3	+/- 2.4	0.45	+/- 7.8	+/- 1.5
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.3	+/- 2.4	0.93	+/- 7.2	+/- 2.3
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.8	+/- 1.5	0.48	+/- 7.2	+/- 2.3

The null hypothesis is accepted regarding the objective findings for the "Left-Sided" Algometer scores between Group One and Two (p = 0.45), Group One and Three (p = 0.93) and Group Two and Three (p = 0.48), which indicates that there were no statistically significant differences between the three groups after treatment at the first consultation. This suggests that these three groups were similarly matched in terms of the "Left-Sided" Algometer score after treatment at the first consultation.

4.4.2.1.2c "Left-Sided" Algometer Comparisons Between Group One, Two and Three at the Second Consultation

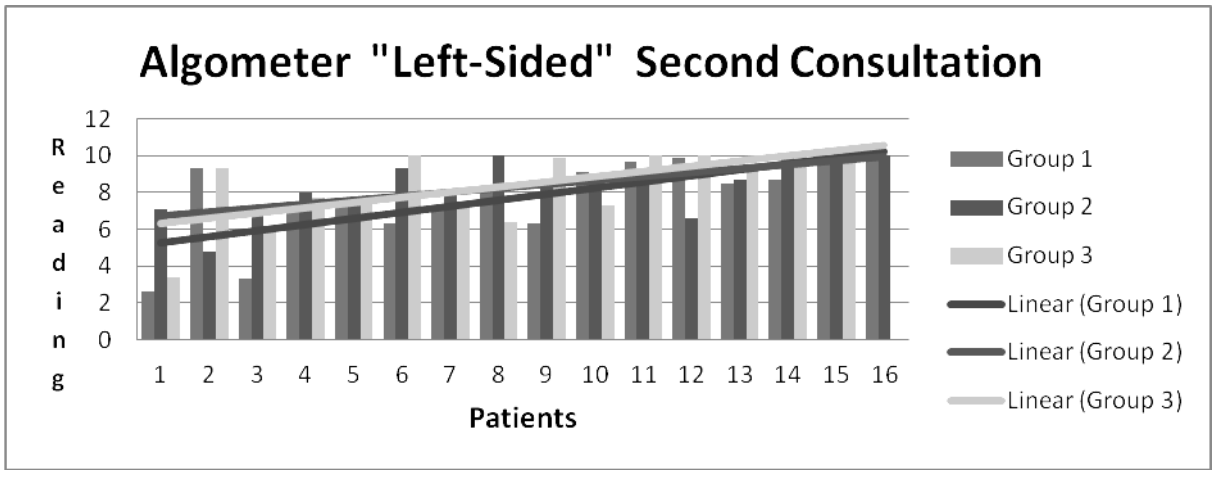


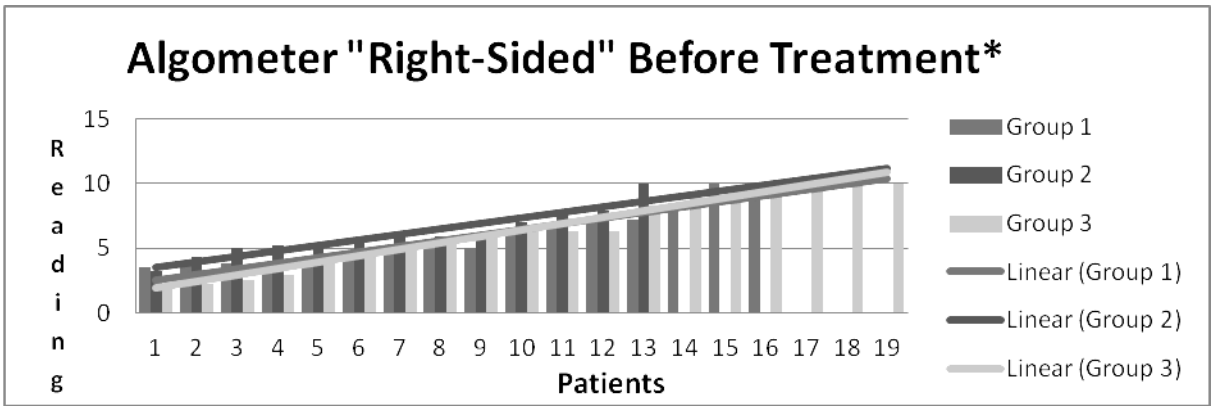
Figure 4.14: Trend-Line Comparison of the "Left-Sided" Algometer Scores at the Second Consultation Between Group One, Two and Three

Table 4.20 Comparison of the "Left-Sided" Algometer Scores Between Group One, Two and Three at the Second Consultation using the Unpaired t-Test

	Group One		***P*-value**	**TGroup Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.7	+/- 2.4	0.39	+/- 8.3	+/- 1.5
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.7	+/- 2.4	0.46	+/- 8.3	+/- 2
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 8.3	+/- 1.5	0.97	+/- 8.3	+/- 2

The null hypothesis is accepted regarding the objective findings for the "Left-Sided" Algometer scores between Group One and Two (p = 0.39), Group One and Three (p = 0.46) and Group Two and Three (p = 0.97), which indicates that there were no statistically significant differences between the three groups at the second consultation. This suggests that these three groups were similarly matched in terms of the "Left-Sided" Algometer score at the second consultation.

4.4.2.1.3a "Right-Sided" Algometer Comparisons Between Group One, Two and Three Before Treatment at the First Consultation



*At the first consultation

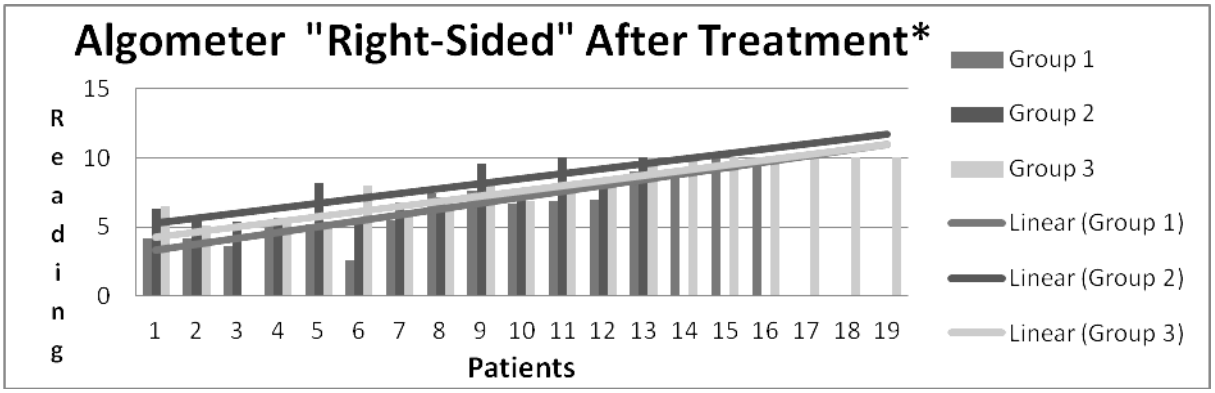
Figure 4.15: Trend-Line Comparison of the "Right-Sided" Algometer Scores Before Treatment at the First Consultation Between Group One, Two and Three

Table 4.21 Comparison of the "Right-Sided" Algometer Scores Between Group One, Two and Three Before Treatment at the First Consultation using the Unpaired t-Test

	Group One		*P*-value	Group Two	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.8	+/- 2.2	0.71	+/- 6.1	+/- 1.8
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.8	+/- 2.2	0.49	+/- 6.4	+/- 2.9
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.1	+/- 1.8	0.69	+/- 6.4	+/- 2.9

The null hypothesis is accepted regarding the objective findings for the "Right-Sided" Algometer scores between Group One and Two (p = 0.71), Group One and Three (p = 0.49) and Group Two and Three (p = 0.69), which indicates that there were no statistically significant differences between the three groups before treatment at the first consultation. This suggests that these three groups were similarly matched in terms of the "Right-Sided" Algometer score before treatment at the first consultation.

4.4.2.1.3b "Right-Sided" Algometer Comparisons Between Group One, Two and Three After Treatment at the First Consultation



*At the first consultation

Figure 4.16: Trend-Line Comparison of the "Right-Sided" Algometer Scores After Treatment at the First Consultation Between Group One, Two and Three

Table 4.22 Comparison of the "Right-Sided" Algometer Scores Between Group One, Two and Three After Treatment at the First Consultation using the Unpaired t-Test

	Group One		*P*-value	Group Two	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.5	+/- 2.3	0.21	+/- 7.4	+/- 1.7
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.5	+/- 2.3	0.17	+/- 7.6	+/- 2.6
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.4	+/- 1.7	0.79	+/- 7.6	+/- 2.6

The null hypothesis is accepted regarding the objective findings for the "Right-Sided" Algometer scores between Group One and Two (p = 0.21), Group One and Three (p = 0.17) and Group Two and Three (p = 0.79), which indicates that there were no statistically significant differences between the three groups after treatment at the first consultation. This suggests that these three groups were similarly matched in terms of the "Right-Sided" Algometer score after treatment at the first consultation.

4.4.2.1.3c "Right-Sided" Algometer Comparisons Between Group One, Two and Three at the Second Consultation

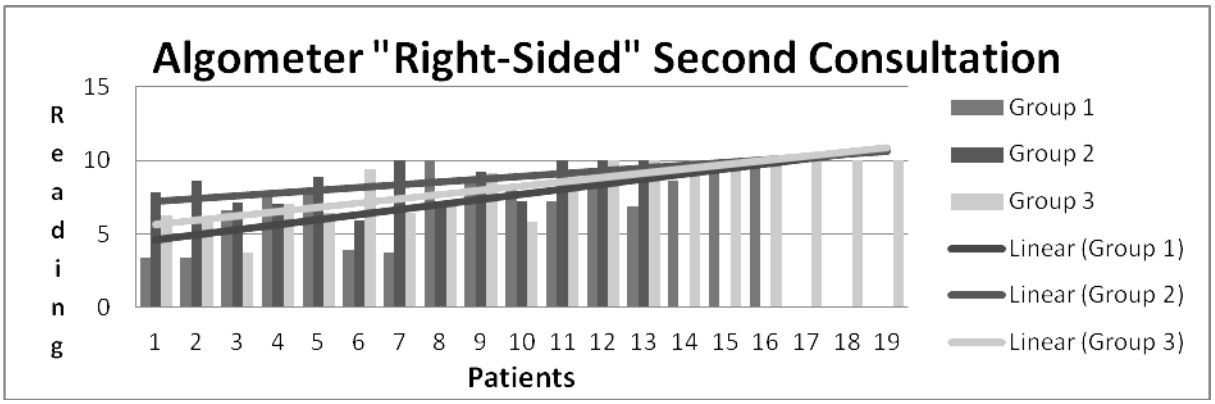


Figure 4.17: Trend-Line Comparison of the "Right-Sided" Algometer Scores at the Second Consultation Between Group One, Two and Three

Table 4.23 Comparison of the "Right-Sided" Algometer Scores Between Group One, Two and Three at the Second Consultation using the Unpaired t-Test

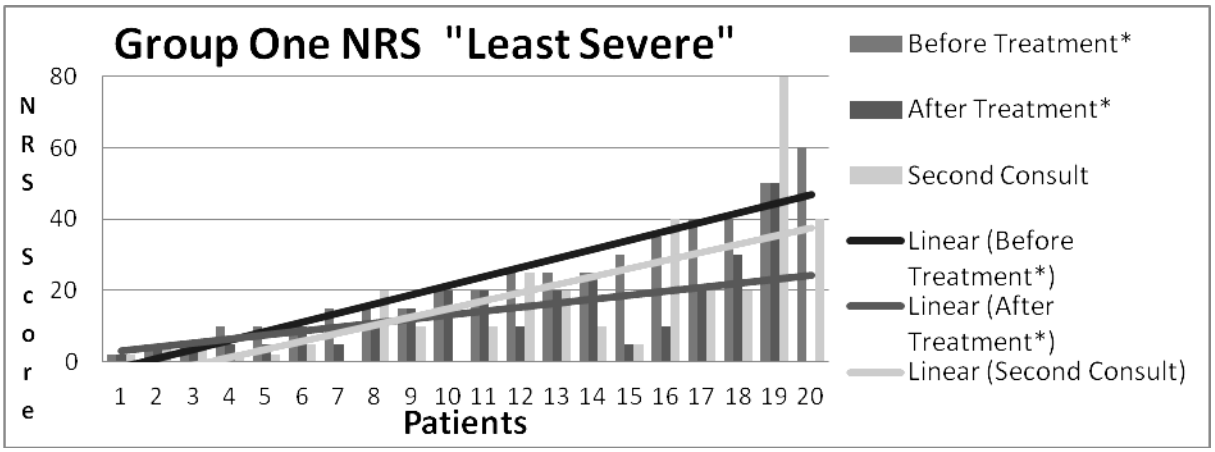
	Group One		***P*-value**	**Group Two**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.2	+/- 2.4	0.1	+/- 8.4	+/- 1.4
	Group One			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.2	+/- 2.4	0.17	+/- 8.2	+/- 2
	Group Two			**Group Three**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 8.4	+/- 1.4	0.8	+/- 8.2	+/- 2

The null hypothesis is accepted regarding the objective findings for the "Right-Sided" Algometer scores between Group One and Two (p = 0.1), Group One and Three (p = 0.17) and Group Two and Three (p = 0.8), which indicates that there were no statistically significant differences between the three groups at the second consultation. This suggests that these three groups were similarly matched in terms of the "Right-Sided" Algometer score at the second consultation.

4.4.3 Intra-group Analysis of the Subjective Measurements

4.4.3.1 Intra-group Analysis of the NRS-101 Scores

4.4.3.1.1a "Least Severe" NRS-101 Scores: Group One



*At the first consultation

Figure 4.18: Trend-Line Analysis Within Group One for the "Least Severe" NRS Score

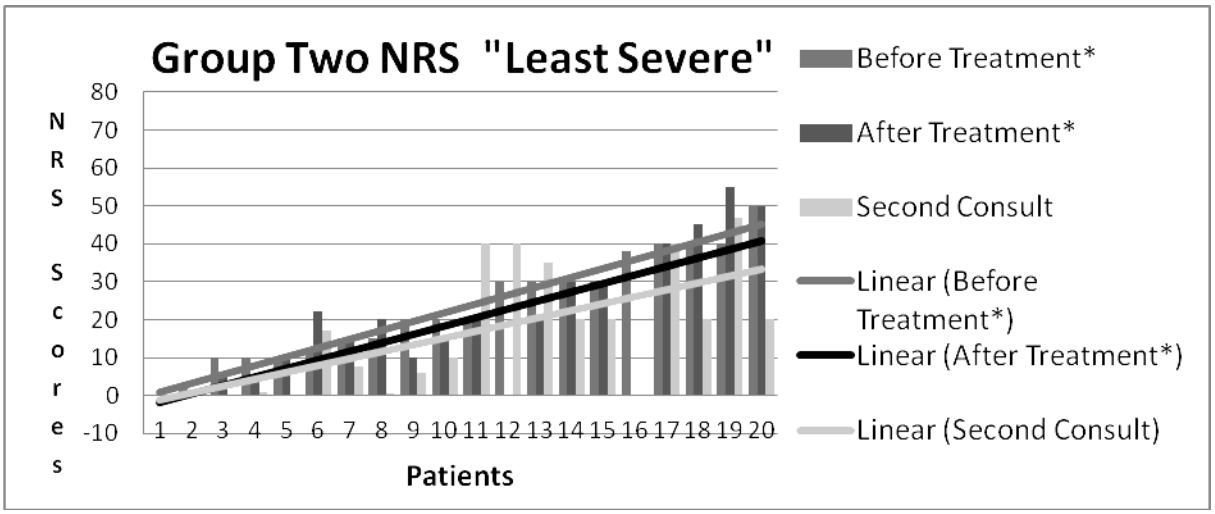
Table 4.24 Comparison of the "Least Severe" Scores within Group One for the NRS-101 using the Paired t-Test

	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 22.9	+/- 15.7	0.01	+/- 13.6	+/- 11.9
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 22.9	+/- 15.7	0.02	+/- 16.1	+/- 19.3
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 13.6	+/- 11.9	0.49	+/- 16.1	+/- 19.3

*At the first consultation

The null hypothesis is rejected regarding the subjective findings for the "Least Severe" NRS-101 Scores from before to after treatment at the first consultation (p = 0.01) and from before treatment at the first consultation to the second consultation (p = 0.02), which indicates that there were statistically significant differences from before to after treatment at the first consultation and from before treatment at the first consultation to the second consultation. The null hypothesis is accepted from after the treatment at the first consultation to the second consultation (p = 0.49), which indicates that there was no statistically significant difference from after the treatment at the first consultation to the second consultation.

4.4.3.1.1b "Least Severe" NRS-101 Scores: Group Two



*At the first consultation

Figure 4.19: Trend-Line Analysis Within Group Two for the "Least Severe" NRS Score

Table 4.25 Comparison of the "Least Severe" Scores within Group Two for the NRS-101 using the Paired t-Test

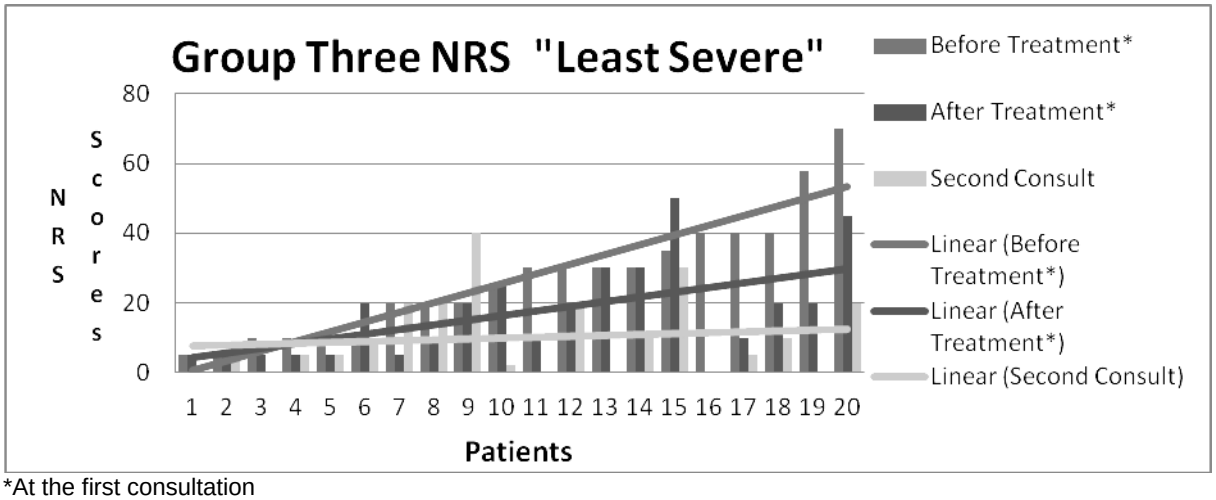
	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 23.2	+/- 14	0.2	+/- 19.6	+/- 17.2
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 23.2	+/- 14	0.03	+/- 16.2	+/- 16.3
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 19.6	+/- 17.2	0.33	+/- 16.2	+/- 16.3

*At the first consultation

The null hypothesis is rejected regarding the subjective findings for the "Least Severe" NRS-101 Scores from before treatment at the first consultation to the second consultation (p = 0.03), which indicates that there was a statistically significant difference from before treatment at the first consultation to the second consultation. The null hypothesis is accepted from before to after the treatment at the first consultation (p

= 0.2) and from after the treatment at the first consultation to the second consultation (*p* = 0.33), which indicates that there were no statistically significant differences from after the treatment at the first consultation to the second consultation.

4.4.3.1.1c "Least Severe" NRS-101 Scores: Group Three



*At the first consultation

Figure 4.20: Trend-Line Analysis Within Group Three for the "Least Severe" NRS Score

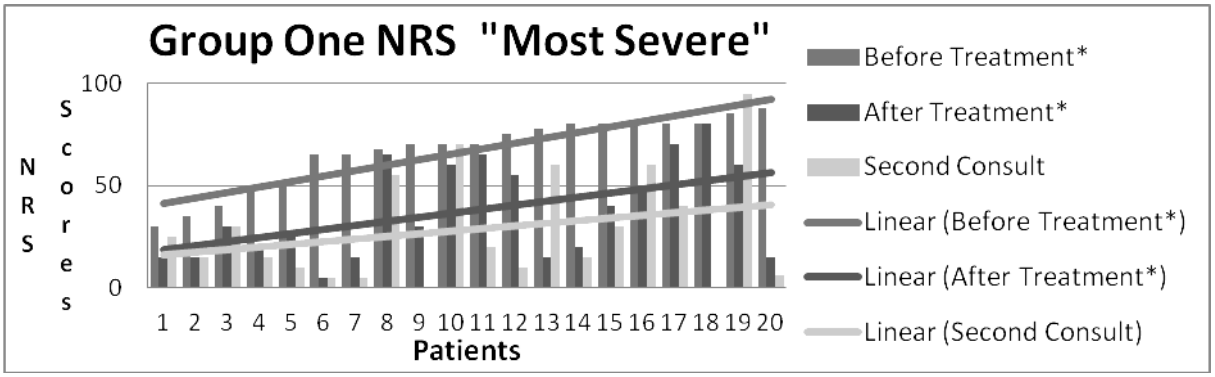
Table 4.26 Comparison of the "Least Severe" Scores within Group Three for the NRS-101 using the Paired t-Test

	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 26.9	+/- 17.3	0.00	+/- 17	+/- 13.8
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 26.9	+/- 17.3	0.00	+/- 10.1	+/- 11.4
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 17	+/- 13.8	0.03	+/- 10.1	+/- 11.4

*At the first consultation

The null hypothesis is rejected regarding the subjective findings for the "Least Severe" NRS-101 Scores from before to after treatment at the first consultation (p = 0.008), from before treatment at the first consultation to the second consultation (p = 0.001) and from after the treatment at the first consultation to the second consultation (p = 0.03) which indicates that there were statistically significant differences throughout all comparisons within Group Three. This is significant as these findings suggest that Kinesio Tex® Tape therapy was effective as an adjunct to SMT in the treatment of chronic SIJ Syndrome. However the sample size was not considerable enough to be able to conclusively state this.

4.4.3.1.2a "Most Severe" NRS-101 Scores: Group One



*At the first consultation

Figure 4.21: Trend-Line Analysis Within Group One for the "Most Severe" NRS Score

Table 4.27 Comparison of the "Most Severe" Scores within Group One for the NRS-101 using the Paired t-Test

	Before Treatment*		*P*-value	After Treatment*	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 67	+/- 17.1	0.00	+/- 37.5	+/- 23.3
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 67	+/- 17.1	0.00	+/- 28.3	+/- 26.7
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 37.5	+/- 23.3	0.16	+/- 28.3	+/- 26.7

*At the first consultation

The null hypothesis is rejected regarding the subjective findings for the "Most Severe" NRS-101 Scores from before to after treatment at the first consultation (p = 0.00001) and from before treatment at the first consultation to the second consultation (p = 0.00001), which indicates that there were statistically significant differences from before to after treatment at the first consultation and from before treatment at the first consultation to the second consultation. The null hypothesis is accepted from after the treatment at the first consultation to the second consultation (p = 0.16), which indicates that there was no statistically significant difference from after the treatment at the first consultation to the second consultation.

4.4.3.1.2b "Most Severe" NRS-101 Scores: Group Two

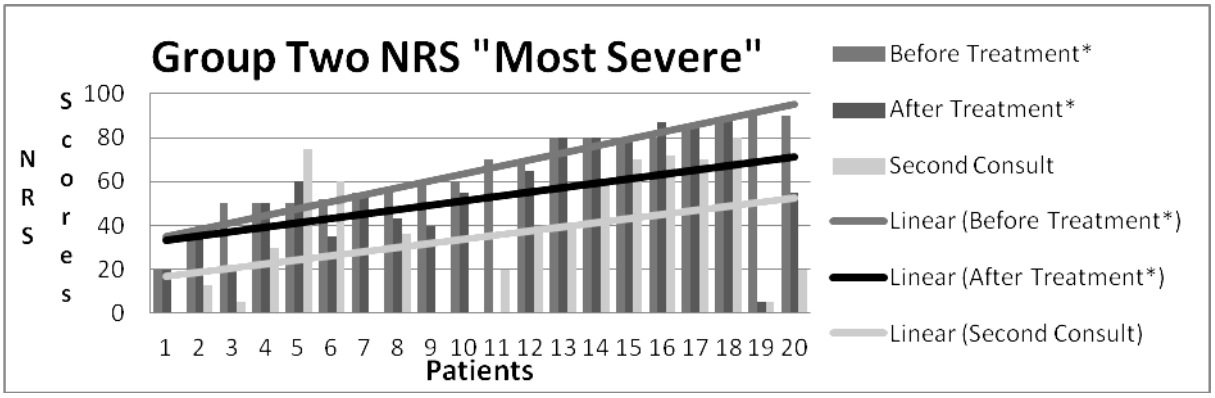


Figure 4.22: Trend-Line Analysis Within Group Two for the "Most Severe" NRS Score

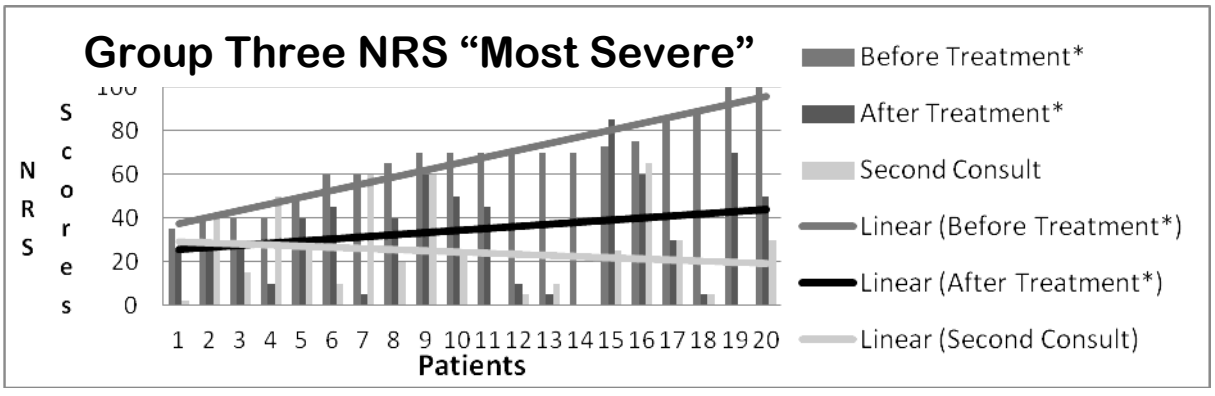
Table 4.28 Comparison of the "Most Severe" Scores within Group Two for the NRS-101 using the Paired t-Test

	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 65.2	+/- 19.4	0.03	+/- 52.2	+/- 27.1
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 65.2	+/- 19.4	0.00	+/- 34.8	+/- 29.4
	After Treatment			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 52.2	+/- 27.1	0.00	+/- 34.8	+/- 29.4

*At the first consultation

The null hypothesis is rejected regarding the subjective findings for the "Most Severe" NRS-101 Scores from before to after treatment at the first consultation (p = 0.03), from before treatment at the first consultation to the second consultation (p = 0.00009) and from after the treatment at the first consultation to the second consultation (p = 0.00003) which indicates that there were statistically significant differences throughout all comparisons within Group Two.

4.4.3.1.2c "Most Severe" NRS-101 Scores: Group Three



*At the first consultation

Figure 4.23: Trend-Line Analysis Within Group Three for the "Most Severe" NRS Score

Table 4.29 Comparison of the "Most Severe" Scores within Group Three for the NRS-101 using the Paired t-Test

	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 66.7	+/- 18.9	0.00	+/- 34.8	+/- 24.1
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 66.7	+/- 18.9	0.00	+/- 24.1	+/- 21.4
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
NRS-101	+/- 34.8	+/- 24.1	0.12	+/- 24.1	+/- 21.4

*At the first consultation

The null hypothesis is rejected regarding the subjective findings for the "Most Severe" NRS-101 Scores from before to after treatment at the first consultation (p = 0.000025) and from before treatment at the first consultation to the second consultation (p = 0.000006), which indicates that there were statistically significant differences from before to after treatment at the first consultation and from before treatment at the first consultation to the second consultation. The null hypothesis is accepted from after the treatment at the first consultation to the second consultation (p = 0.12), which indicates that there was no statistically significant difference from after the treatment at the first consultation to the second consultation.

4.4.3.2 Intra-group Analysis of the ODI Scores

4.4.3.2.1a. ODI Score Graphs

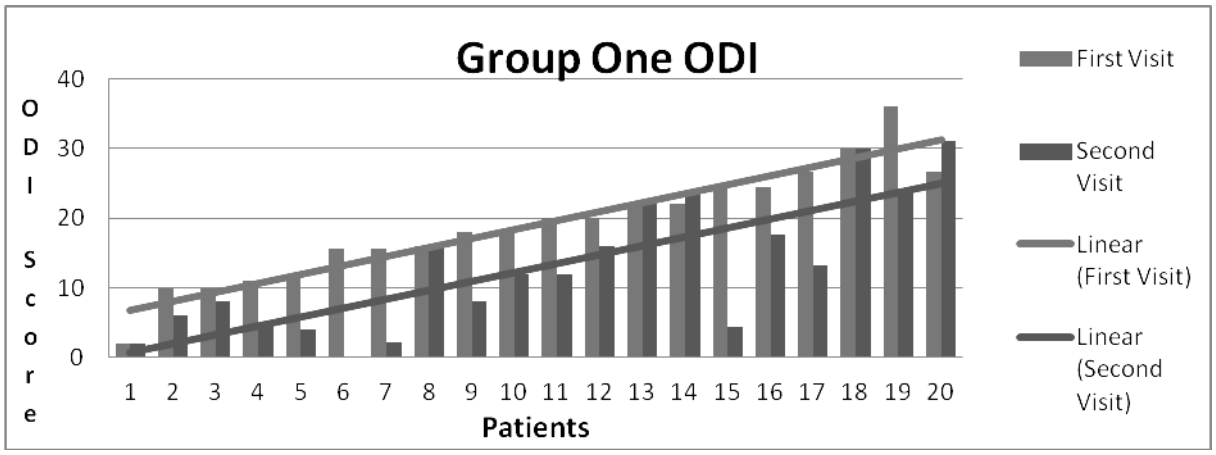


Figure 4.24: Trend-Line Analysis Within Group One for the ODI Score

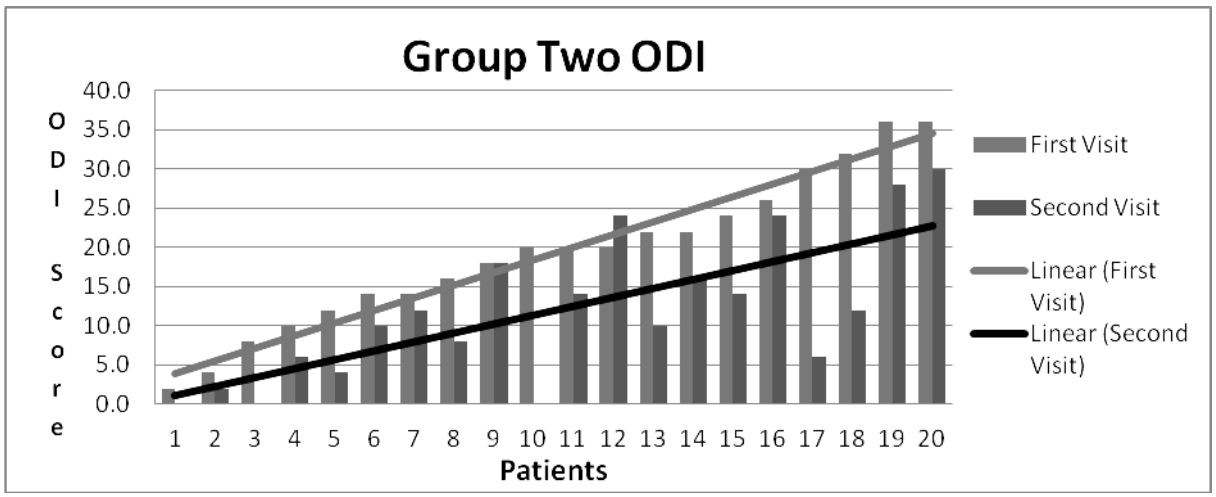


Figure 4.25: Trend-Line Analysis Within Group Two for the ODI Score

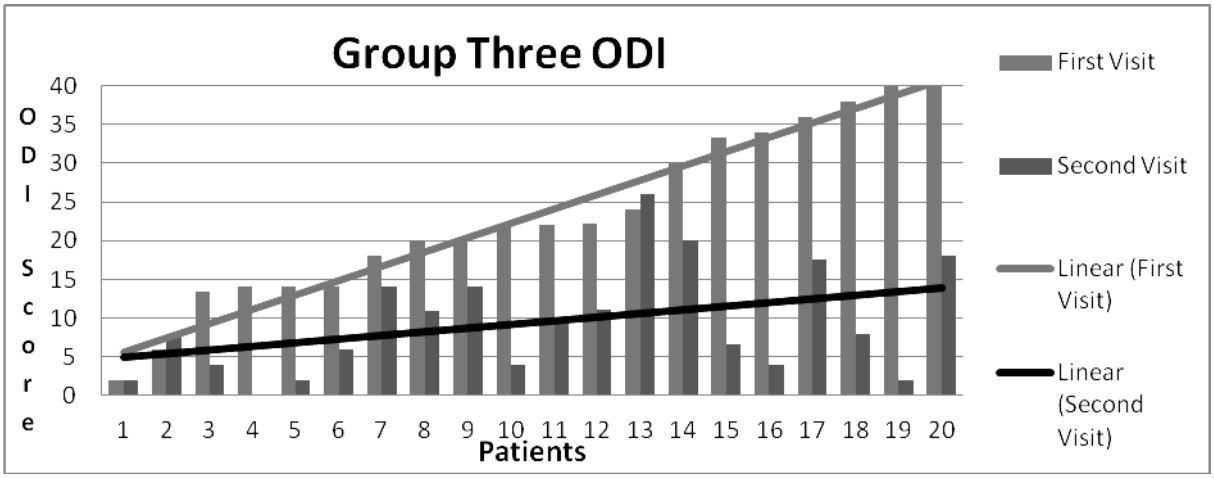


Figure 4.26: Trend-Line Analysis Within Group Three for the ODI Score

4.4.3.2.1b ODI Score: Group One, Two and Three

Refer to Figure 4.24 – 4.26 above:

Table 4.30 Comparison of the ODI Scores within Group One, Two and Three using the Paired t-Test

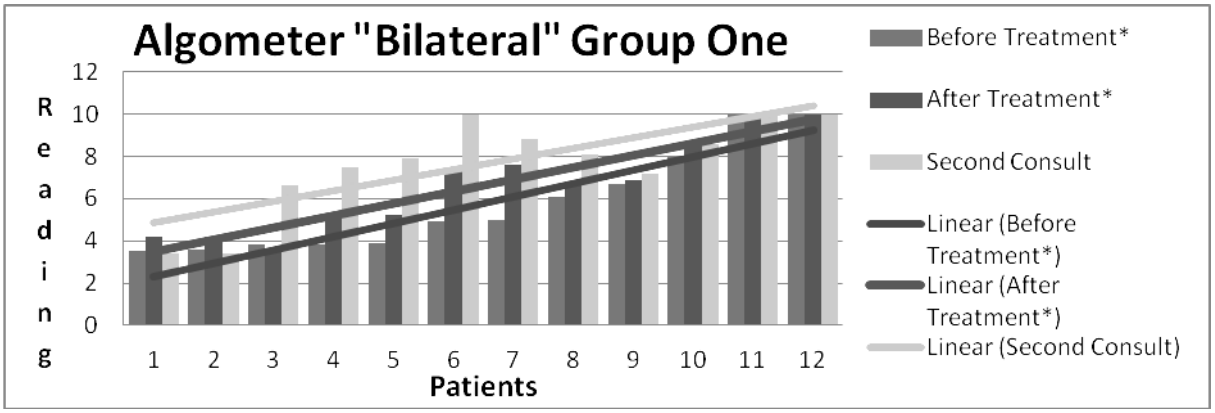
	Group One First Consultation		***P*-value**	**Group One Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 19	+/- 8	0.00	+/- 12.9	+/- 9.5
	Group Two First Consultation			**Group Two Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 19.3	+/- 9.7	0.00	+/- 11.9	+/- 9.2
	Group Three First Consultation			**Group Three Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
ODI	+/- 23.1	+/- 11.1	0.00	+/- 9.4	+/- 7

The null hypothesis is rejected regarding the subjective findings for the ODI Scores from the first to the second consultation for Group One (p = 0.0004), from the first to the second consultation for Group Two (p = 0.0002) and for the first to the second consultation for Group Three (p = 0.00002) which indicates that there were statistically significant differences for all three groups.

4.4.4 Intra-Group Analysis of the Objective Measurements

4.4.4.1 Intra-Group Analysis of the Algometer Scores

4.4.4.1.1a "Bilateral" Algometer Score: Group One



*At the first consultation

Figure 4.27: Trend-Line Analysis Within Group One for the "Bilateral" Algometer Score

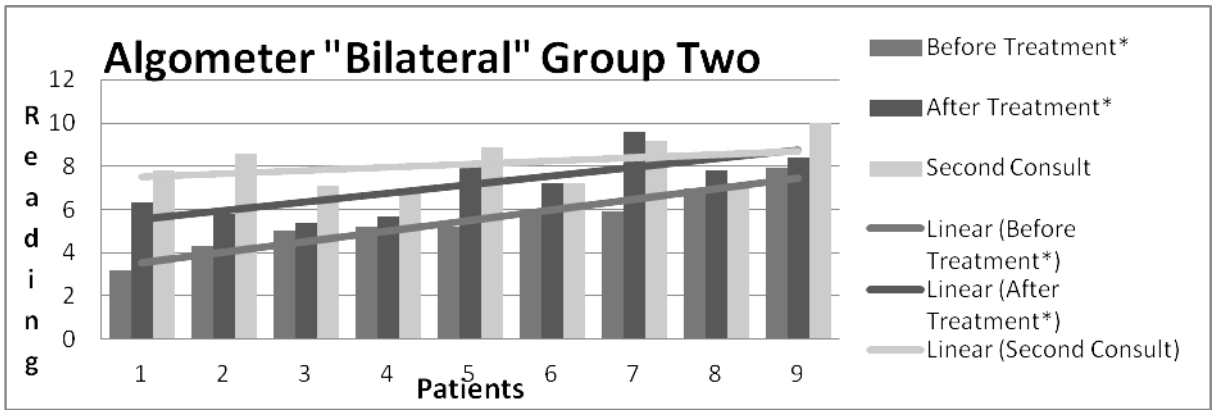
Table 4.31 Comparison of the "Bilateral" Algometer Scores within Group One using the Paired t-Test

	Before Treatment*		*P*-value	After Treatment*	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.8	+/- 2.4	0.00	+/- 6.6	+/- 2.2
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.8	+/- 2.4	0.00	+/- 7.6	+/- 2.3
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.6	+/- 2.2	0.03	+/- 7.6	+/- 2.3

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Bilateral" Algometer scores from before to after treatment at the first consultation (p = 0.008), from before treatment at the first consultation to the second consultation (p = 0.007) and from after treatment at the first consultation to the second consultation (p = 0.03) which indicates that there were statistically significant differences for all comparisons within Group One.

4.4.4.1.1b "Bilateral" Algometer Score: Group Two



*At the first consultation

Figure 4.28: Trend-Line Analysis Within Group Two for the "Bilateral" Algometer Score

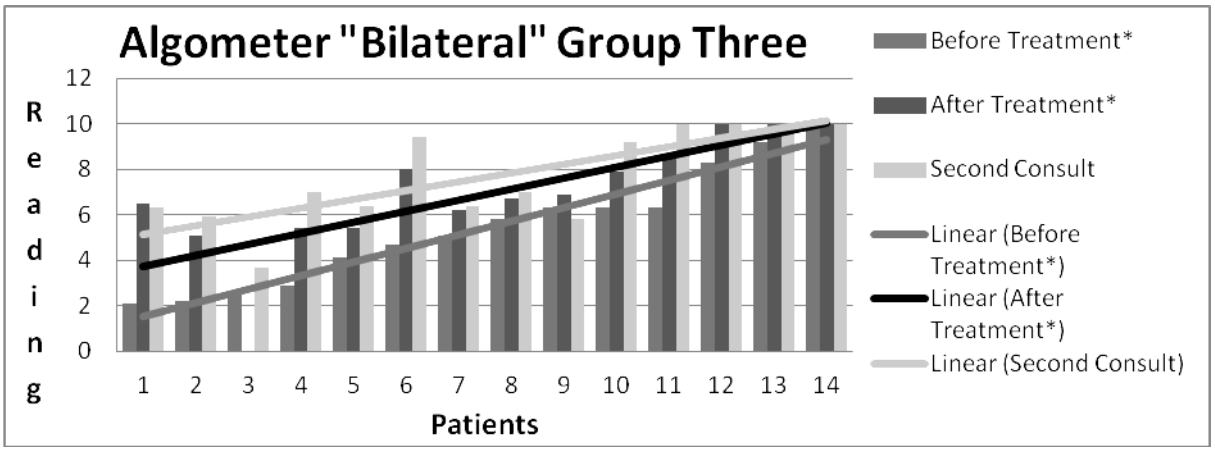
Table 4.32 Comparison of the "Bilateral" Algometer Scores within Group Two using the Paired t-Test

	Before Treatment*		*P*-value	After Treatment*	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.5	+/- 1.4	0.00	+/- 7.2	+/- 1.4
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.5	+/- 1.4	0.00	+/- 8.1	+/- 1.1
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.2	+/- 1.4	0.03	+/- 8.1	+/- 1.1

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Bilateral" Algometer scores from before to after treatment at the first consultation (p = 0.005), from before treatment at the first consultation to the second consultation (p = 0.007) and from after treatment at the first consultation to the second consultation (p = 0.03) which indicates that there were statistically significant differences for all comparisons within Group Two.

4.4.4.1.1c "Bilateral" Algometer Score: Group Three



*At the first consultation

Figure 4.29: Trend-Line Analysis Within Group Three for the "Bilateral" Algometer Score

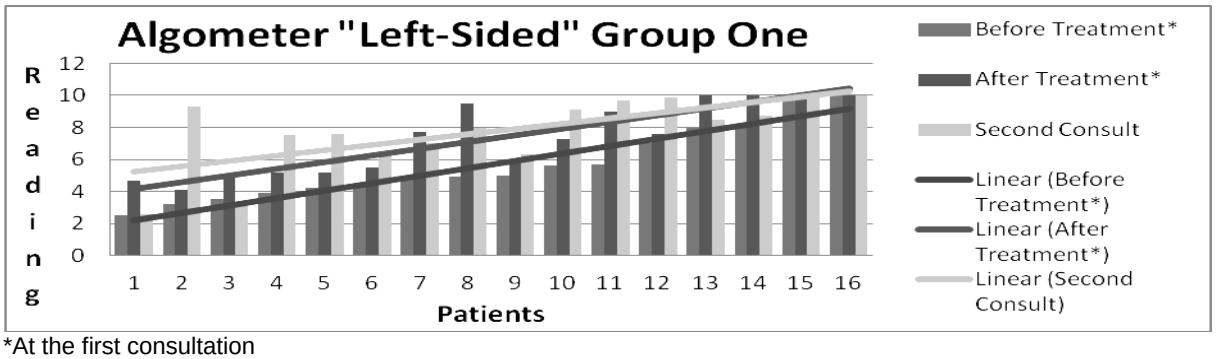
Table 4.33 Comparison of the "Bilateral" Algometer Scores within Group Three using the Paired t-Test

	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.4	+/- 2.6	0.00	+/- 6.9	+/- 2.6
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.4	+/- 2.6	0.00	+/- 7.7	+/- 2.1
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.9	+/- 2.6	0.03	+/- 7.7	+/- 2.1

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Bilateral" Algometer scores from before to after treatment at the first consultation (p = 0.005), from before treatment at the first consultation to the second consultation (p = 0.007) and from after treatment at the first consultation to the second consultation (p = 0.03) which indicates that there were statistically significant differences for all comparisons within Group Three.

4.4.4.1.2a "Left-Sided" Algometer Score: Group One



*At the first consultation

Figure 4.30: Trend-Line Analysis Within Group One for the "Left-Sided" Algometer Score

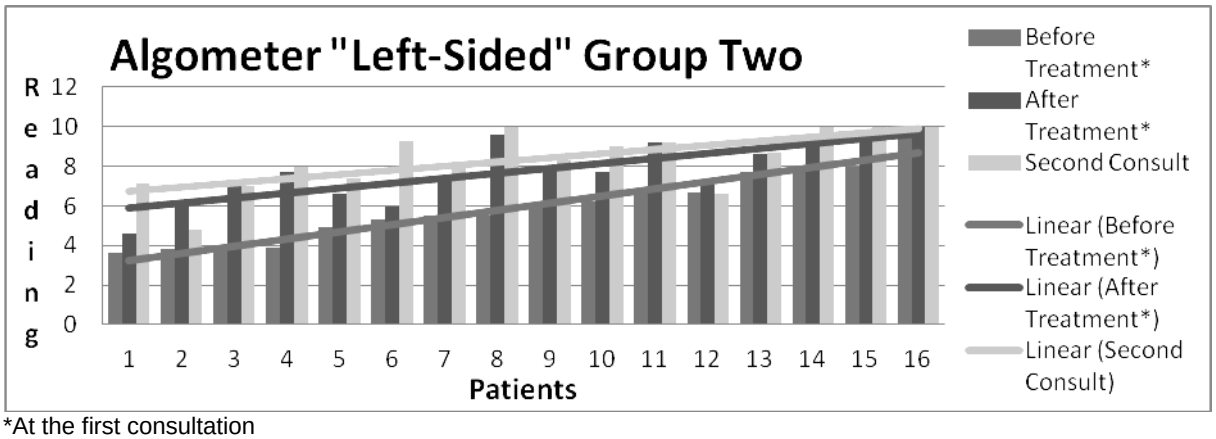
Table 4.34 Comparison of the "Left-Sided" Algometer Scores within Group One using the Paired t-Test

	Before Treatment*		*P*-value	After Treatment*	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.7	+/- 2.3	0.00	+/- 7.3	+/- 2.2
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.7	+/- 2.3	0.00	+/- 7.7	+/- 2.2
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.3	+/- 2.2	0.00	+/- 7.7	+/- 2.2

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Left-Sided" Algometer scores from before to after treatment at the first consultation (p = 0.00009), from before treatment at the first consultation to the second consultation (p = 0.0004) and from after treatment at the first consultation to the second consultation (p = 0.0004) which indicates that there were statistically significant differences for all comparisons within Group One.

4.4.4.1.2b "Left-Sided" Algometer Score: Group Two



*At the first consultation

Figure 4.31: Trend-Line Analysis Within Group Two for the "Left-Sided" Algometer Score

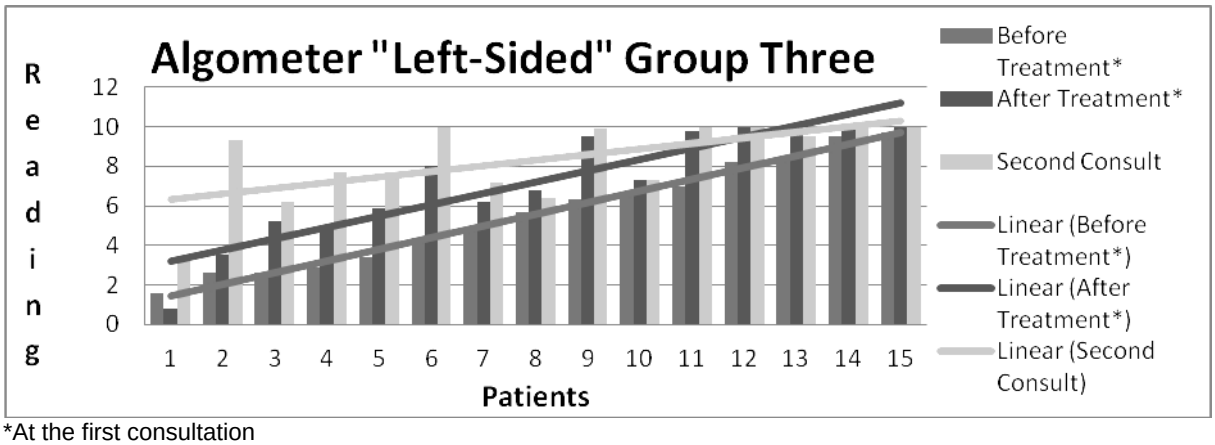
Table 4.35 Comparison of the "Left-Sided" Algometer Scores within Group Two using the Paired t-Test

	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6	+/- 1.8	0.00	+/- 7.5	+/- 1.5
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6	+/- 1.8	0.00	+/- 8.3	+/- 1.5
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.5	+/- 1.5	0.08	+/- 8.3	+/- 1.5

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Left-Sided" Algometer scores from before to after treatment at the first consultation (p = 0.00002) and from before treatment at the first consultation to the second consultation (p = 0.000005) which indicates that there were statistically significant differences from before to after treatment at the first consultation and from before treatment at the first consultation to the second consultation. The null hypothesis is accepted from after treatment at the first consultation to the second consultation (p = 0.08) which indicates that there was no statistically significant difference from after treatment at the first consultation to the second consultation.

4.4.4.1.2c "Left-Sided" Algometer Score: Group Three



*At the first consultation

Figure 4.32: Trend-Line Analysis Within Group Three for the "Left-Sided" Algometer Score

Table 4.36 Comparison of the "Left-Sided" Algometer Scores within Group Three using the Paired t-Test

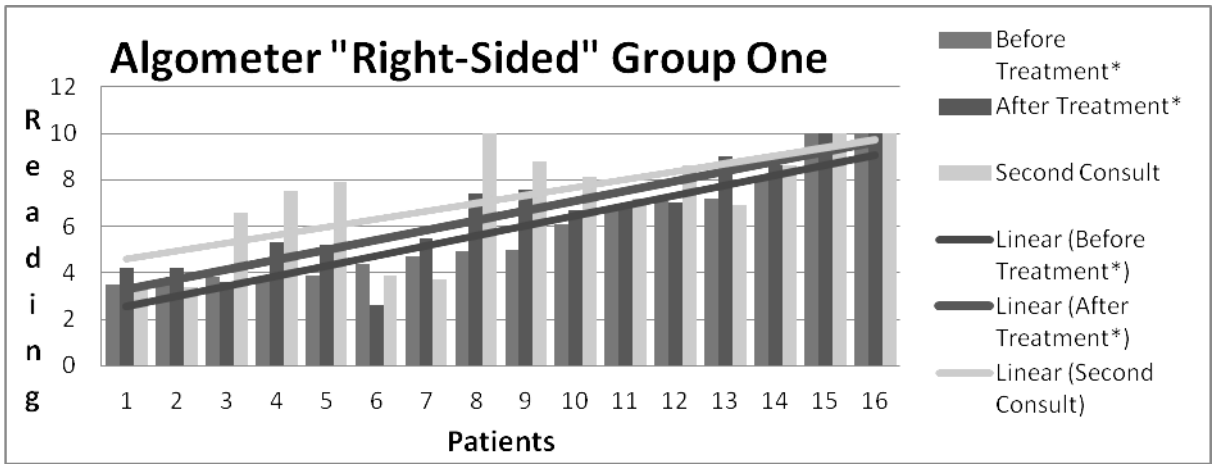
	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.6	+/- 2.6	0.00	+/- 7.2	+/- 2.8
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.6	+/- 2.6	0.00	+/- 8.3	+/- 2
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.2	+/- 2.8	0.02	+/- 8.3	+/- 2

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Left-Sided" Algometer scores from before to after treatment at the first consultation (p = 0.0001), from before treatment at the first consultation to the second consultation (p = 0.0001) and from after treatment at the first consultation to the second consultation (p = 0.02)

which indicates that there were statistically significant differences for all comparisons within Group Three.

4.4.4.1.3a "Right-Sided" Algometer Score: Group One



*At the first consultation

Figure 4.33: Trend-Line Analysis Within Group One for the "Right-Sided" Algometer Score

Table 4.37 Comparison of the "Right-Sided" Algometer Scores within Group One using the Paired t-Test

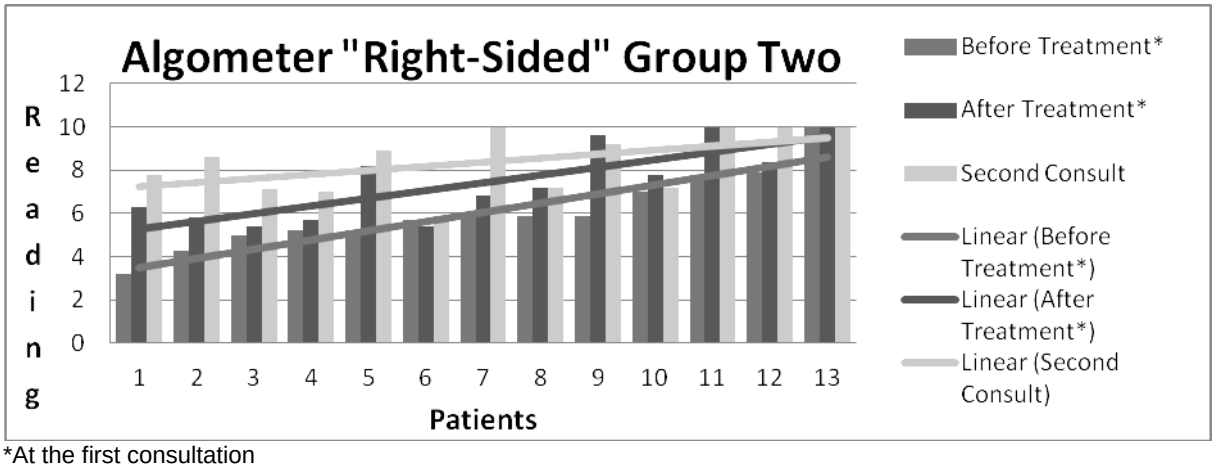
	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.8	+/- 2.2	0.02	+/- 6.5	+/- 2.3
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 5.8	+/- 2.2	0.01	+/- 7.2	+/- 2.4
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.5	+/- 2.3	0.11	+/- 7.2	+/- 2.4

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Right-Sided" Algometer scores from before to after treatment at the first consultation (p = 0.02) and

from before treatment at the first consultation to the second consultation (p = 0.01) which indicates that there were statistically significant differences from before to after treatment at the first consultation and from before treatment at the first consultation to the second consultation. The null hypothesis is accepted from after treatment at the first consultation to the second consultation (p = 0.11) which indicates that there was no statistically significant difference from after treatment at the first consultation to the second consultation.

4.4.4.1.3b "Right-Sided" Algometer Score: Group Two



*At the first consultation

Figure 4.34: Trend-Line Analysis Within Group Two for the "Right-Sided" Algometer Score

Table 4.38 Comparison of the "Right-Sided" Algometer Scores within Group Two using the Paired t-Test

	Before Treatment*		*P*-value	After Treatment*	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.1	+/- 1.8	0.00	+/- 7.4	+/- 1.7
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.1	+/- 1.8	0.00	+/- 8.4	+/- 1.4
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.4	+/- 1.7	0.01	+/- 8.4	+/- 1.4

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Right-Sided" Algometer scores from before to after treatment at the first consultation (p = 0.002), from before treatment at the first consultation to the second consultation (p = 0.0002) and from after treatment at the first consultation to the second consultation (p = 0.01) which indicates that there were statistically significant differences for all comparisons within Group Two.

4.4.4.1.3c "Right-Sided" Algometer Score: Group Three

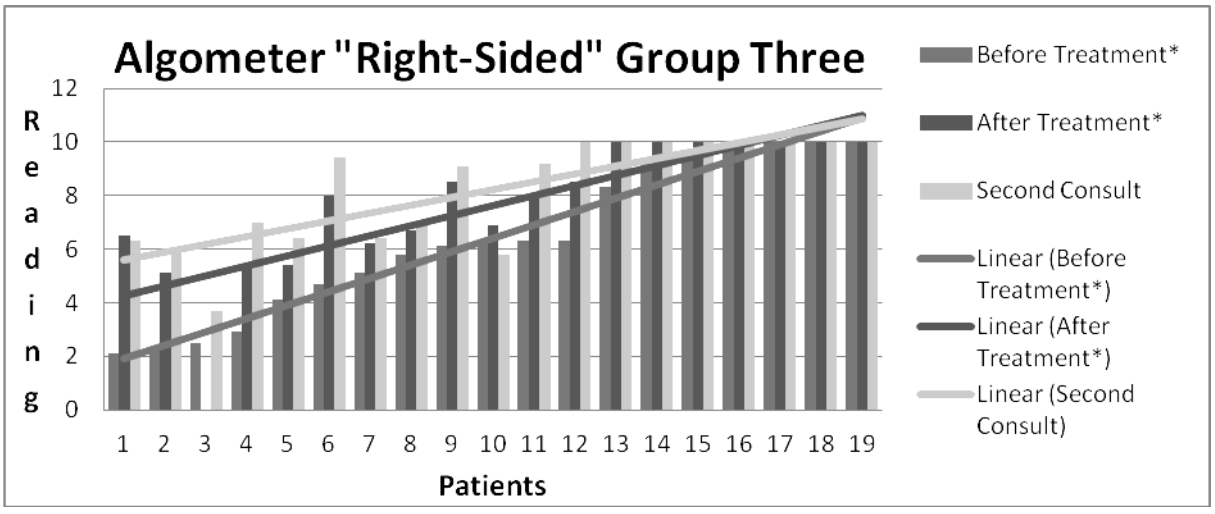


Figure 4.35: Trend-Line Analysis Within Group Three for the "Right-Sided" Algometer Score

Table 4.39 Comparison of the "Right-Sided" Algometer Scores within Group Three using the Paired t-Test

	Before Treatment*		***P*-value**	**After Treatment***	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.4	+/- 2.9	0.00	+/- 7.6	+/- 2.6
	Before Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 6.4	+/- 2.9	0.00	+/- 8.2	+/- 2
	After Treatment*			**Second Consultation**	
	Mean	**S.D.**		**Mean**	**S.D.**
Algometer	+/- 7.6	+/- 2.6	0.02	+/- 8.2	+/- 2

*At the first consultation

The null hypothesis is rejected regarding the objective findings for the "Right-Sided" Algometer scores from before to after treatment at the first consultation (p = 0.002), from before treatment at the first consultation to the second consultation (p = 0.0001) and from after treatment at the first consultation to the second consultation (p = 0.02) which indicates that there were statistically significant differences for all comparisons within Group Two.

4.5 Conclusion

For the Inter-group analyses most comparisons were statistically insignificant ($p \geq 0.05$) which indicates that all treatment groups appeared to improve to a similar degree, and that there was no treatment that was superior.

For the Intra-group analyses most comparisons were statistically significant ($p < 0.05$), especially from before the treatment at the first consultation to the second consultation. Even so, group three seemed to have improved more than any other group for all measurements. These results suggest that Kinesio Tex® Tape therapy is effective as an adjunct to SMT in the treatment of chronic SIJ Syndrome, however, it is not statistically more or less effective than SMT or Kinesio Tex® Tape therapy alone.

CHAPTER FIVE

Discussion

5.1 Introduction

In this chapter the results from Chapter Four will be discussed. The discussion will include demographic, subjective and objective data obtained from this study. The subjective data consisted of the NRS-101 and the ODI Questionnaires. The objective data consisted of the Algometer data.

The NRS-101 and Algometer data was collected before and after the treatment at the first consultation, as well as at the second consultation. The ODI data was collected before the treatment at the first consultation and at the second consultation. Inter-group and intra-group statistical analyses were performed to test for significant or insignificant findings.

The initial part of this chapter will deal with the analysis of the data according to the demographics. The latter part will deal with the interpretation of the inter-and-intra group analyses.

5.2 Demographic Data

5.2.1 Age Distribution

This study was limited to include participants of between 18 - 50 years of age. It was found that the majority (75%) of participants were between 21 - 30 years of age (Table 4.1). The mean age for this sample was 26.12 years. This is comparable to a similar study by Moodley (2002), who had a sample size of 60, and reported the majority of participants were between the ages of 21 - 31. However, Moodley's (2002) study included participants between the ages of 18-65. The present study is also comparible

to a similar study by Thompson (2002), who had a sample size of 60, and reported the majority of participants were between the ages of 20 - 30. In another similar study in which participants between the ages of 18-49 were included, Bisset (2003) reported a mean age of 33.3 years, which is higher than this research. DePalma, Ketchum and Saullo (2011) found that chronic SIJ Syndrome was more likely to occur in older patients (dePalma, Ketchum and Saullo 2011), even though an age was not stated. In support of that study, the average age of chronic SIJ Syndrome patients was 50.05 years according to Irwin, Watson, Minick and Ambrosius (2007). Furthermore, Dyer (2012) found a correlation between older age and a predisposition for LBP. The reason that the present study may have had dissimilar results in terms of age distribution may have been due to not only the small sample size, but also due to the fact that the research was conducted in a tertiary institution, and therefore, a large portion of the participants were students between the ages of 20 - 30.

5.2.2 Gender Distribution

The gender distribution within the sample of 60 participants (Table 4.2) was near equal with 55% male and 45% female participation, which is in contrast with Statistics South Africa where a female predominance in South Africa in 2011 of 51.5% as compared to 48.5% for males is reported (Statistical Release, 2011). The reason why the present study does not represent a similar gender distribution to the country as a whole may be due to the small sample size, as well as convenience sampling methodology. This supports similar studies by Moodley (2002) who had a slightly higher female percentage, and Bisset (2003) who had a 50% - 50% gender distribution. Furthermore, Dyer (2012) found gender distribution to be similar in her study (53.3% female, 46.7 male). The present study was, however, in contrast to a study by Thompson (2002) had a male predominance of 63.5%. Another study by Irwin *et al.,* (2007) found a female predominance of 63.2%. This could be attributed to a differing sample size (n = 158), however it could also be due to chance.

5.2.3 Ethnic Distribution

The ethnic distribution (Table 4.3) in this study varied, as 56.67% of the participants were Black, 33.3% where White, 6.67% were Indian and 3.3% were "Other" (i.e. mixed race). This research showed a predominance of Black participants with chronic SIJ Syndrome. This is in contrast with Moodley (2002), who found the Indian ethnic group to have a predominance of SIJ Syndrome, while Thompson (2002) and Bisset (2003) both found White ethnicity predominance. The reason for this may have been due to the fact that the present research was conducted in a tertiary institution in which there is a predominance of Black students, and in a country, according to Statistics South Africa, with a Black demographic predominance of 79.5% (Statistical Release, 2011).

5.2.4 Occupation Distribution

The occupation of participants (Table 3.4) revealed that the highest proportion of participants with chronic SIJ Syndrome were students. The reason for this could have been due to the fact that the research was conducted in a tertiary institution and therefore a large portion of the participants were students. The present study supports findings by authors Gemmell and Jacobson (1990) who found that the overall incidence of chronic SIJ Syndrome was 19.3% in a group of fit university students.

5.2.5 Side of Involvement

The left and right sides were similarly affected (20% left and 21.67% right) and there was bilateral involvement in 58.33%. This is in contrast with Thompson (2002) and Moodley (2002) and Bisset (2003) who found a right sided predominance. The reason for this may be due to differing research methodologies to the present study. In the above mentioned studies the participants with bilateral SIJ pain were asked to choose a side that was thought to be more painful than the other, which resulted in unilateral interventions throughout the samples. In the present study, this was not done, and

participants with bilateral pain were treated bilaterally. Had the researcher followed the former methodology, it may have shown similar results to the above mentioned studies. Additionally, Slipman *et al.,* (2001) describes that the epidemiology of sacroiliac joint pain has been reported to present with right sided symptoms in 45% of cases, left in 35%, and bilaterally in 20%.

5.3 Intra-Group Comparisons

5.3.1 Subjective Data

5.3.1.1 The Numerical Pain Rating Scale (NRS-101)

The NRS-101 scores were analysed using the two-sample paired t-test.

5.3.1.1a Group One (SMT alone)

Regarding the "Least Severe" NRS-101 score (Table 4.24), there was an improvement from before to after treatment at the first consultation (p = 0.01) and from before treatment at the first consultation to the second consultation (p = 0.02). There was no improvement from after the treatment at the first consultation to the second consultation (p = 0.49). This indicates that the treatment effects of SMT were effective in reducing the "Least Severe" NRS-101 pain intensity.

Regarding the "Most Severe" NRS-101 score (Table 4.27), there was an improvement from before to after treatment at the first consultation (p = 0.00001) and from before treatment at the first consultation to the second consultation (p = 0.00001). There was no improvement from after the treatment at the first consultation to the second consultation (p = 0.16). This indicates that the treatment effects of SMT were effective in reducing the "Most Severe" NRS-101 pain intensity.

The reason for the statistically insignificant results from after the treatment at the first consultation to the second consultation may be as a result of the possible immediate therapeutic effect of SMT (Cleland, Childs, McRae, Palmer, and Stowell, 2005). The majority of the participants (70%) within this group experienced immediate pain relief after SMT, those that did not have a similar experience did not, however, report that their symptoms deteriorated. Only one participant felt an exacerbation of symptoms immediately after SMT. A possible reason for these results may have been due to this study not having a large enough sample size, and therefore, a reduced power. The power of the study is determined from the size of the sample. The larger the sample size, the higher the power of the study, which yields more significant results (and vice versa).

The First Objective was to determine the clinical effectiveness of one SMT treatment on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. With the exception of the "Least Severe" and "Most Severe" NRS-101 scores from after the treatment at the first consultation to the second consultation (p = 0.49 and p = 0.16 respectively), for which null hypothesis one was accepted, null hypothesis one was rejected for all other comparisons above for the NRS-101 Questionnaire.

When examining the results of similar studies done by Bisset (2003) and Morgan (2005) in which statistically significant results were found after only one SMT, the present study confirms the effectiveness of one SMT in the treatment of chronic SIJ Syndrome.

5.3.1.1b Group Two (KT alone)

Regarding the "Least Severe" NRS-101 score (Table 4.25), there was no improvement from before to after treatment at the first consultation (p = 0.2), there was an improvement from before treatment at the first consultation to the second consultation (p = 0.03), and there was no improvement from after the treatment at the first consultation to the second consultation (p = 0.33). This indicates that the treatment

effects of KT were effective in reducing the "Least Severe" NRS-101 pain intensity from before the treatment at the first consultation to the second consultation.

Regarding the "Most Severe" NRS-101 score (Table 4.28), there was an improvement from before to after treatment at the first consultation (p = 0.03), from before treatment at the first consultation to the second consultation (p = 0.00009) and from after the treatment at the first consultation to the second consultation (p = 0.0003). This indicates that the treatment effects of KT were effective in reducing the "Most Severe" NRS-101 pain intensity.

A possible reason that there was no difference from before to immediately after treatment for the "Least Severe" NRS-101 score is that the therapeutic effects of Kinesio Tex® Tape therapy may not have been immediate. There is a paucity of information regarding the timing of the therapeutic effects of Kinesio Tex® Tape therapy, however according to Kase, Wallis and Kase (2003) Kinesio Tex® Tape therapy may be therapeutically effective for a minimum of 72 hours. Another possible reason may be due to the score numbers obtained from the "Least Severe" NRS-101 questionnaire having small magnitude, and the small sample size of the study, which may have resulted in limited statistical power. This may have led to a type I error. Additionally, if the "Least Severe" results are compared with the "Most Severe" results, one may see that there were statistically significant results between all three measurements (before, after and at the second consultation) for the "Most Severe" NRS-101 scores within Group Two. This was not shown to be the same as the "Least Severe" NSR-101 score from before to immediately after treatment because of the small range of numbers, as in a telephonic conversation on 19 November 2011 with research statistician Dr Hammond, smaller numbers do not result in statistically significant results. Similarly for the comparison from after treatment at the first consultation to the second consultation for the "Least Severe" NRS-101 score, the small range of scores may have resulted in a type I error.

The Second Objective was to determine the clinical effectiveness of one application of Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. With the exception of the "Least Severe" NRS-101 scores from before to after treatment at the first consultation (p = 0.2) and from after the treatment at the first consultation to the second consultation (p = 0.33), for which null hypothesis two was accepted, null hypothesis two was rejected for all other comparisons above for the NRS-101 Questionnaire.

These results cannot be compared to other taping studies as there is a paucity of information in the literature on Kinesio Tex® Tape therapy on chronic SIJ Syndrome and LBP due to LFJ Syndrome.

5.3.1.1c Group Three (SMT and KT)

Regarding the "Least Severe" NRS-101 score (Table 4.26), there was an improvement from before to after treatment at the first consultation (p = 0.008), from before treatment at the first consultation to the second consultation (p = 0.001) and from after the treatment at the first consultation to the second consultation (p = 0.03). This indicates that the treatment effect of the combined group (SMT and KT) were effective in reducing the "Least Severe" NRS-101 pain intensity. The null hypothesis is rejected.

Regarding the "Most Severe" NRS-101 score (Table 4.29), there was an improvement from before to after treatment at the first consultation (p = 0.00003), from before treatment at the first consultation to the second consultation (p = 0.000006). There was no improvement from after the treatment at the first consultation to the second consultation (p = 0.12). This indicates that the treatment effects of the combined group (SMT andKT) were effective in reducing the "Most Severe" NRS-101 pain intensity. The null hypothesis is rejected.

A possibility for the insignificant finding from after the treatment at the first consultation to the second consultation may be due to a probable low power of the study as a result of a small sample size. Another possibility may have been from the immediate therapeutic effects of SMT (Cleland *et al.,* 2005).

The Third Objective was to determine the clinical effectiveness of one SMT in combination with Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. With exception of the "Most Severe" NRS-101 score from after the treatment at the first consultation to the second consultation (p = 0.12), for which null hypothesis three was accepted, null hypothesis three was rejected for all other comparisons above for the NRS-101 Questionnaire.

By examining the "Least Severe" NRS-101 results from before treatment at the first consultation to the second consultation, Group One (p = 0.02) and Group Two improved (p = 0.03) at a similar rate, indicating that both SMT and Kinesio Tex® Tape therapy were effective. However Group Three improved (p = 0.001) at a greater rate, indicating that Kinesio Tex® Tape therapy is effective as an adjunct to SMT in the treatment of chronic SIJ Syndrome.

Similarly by investigating the "Most Severe" NRS-101 results from before treatment at the first consultation to the second consultation, Group One (p = 0.00001) and Group Two improved (p = 0.00009), indicating that both SMT and Kinesio Tex® Tape therapy were effective. However Group Three improved (p = 0.000006) at a greater rate, indicating that Kinesio Tex® Tape therapy is effective as an adjunct to SMT in the treatment of chronic SIJ Syndrome.

However, with a small sample size there may be a chance of rejecting a null hypothesis when it is not correct, as the power of the study is weaker with a smaller sample size. Therefore while there are statistically significant differences, they should be interpreted with the power of this study in mind.

There is, however, a paucity of information in the literature on SMT and Kinesio Tex® Tape therapy in combination on chronic SIJ Syndrome and LBP due to LFJ Syndrome which makes analytic comparison difficult.

5.3.1.2 The Oswestry Low Back Pain Disability Index

The ODI scores were analysed using the two-sample paired t-test.

5.3.1.2a Group One

There was an improvement (p = 0.0004) from the first consultation to the second consultation (Table 4.30).

The First Objective was to determine the clinical effectiveness of one SMT treatment on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. Null hypothesis one was rejected.

This indicates that the treatment effects of SMT were effective in reducing disability due to chronic SIJ Syndrome. This also serves to confirm the work of Haldeman (2005) and Gatterman (2005), who state that SMT is an effective treatment protocol in the management of chronic SIJ Syndrome.

When examining the results of similar studies done by Bisset (2003) and Morgan (2005) in which statistically significant results were found after one SMT, the present study confirms the effectiveness of one SMT in the treatment of chronic SIJ Syndrome.

5.3.1.2b GroupTwo

There was an improvement (p = 0.0002) from the first consultation to the second consultation (Table 4.30).

The Second Objective was to determine the clinical effectiveness of one application of Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. Null hypothesis two was rejected.

This indicates that the treatment effects of Kinesio Tex® Tape therapy were effective in reducing disability due to chronic SIJ Syndrome. However, there is a paucity of information on the effects of Kinesio Tex® Tape therapy on chronic SIJ Syndrome, the results of this study seem to indicate that Kinesio Tex® Tape therapy is effective in the treatment of chronic SIJ Syndrome. There is, however, a paucity of information in the literature on Kinesio Tex® Tape therapy on chronic SIJ Syndrome and LBP due to LFJ Syndrome which makes analytic comparison difficult. .

5.3.1.2c GroupThree

There was an improvement (p = 0.00002) from the first consultation to the second consultation (Table 4.30).

The Third Objective was to determine the clinical effectiveness of one SMT in combination with Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. Null hypothesis three was rejected.

By examining the ODI results from before treatment at the first consultation to the second consultation, Group One (p = 0.0004) and Group Two improved (p = 0.0002), indicating that both SMT and Kinesio Tex® Tape therapy were effective. However Group Three improved (p = 0.00002) at a greater rate, indicating that Kinesio Tex®

Tape therapy is effective as an adjunct to SMT in the treatment of chronic SIJ Syndrome. However, with a small sample size there may be a chance of rejecting a null hypothesis when it is not correct, as the power of the study is weaker with a smaller sample size. Therefore, while there are statistically significant differences, the results should be interpreted with the power of this study in mind.

According to the research statistician Dr Hammond, in an e-mail communication, the chi-square test showed that there was a significant difference for all comparisons, but it was not the ideal test to use (Appendix J). Instead the t-test for paired samples gave a more accurate result.

There is, however, a paucity of information in the literature on SMT and Kinesio Tex® Tape therapy in combination on chronic SIJ Syndrome and LBP due to LFJ Syndrome which makes analytic comparison difficult.

5.3.2 Objective Data

5.3.2.1 The Algometer

The Algometer measurements were done either bilaterally or on the side of pain where participants had unilateral pain. This resulted in "Bilateral", "Left-Sided" or "Right-Sided" Algometer measurements. The “Left-Sided” and “Right-Sided” Algometer mesurements were included the “Bilateral” Algometer measurements as the left and right sides respectively were involved in this category. This resulted in unequal distribution within the groups for each category, and this should be kept in mind as it decreased the significance of these results.

The Algometer scores were analysed using the two-sample paired t-test.

5.3.2.1a Group One

Regarding the "Bilateral" Algometer readings, there was an improvement (p = 0.008) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.007) from before the treatment at the first consultation to the second consultation and there was an improvement (p = 0.03) from immediately after treatment at the first consultation to the second consultation (Table 4.31).

This indicates that the therapeutic effects of SMT were successful in improving the "Bilateral" Algometer readings.

Regarding the "Left-Sided" Algometer readings, there was an improvement (p = 0.00009) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.0004) from before the treatment at the first consultation to the second consultation and there was an improvement (p = 0.0004) from immediately after treatment at the first consultation to the second consultation (Table 4.34).

This indicates that the therapeutic effects of SMT were successful in improving the "Left-Sided" Algometer readings.

Regarding the "Right-Sided" Algometer readings, there was an improvement (p = 0.02) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.01) from before the treatment at the first consultation to the second consultation and there was no improvement (p = 0.11) from immediately after treatment at the first consultation to the second consultation (Table 4.37).

This indicates that the therapeutic effects of SMT were successful in improving the "Right-Sided" Algometer readings from before to immediately after treatment at the first consultation and from before treatment at the first consultation to the second consultation. The null hypothesis was rejected. However the other comparison was

statistically insignificant (p = 0.11), indicating that the therapeutic effects of SMT were not successful in improving the "Right-Sided" Algometer readings from after treatment at the first consultation to the second consultation. A possible reason for this may be attributed to the immediate effect of SMT (Cleland *et al.,* 2005), and possibly also due to the small sample size, which gave this study lower power.

The First Objective was to determine the clinical effectiveness of one SMT treatment on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. Null hypothesis one was rejected for the "Bilateral" and "Left-Sided" Algometer readings. With the exception of the "Right-Sided" Algometer reading from immediately after treatment at the first consultation to the second consultation (p = 0.11), for which null hypothesis one was accepted, null hypothesis one was rejected for all other comparisons above for the "Right-Sided" Algometer readings.

When examining the results of similar studies done by Bisset (2003) and Morgan (2005) in which statistically significant results were found after only one SMT, the present study confirms the effectiveness of one SMT in the treatment of chronic SIJ Syndrome.

5.3.2.1b Group Two

Regarding the "Bilateral" Algometer readings, there was an improvement (p = 0.005) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.007) from before the treatment at the first consultation to the second consultation and there was an improvement (p = 0.03) from immediately after treatment at the first consultation to the second consultation (Table 4.32).

This indicates that the therapeutic effects of Kinesio Tex® Tape therapy were successful in improving the "Bilateral" Algometer readings. The null hypothesis was rejected.

Regarding the "Left-Sided" Algometer readings, there was an improvement (p = 0.00002) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.000005) from before the treatment at the first consultation to the second consultation and there was no improvement (p = 0.08) from immediately after treatment at the first consultation to the second consultation (Table 4.35).

This indicates that the therapeutic effects of Kinesio Tex® Tape therapy was successful (null hypothesis was rejected) in improving the "Left-Sided" Algometer readings except from immediately after treatment at the first consultation to the second consultation (null hypothesis was accepted). The reason for this could be that the Kinesio Tex® Tape therapy after the treatment at the first consultation may not have had immediate effects, as the therapeutic effects of Kinesio Tex® Tape therapy may not occur instantaneously (Kase, Wallis and Kase, 2003).

Regarding the "Right-Sided" Algometer readings, there was an improvement (p = 0.002) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.0002) from before the treatment at the first consultation to the second consultation and there was no improvement (p = 0.01) from immediately after treatment at the first consultation to the second consultation (Table 4.38).

This indicates that the therapeutic effects of Kinesio Tex® Tape therapy were successful in improving the "Right-Sided" Algometer readings. The null hypothesis was rejected.

The Second Objective was to determine the clinical effectiveness of one application of Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. Null hypothesis two was rejected for the "Bilateral" and "Right-Sided" Algometer readings. With the exception of the "Left-Sided" Algometer reading from immediately after treatment at the first consultation to the second

consultation (p = 0.08), for which null hypothesis two was accepted, null hypothesis two was rejected for all other comparisons above for the "Left-Sided" Algometer readings. There is, however, a paucity of information in the literature on Kinesio Tex® Tape therapy eon chronic SIJ Syndrome and LBP due to LFJ Syndrome which makes analytic comparison difficult.

5.3.2.1c Group Three

Regarding the "Bilateral" Algometer readings, there was an improvement (p = 0.005) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.0002) from before the treatment at the first consultation to the second consultation and there was an improvement (p = 0.03) from immediately after treatment at the first consultation to the second consultation (Table 4.33).

This indicates that the therapeutic effects of SMT and Kinesio Tex® Tape therapy as an adjunct was successful in improving the "Bilateral" Algometer readings. The null hypothesis was rejected.

Regarding the "Left-Sided" Algometer readings, there was an improvement (p = 0.0001) from before to immediately after the treatment at the first consultation, there was an improvement (p = 0.0001) from before the treatment at the first consultation to the second consultation and there was an improvement (p = 0.02) from immediately after treatment at the first consultation to the second consultation (Table 4.36).

This indicates that the therapeutic effects of SMT and Kinesio Tex® Tape therapy as an adjunct were successful in improving the "Left-Sided" Algometer readings. The null hypothesis was rejected.

Regarding the "Left-Sided" Algometer readings, there was an improvement (p = 0.002) from before to immediately after the treatment at the first consultation, there was an

improvement (p = 0.0001) from before the treatment at the first consultation to the second consultation and there was an improvement (p = 0.02) from immediately after treatment at the first consultation to the second consultation (Table 4.39).

This indicates that the therapeutic effects of SMT and Kinesio Tex® Tape therapy as an adjunct were successful in improving the "Right-Sided" Algometer readings. The null hypothesis was rejected.

The Third Objective was to determine the clinical effectiveness of one SMT in combination with Kinesio Tex® Tape therapy on patients with chronic SIJ Syndrome in terms of subjective and objective clinical data. Null hypothesis three was accepted for all comparisons above for the "Bilateral", "Left-Sided" and "Right-Sided" Algometer readings.

By examining the "Bilateral" Algometer results from before treatment at the first consultation to the second consultation, Group One (p = 0.007) and Group Two improved (p = 0.007), indicating that both SMT and Kinesio Tex® Tape therapy were effective. However Group Three improved (p = 0.0002) at a greater rate, indicating that Kinesio Tex® Tape therapy is effective as an adjunct to SMT in the treatment of chronic SIJ Syndrome.

By investigating the "Left-Sided" Algometer results from before treatment at the first consultation to the second consultation, Group One (p = 0.0004) improved, however Group Two improved (p = 0.000005) to a greater degree, indicating that both SMT and Kinesio Tex® Tape therapy respectively were effective, however Kinesio Tex® Tape therapy alone was more effective than SMT alone or in combination with SMT. Group Three, however, did improve (p = 0.0001) to a greater degree than group one, indicating that Kinesio Tex® Tape therapy is more effective as an adjunct to SMT in the treatment of chronic SIJ Syndrome than SMT alone. While Kinesio Tex® Tape therapy alone was more effective than the combination of Kinesio Tex® Tape therapy and SMT, the two

groups involving Kinesio Tex® Tape therapy were both more effective than SMT alone. This supports the use of Kinesio Tex® Tape therapy in the treatment of chronic SIJ Syndrome. These results should be interpreted with the low power of this study in mind, as well as the small number of participants (20%) who had "Left-Sided" SIJ pain.

By considering the "Right-Sided" Algometer results from before treatment at the first consultation to the second consultation, Group One (p = 0.01) improved, indicating that SMT was effective. However, Group Two (p = 0.0002) and Three (p = 0.0001) improved at a greater rate than Group One, but yet to a similar degree to each other, indicating that both Kinesio Tex® Tape therapy as well as the combination of Kinesio Tex® Tape therapy and SMT was effective, and that neither of these two treatment interventions were superior in improving the "Right-Sided" Algometer scores.

However, with a small sample size there may be a chance of rejecting a null hypothesis when it is not correct, as the power of the study is weaker with a smaller sample size. Therefore, while there are statistically significant differences, they should be interpreted with the power of this study in mind.
There is, however, a paucity of information in the literature on SMT and Kinesio Tex® Tape therapy in combination on chronic SIJ Syndrome and LBP due to LFJ Syndrom which makes analytic comparison difficult.

5.4 Inter-Group Comparisons

5.4.1 NRS-101 Questionnaire

5.4.1.1 NRS-101 Questionnaire: "Least Severe" Score

The "Least Severe" NRS-101 scores were analysed using the two-sample unpaired t-test. The scores before and after treatment at the first consultation and at the second consultation were analysed.

There was no statistically significant difference ($p = 0.95$) between Group One and Two before treatment at the initial consultation, no statistically significant difference ($p = 0.44$) between Group One and Three before treatment at the initial consultation and there was no statistically significant difference ($p = 0.05$) between Group Two and Three before treatment at the initial consultation (Table 4.7).

These results indicate that, in terms of the "Least Severe" subjective pain intensity and disability, there was no statistically significant difference between Group One, Two and Three which indicates that participants in all three groups entered the study with similar levels of pain. This was an important finding as it suggests that none of the groups had more or less levels of pain than the other, which indicates that the three groups entered the study with similar levels of pain.

Similarly, there were no differences between the three groups after the treatment at the first consultation and at the second consultation ($p \geq 0.05$), indicating that all three treatment protocols were effective and that no treatment intervention was superior in reducing pain intensity in terms of the “Least Severe” NRS-101 scores. See Chapter Four, Tables 4.8 and 4.9.

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data. Null hypothesis four was accepted for all comparisons mentioned above for the "Least Severe" NRS-101 Questionnaire.

5.4.1.2 NRS-101 Questionnaire: "Most Severe" Score

The "Most Severe" NRS-101 scores were analysed using the two-sample unpaired t-test. The scores before and after treatment at the first consultation and at the second consultation were analysed.

There was no statistically significant difference ($p = 0.76$) between Group One and Two before treatment at the initial consultation, no statistically significant difference ($p = 0.96$) between Group One and Three before treatment at the initial consultation and there was no statistically significant difference ($p = 0.81$) between Group Two and Three before treatment at the initial consultation (Table 4.10).

These results indicate that, in terms of the "Most Severe" subjective pain intensity and disability, there was no statistically significant difference between Group One, Two and Three which indicates that participants in all three groups entered the study with similar levels of pain. This was an important finding as it suggests that none of the groups had markedly more or less severe levels of pain than the other.

Similarly, there were no differences between the three groups after the treatment at the first consultation and at the second consultation ($p \geq 0.05$), indicating that all three treatment protocols were effective (See Chapter Four, Tables 4.11 and 4.12), with the exception of Group Two and Three after the treatment at the first consultation, which had a statistically significant finding ($p = 0.04$; Table 4.11; Figure 4.5), indicating that Kinesio Tex® Tape therapy was not more effective in reducing the "Most Severe" NRS-101 score immediately after treatment at the first consultation (the null hypothesis was rejected). The reason for this could be that the Kinesio Tex® Tape therapy after the

treatment at the first consultation may not have had immediate effects, as the therapeutic effects of Kinesio Tex® Tape therapy may not occur instantaneously. According to Kase, Wallis and Kase (2003), the treatment effects of Kinesio Tex® Tape therapy may be therapeutically effective for a minimum of 72 hours, however the authors do not indicate how long it would take before the effects would start taking place. There is a paucity of findings regarding the timing of the effects of Kinesio Tex® Tape therapy, therefore this may need to be assessed further in future studies.

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data. With the exception of one statistically significant finding above, for which null hypothesis four was rejected, null hypothesis four was accepted for all other comparisons mentioned for the "Most Severe" NRS-101 Questionnaire.

5.4.2 ODI Questionnaire

The ODI scores were analysed using the two-sample unpaired t-test. The scores at the first and second consultation were analysed.

There was no statistically significant difference (p = 0.91) between Group One and Two at the initial consultation, no statistically significant difference (p = 0.19) between group One and Three at the initial consultation and there was no statistically significant difference (p = 0.25) between group Two and Three at the initial consultation (Table 4.13).

The results indicate that there was no statistically significant difference between Group One, Two and Three at the first consultation, which indicates that all three groups entered the study with similar disability. This was a significant finding as it suggests that none of the groups had more or less disability than the other.

There was no statistically significant difference (p = 0.75) between Group One and Two at the second consultation, no statistically significant difference (p = 0.2) between group One and Three at the second consultation and there was no statistically significant difference (p = 0.34) between Group Two and Three at the second consultation (Table 4.14).

The results indicate that there were no statistically significant differences between Group One, Two and Three at the second consultation which indicates that all three groups improved (the interventions were effective in reducing disability) and that no treatment intervention was superior in reducing disability.

However, a clinically significant difference could be observed, especially within Group Three which had the combination of SMT and Kinesio Tex® Tape therapy as an adjunct. Had the sample size been large enough, statistically significant results may have been observed for all comparisons regarding the ODI scores.

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data. Null hypothesis four was accepted for all comparisons mentioned above for the ODI Questionnaire.

5.4.3 Algometer Readings

5.4.3.1 "Bilateral" Algometer Readings

The "Bilateral" Algometer scores were analysed using the two-sample unpaired t-test. The scores before and after treatment at the first consultation and at the second consultation were analysed.

There was no statistically significant difference (p = 0.76) between group one and two at the initial consultation, no statistically significant difference (p = 0.71) between group

one and three at the initial consultation and there was no statistically significant difference (p = 0.91) between group two and three at the initial consultation (Table 4.15).

The results indicate that there was no statistically significant difference between group one, two and three which indicates that all three groups entered the study with similar pain and pressure threshold levels.

Similarly, there were no statistically significant differences between the three groups after the treatment at the first consultation and at the second consultation ($p \geq 0.05$), indicating that all three treatment protocols were effective and that no treatment intervention was superior in improving the Algometer scores (See Chapter Four, Tables 4.16 and 4.17).

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data. Null hypothesis four was accepted for all comparisons mentioned above for the "Bilateral" Algometer readings.

5.4.3.2 "Left-Sided" Algometer Readings

The "Left-Sided" Algometer scores were analysed using the two-sample unpaired t-test. The scores before and after treatment at the first consultation and at the second consultation were analysed.

There was no statistically significant difference (p = 0.71) between group one and two at the initial consultation, no statistically significant difference (p = 0.9) between group one and three at the initial consultation and there was no statistically significant difference (p = 0.64) between group two and three at the initial consultation (Table 4.18).

The results indicate that there was no statistically significant difference between group one, two and three which indicates that all three groups entered the study with similar pain and pressure threshold levels.

Similarly, there were no statistically significant differences between the three groups after the treatment at the first consultation and at the second consultation ($p \geq 0.05$), indicating that all three treatment protocols were effective and that no treatment intervention was superior in improving the Algometer scores (See Chapter Four, Tables 4.19 and 4.20).

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data. Null hypothesis four was accepted for all comparisons mentioned above for the "Left-Sided" Algometer readings.

5.4.3.3 "Right-Sided" Algometer Readings

The "Right-Sided" Algometer scores were analysed using the two-sample unpaired t-test. The scores before and after treatment at the first consultation and at the second consultation were analysed.

There was no statistically significant difference ($p = 0.71$) between group one and two at the initial consultation, no statistically significant difference ($p = 0.49$) between group one and three at the initial consultation and there was no statistically significant difference ($p = 0.69$) between group two and three at the initial consultation (Table 4.21).

The results indicate that there was no statistically significant difference between group one, two and three which indicates that all three groups entered the study with similar pain and pressure threshold levels.

Similarly, there were no statistically significant differences between the three groups after the treatment at the first consultation and at the second consultation ($p \geq 0.05$), indicating that all three treatment protocols were effective and that no treatment intervention was superior in improving the Algometer scores (See Chapter Four, Tables 4.22 and 4.23).

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data. Null hypothesis four was accepted for all comparisons mentioned above for the "Right-Sided" Algometer readings.

5.4.3.4 Conclusion of Inter-Group Analyses

As discussed in Chapter Two, Haldeman (2005) and Gatterman (2005) state that SMT is an effective treatment protocol in the management of chronic SIJ Syndrome. The results from the subjective and objective data confirm this. There is, however, a paucity of information on the effectiveness of Kinesio Tex® Tape therapy on chronic SIJ Syndrome. Therefore, the results from this measurement suggest that it may be an effective treatment protocol in the management of chronic SIJ Syndrome, however it is not more or less effective than SMT alone or as an adjunct to SMT.

Neurologically, as discussed in Chapter Two, Hilton's Law is not applicable to the SIJ (Standring, 2008). The implication of this is that for all three groups there were no specific neurologic consequences of treatment, and the only neurologic target in the SIJ were the proprioceptors (Melzack and Wall, 1965; Bergmann, Peterson and Lawrence, 1993; Jaraczewsca and Long, 2006). For this reason Kinesio Tex® Tape therapy may be an appropriate adjunct to SMT as both of these treatment modalities may have therapeutic effects which target the proprioceptors within the SIJ (Bergmann, Peterson and Lawrence, 1993; Pickar, 2002; Jaraczewsca and Long, 2006; Baker *et al.,* 2011).

The Fourth Objective was to compare the groups in terms of subjective and objective clinical data. Except for the statistically significant finding between Group Two and Three after the treatment at the first consultation for the "Most Severe" NRS-101 Questionnaire (p = 0.04; Table 4.11; Figure 4.5), null hypothesis four was accepted for all other comparisons mentioned above for the subjective and objective data. However, as mentioned under Section 1.6, it must be kept in mind that this study had a small sample size which limited the power of the study, and therefore, the results of the study. A larger sample size may have yielded statistically significant results in terms of subjective and objective clinical data, and repeating this study with a larger sample size may be of benefit in the future.

When observing the immediate effects of the treatment interventions, in the present study, it is necessary to mention that anecdotal evidence in clinical practice suggests that one SMT treatment often makes a significant positive impact on chronic SIJ Syndrome. Similar studies that support this notion include Bisset (2003) and Morgan (2005). In terms of Group One (SMT alone), when examining the results of studies done by Bisset (2003) and Morgan (2005) in which statistically significant results were found after only one SMT, the present study confirms the effectiveness of one SMT in the treatment of chronic SIJ Syndrome. In terms of Group Two (Kinesio Tex® Tape alone) and Three (SMT and Kinesio Tex® Tape), the results cannot be compared to any studies as there is a paucity of information in the literature on Kinesio Tex® Tape therapy alone, and SMT and Kinesio Tex® Tape therapy in combination on chronic SIJ Syndrome and LBP due to LFJ Syndrome.

5.5 Summary

After statistical analysis and its interpretation regarding the use of Kinesio Tex® Tape therapy as an adjunct to SMT in the treatment of chronic SIJ Syndrome as opposed to either treatment modalities used in isolation, it was found that some differences did occur, favouring the combination of Kinesio Tex® Tape therapy and SMT in most cases.

However, these differences were not sufficient enough to conclude that one treatment was more effective than the other.

CHAPTER 6

Conclusions and Recommendations

6.1 Conclusion

Although some results were more significant than others, the intra-group analysis showed statistically significant differences for all three treatment groups, indicating that all three treatment protocols were effective in reducing symptoms of chronic SIJ Syndrome. The inter-group analysis showed little statistically significant differences between the three treatment groups, indicating that all three groups improved at similar rates. This implies that Kinesio Tex® Tape therapy may be used with equal confidence as compared to SMT when treating patients with chronic SIJ Syndrome. However in this short term study it was found that it is not statistically more significant to treat patients using SMT with Kinesio Tex® Tape therapy as an adjunct than treating with either SMT or Kinesio Tex® Tape therapy alone. Nevertheless, a long term study may demonstrate otherwise.

Further research is needed in order to establish the effectiveness of Kinesio Tex® Tape therapy, in the treatment of chronic SIJ Syndrome. Until then it is up to the clinician whether this treatment modality would have any clinical value and be of benefit to the patient.

To conclude, this study has served to demonstrate that SMT and Kinesio Tex® Tape therapy of the SIJ alone is as effective as SMT followed by Kinesio Tex® Tape therapy in the treatment of chronic SIJ Syndrome.

6.2 Recommendations

Sample Size

The sample size of this study was limited to 60 participants. Although this was a sufficient number in order to perform statistical analysis, a larger sample size may greatly increase the accuracy of the results and prevent the chance of type I and II errors occurring. It may be of more benefit to repeat this study with two groups (i.e. SMT alone compared to SMT and Kinesio Tex® Tape therapy in combination) which would increase the number of participants in each group to 30 each.

Homogeneity

The strength of this study may be further enhanced if there were to be strict adherence with regards to the inclusion and exclusion criteria by the use of stratification of variables such as age, gender, ethnicity, height, weight, occupation and extent of pain and disability. Additionally, the side of involvement with regards to the diagnosis of SIJ Syndrome and the side to be treated should be kept constant. This would ensure homogeneity within the three groups.

Blinding

This study did not employ the use of blinding, which may have resulted in the possibility of researcher bias and, therefore, influencing of the results. Observer bias could be eliminated by allowing another person to perform the Algometer readings and record the results from subjective questionnaires. Additionally, the researcher should not be allowed to view the treatment readings until after the data collection.

Treatment Frequency

The nature of this study was to assess the efficacy of three treatment protocols in terms of a single treatment with a follow-up consultation. Future studies may investigate multiple treatments over a longer peried of time which may be useful in determining the long term effects of the treatment protocols, especially in order to determine whether

Kinesio Tex® Tape therapy would aid SMT in reducing the number of treatments necessary to reduce the symptoms of chronic SIJ Syndrome. A long term study may additionally increase the strength of the study.

Use of the Revised Oswestry Disability Index

The Revised ODI Questionnaire should be used in the future as it is designed to be more sensitive and to produce more accurate results.

Measurement Error

Although the posterior superior iliac spine anatomical landmark is relatively easy to find, it was difficult to keep the placement of the Algometer constant on each participant. Human error with regards to placement of the Algometer could be limited if a Henna marker is utilised to mark the site of the original measurement location, so that subsequent measurements would be taken on the same mark.

Pain Threshold

A potential factor that could not be excluded in the present study was the differing pain threshold levels between various ethnic groups. Future studies may consider focusing on a particular ethnic group.

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APPENDICES Appendix A: Case History

DURBAN UNIVERSITY OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient Code: _____ Date: _____

File # : _____ Age: _____

Intern: _____ Signature _____

FOR CLINICIANS USE ONLY:

Initial visit

Clinician: Signature:

Case History:

Examination:

Previous: Current:

X-Ray Studies:

Previous: Current:

Clinical Path. lab:

Previous: Current:

CASE STATUS:PTT: Signature: Date:

Intern's Case History:

1. **Source of History:**
2. **Chief Complaint: (patient's own words):**
3. **Present Illness:**

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

4. Other Complaints:

5. Past Medical History:

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

6. Current health status and life-style:

Allergies

Immunizations

Screening Tests incl. x-rays

Environmental Hazards (Home, School, Work)

Exercise and Leisure

Sleep Patterns

Diet

Current Medication

Analgesics/week:

Tobacco

Alcohol

Social Drugs

7. Immediate Family Medical History:

Age

Health

Cause of Death

DM
Heart Disease
TB
Stroke
Kidney Disease
CA
Arthritis
Anaemia
Headaches
Thyroid Disease
Epilepsy
Mental Illness
Alcoholism
Drug Addiction
Other

8. Psychosocial history:

Home Situation and daily life

Important experiences

Religious Beliefs

9. Review of Systems:

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

Appendix B: Physical Examination

Durban University of Technology

PHYSICAL EXAMINATION: SENIOR

Patient Name : **File no :** **Date :_____**
Student : **Signature :**

VITALS:				
Pulse rate:			Respiratory rate:	
Blood pressure:	R	L	Medication if hypertensive:	
Temperature:			Height:	
Weight:	Any recent change? Y / N		If Yes: How much gain/loss	Over what period

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

SYSTEM SPECIFIC EXAMINATION:
CARDIOVASCULAR EXAMINATION
RESPIRATORY EXAMINATION
ABDOMINAL EXAMINATION
NEUROLOGICAL EXAMINATION
COMMENTS

Clinician: **Signature :**

Appendix C: Lumbar Regional Examination

REGIONAL EXAMINATION - LUMBAR SPINE AND PELVIS

DURBAN UNIVERSITY of TECHNOLOGY

Patient:_____ File#:_____Date:_________

Intern\Resident:_____ Clinician:_____

STANDING:

Posture– scoliosis, antalgia, kyphosis
Body Type
Skin
Scars
Discolouration

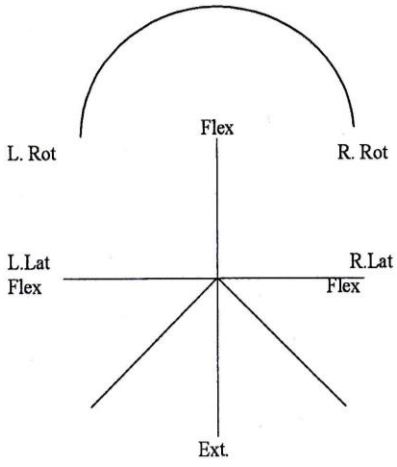
Minor's Sign
Muscle tone
Spinous Percussion
Scober's Test (6cm)
Bony and Soft Tissue Contours

GAIT:

Normal walking
Toe walking
Heel Walking
Half squat

ROM:

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



Which movt. reproduces the pain or is the worst?

- Location of pain
- Supported Adams: Relief? (SI)
- Aggravates? (disc, muscle strain)

SUPINE:

Observe abdomen (hair, skin, nails)
Palpate abdomen\groin
Pulses - abdominal
- lower extremity
Abdominal reflexes

		Degree	LBP?	Location	Leg pain	Buttock	Thigh	Calf	Heel	Foot	Braggard
SLR	L										
	R										

	L	R
Bowstring		
Sciatic notch		
Circumference (thigh and calf)		
Leg length: actual -		
apparent -		
Patrick FABERE: pos\neg – location of pain?		
Gaenslen's Test		
Gluteus max stretch		
Piriformis test (hypertonicity?)		
Thomas test: hip \ psoas? \ rectus femoris?		
Psoas Test		

SITTING:

Spinous Percussion
Valsalva
Lhermitte

		Degree	LBP?	Location	Leg pain	Buttock	Thigh	Calf	Heel	Foot	Braggard
TRIPOD Sl, +, ++	**L**										
	R										
Slump 7 test	**L**										
	R										

LATERAL RECUMBENT:

	L	R
Ober's		
Femoral n. stretch		
SI Compression		

PRONE:

	L	R
Gluteal skyline		
Skin rolling		
Iliac crest compression		
Facet joint challenge		
SI tenderness		
SI compression		
Erichson's		
Pheasant's		

MF tp's	**Latent**	**Active**	**Radiation**
QL			
Paraspinal			
Glut Max			
Glut Med			
Glut Min			
Piriformis			
Hamstring			
TFL			
Iliopsoas			
Rectus Abdominis			
Ext/Int Oblique muscles			

NON ORGANIC SIGNS:

Pin point pain
Axial compression
Trunk rotation
Burn's Bench test

Flip Test
Hoover's test
Ankle dorsiflexion test
Repeat Pin point test

NEUROLOGICAL EXAMINATION

Fasciculations

Plantar reflex

level	**Tender?**	**Dermatomes**		**DTR**		
		L	R		L	R
T12				Patellar		
L1				Achilles		
L2						
L3				Proproception		
L4						
L5						
S1 S2						
S3						

MYOTOMES

Action	Muscles	Levels	L	R	
Lateral Flexion spine	Muscle QL				
Hip flexion	Psoas, Rectus femoris				5+ Full strength
Hip extension	Hamstring, glutes				4+ Weakness
Hip internal rotat	Glutmed, min;TFL, adductors				3+ Weak against grav
Hip external rotat	Gluteus max, Piriformis				2+ Weak w\o gravity
Hip abduction	TFL, Glut med and minimus				1+ Fascic w\o gross movt
Hip adduction	Adductors				0 No movement
Knee flexion	Hamstring,				
Knee extension	Quad				W - wasting
Ankle plantarflex	Gastroc, soleus				
Ankle dorsiflexion	Tibialis anterior				
Inversion	Tibialis anterior				
Eversion	Peroneus longus				
Great toe extens	EHL				

BASIC THORACIC EXAM

History
Passive ROM
Orthopedic

BASIC HIP EXAM

History
ROM: Active
Passive : Medial rotation : A) Supine (neutral) If reduced - hard \ soft end feel
B) Supine (hip flexed): - Trochanteric bursa

MOTION PALPATION AND JOINT PLAY

	L	R
Upper Thoracics		
Lumbar Spine		
Sacroiliac Joint		

Appendix D: NRS-101 - Prior to, 10 Min and 24 Hours After Initial Consultation

Date: _____ **File number:** _____ **Group:** _____
Patient Code: _____

Numerical Pain Rating Scale - 101

Prior to initial treatment

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its least severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean, "pain as bad as it could be" / "worst pain imaginable".
Please write only one number.

0_____100

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its most severe.** A zero (0) would mean "no pain at all", and one hundred (100) would mean "pain as bad as it could be" / "worst pain imaginable".
Please write only one number.

0_____100

Date: _____ **File number:** _____ **Group:** _____
Patient Code: _____

Numerical Pain Rating Scale - 101

10 minutes following initial treatment

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its least severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean, "pain as bad as it could be" / "worst pain imaginable".
Please write only one number.

0_____100

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its most severe.** A zero (0) would mean "no pain at all", and one hundred (100) would mean "pain as bad as it could be" / "worst pain imaginable".
Please write only one number.

0_____100

Date: _____ **File number:** _____ **Group:** _____
Patient Code: _____

Numerical Pain Rating Scale - 101

24 hours following initial treatment

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its least severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean, "pain as bad as it could be" / "worst pain imaginable".
Please write only one number.

0_____100

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its most severe.** A zero (0) would mean "no pain at all", and one hundred (100) would mean "pain as bad as it could be" / "worst pain imaginable".
Please write only one number.

0_____100

Appendix E: ODI

Date: _____ File number: _____ Group: _____
Patient Code: _____

This questionnaire has been designed to give the doctor 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 realise you may consider that two of the statements in any one section relate to you, but please just mark the box that most closely describes your problem.

Oswestry Low Back Pain Disability Index

Section 1 – Pain Intensity

- ◘ I have no pain at the moment.
- ◘ The pain is very mild at the moment.
- ◘ The pain is moderate at the moment.
- ◘ The pain is fairly severe at the moment.
- ◘ The pain is very severe at the moment.
- ◘ The pain is the worst imaginable at the moment.

Section 2 – Personal Care (washing, dressing, etc.)

- ◘ I can look after myself normally but it is very painful.
- ◘ I can look after myself normally but it is very painful.
- ◘ 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 my personal care.
- ◘ I need help every day in most aspects of self-care.
- ◘ I do not get dressed, wash with difficulty, and stay in bed.

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 (i.e. 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 4 – Walking

- ◘ Pain does not prevent me walking any distance.
- ◘ Pain prevents me walking more than 1mile.
- ◘ Pain prevents me walking more than ¼ of a mile.
- ◘ Pain prevents me walking more than 100 yards.
- ◘ I can only walk using a stick or crutches.
- ◘ I am in bed most of the time and have to crawl to the toilet.

Section 5 – Sitting

- ◘ I can sit in any chair as long as I like.

- ▫ I can sit in my favourite chair as long as I like.
- ▫ Pain prevents me from sitting for more than 1 hour.
- ▫ Pain prevents me from sitting for more than ½ hour.
- ▫ Pain prevents me from sitting for more than 10 minutes.
- ▫ Pain prevents me from sitting at all.

Section 6 – Standing

- ▫ 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 more than 1 hour.
- ▫ Pain prevents me from standing for more than ½ an hour.
- ▫ Pain prevents me from standing for more than 10 minutes.
- ▫ Pain prevents me from standing at all.

Section 7 – Sleeping

- ▫ My sleep is never disturbed by pain.
- ▫ My sleep is occasionally disturbed by pain.
- ▫ Because of pain, I have less than 6 hours sleep.
- ▫ Because of pain, I have less than 4 hours sleep.
- ▫ Because of pain, I have less than 2 hours sleep.
- ▫ Pain prevents me from sleeping at all.

Section 8 – Sex life (if applicable)

- ▫ 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 9 – Social Life

- ▫ My social life is normal and cause 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 my more energetic interests, i.e. sports.
- ▫ Pain has restricted my social life and I do not go out as often.
- ▫ Pain has restricted social life to my home.
- ▫ I have no social life because of pain.

Section 10 – Travelling

- ▫ I can travel anywhere without pain.
- ▫ I can travel anywhere but it gives extra pain.
- ▫ Pain is bad but I manage journeys of over two hours.
- ▫ Pain restricts me to short necessary journeys under 30 minutes.
- ▫ Pain prevents me from travelling except to receive treatment.

Appendix F: Algometer Form

Date: _____ File number: _____ Group: _____
Patient Code: _____

Algometer Readings

Prior to initial treatment: _____

10 minutes following initial treatment : _____

24 hours after initial treatment: _____

Appendix G: Faculty of Health Institutional Research and Ethics Committee (IREC 004/12) Research Approval Letter

DURBAN UNIVERSITY of TECHNOLOGY

INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

14 February 2012

IREC Reference Number: **REC 12/11**

Mr Q H de Beer
40 Beryldene Road
Kloof
Durban
3610

Dear Mr de Beer

The relative effectiveness of Kinesio® taping methods as an adjunct to a single sacroiliac joint manipulation in the treatment of chronic Sacroiliac Joint Syndrome

I am pleased to inform you that Full Approval has been granted to your proposal REC 12/11.

The Proposal has been allocated the following Ethical Clearance number IREC 004/12. Please use this number in all communication with this office.

Approval has been granted for a period of one year, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

Please note that ANY amendments in the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

[redacted]

Prof T Puckree
Chairperson: IREC

Appendix H: Advertisement/Leaflets

Are you between the ages of **18** and **50** and suffering from:

Low Back Pain?

Research is currently being carried out at the Durban University of Technology Chiropractic Day Clinic

Treatment available to those who qualify to take part in this study.

Contact **Quintin de Beer** on 0711170811 or 031 373 2205 / 2512 for more information.

Appendix I : Letter of Information and Informed Consent

Dear Participant

Welcome to the Durban University of Technology Chiopractic Day Clinic.

I am a chiropractic student completing my Masters in Technology Chiropractic degree. Outlined below is a brief description of the study and what will be needed from you. Your participation is greatly appreciated and your involvement is contributing to making a successful study.

Title of the research study: *The relative effectiveness of Kinesio Taping® Methods as an adjunct to a single sacroiliac joint manipulation in the treatment of chronic Sacroiliac Joint Syndrome.*

Principle researcher:
Quintin de Beer Contact number 0313732205

Research supervisor:
Dr. Andrew Jones [M.Tech-Chiropractic] Contact number 0319034467

Brief Introduction and Purpose of the Study:
This research will determine the effectiveness of Kinesio Taping® in aiding the healing of low back pain.
All participants will be purposively split into three equal groups. Each individual will receive a clinical treatment depending on the group they are allocated to.

Outline of the procedures:
You will have to attend two consultations 72 hours apart. At the initial appointment you will be screened to determine whether you are suitable as a participant, using a case history, physical examination and lower back (lumbar spine) examination. If you are included into this study, you will receive treatment and measurements will be taken as part of the data for statistical analysis at this consultation. This appointment will be 1 and a half to 2 hours in duration. The second appointment will be scheduled 72 hours (3days) after the first. At this consultation the same statistical measurements will be taken with no treatment intervention. This consultation will be 30 minutes long. Please do not change your daily activities/lifestyle as this may interfere with the readings of the study. All participants that have contra-indications to either Kinesio Tex® Tape therapy or spinal manipulative therapy or do not sign the informed consent form will not be allowed to participate in this study.

Risks or discomforts to the subject:
All groups in the study will receive treatment that is safe and efficient with all the treatments carried out under the supervision of a qualified chiropractor. Spinal manipulative therapy is considered a non-invasive (no injectables, non-surgical etc.) form of manual therapy with minimal or no side effects. Patients may at times experience post treatment soreness, but this is the minority of cases and is often uncomplicated. Kinesio Tex® Tape therapy is also a non-invasive form of therapy in which strips of tape are applied to the skin over the area which requires its effects. Contra-indications to spinal manipulative and Kinesio Tex® Tape therapy are minimal and will be excluded as per the complete case history, physical and regional examinations as well as an in depth discussion with the qualified clinician on duty as per the standard clinic operating protocol.

Benefits:
You, the participant, may experience a relief in your low back pain symptoms.

Reason/s why the subject may be withdrawn from the study:
If you are non-compliant of what is expected of you during the course of the study.
If you have unpleasant reactions to the treatment and you do not wish to continue.

Withdrawal:
You may withdraw from participation in this study for any reason at any point.

Remuneration:
Patients taking part in the study will not receive any form of remuneration for taking part in the study.

Costs of the study:
Participants will not be charged for the treatments involved in the study, however if the participant wants further treatment upon completion of the study, normal consultation rates will apply.

Confidentiality:
All patient information relevant to the study will be coded and kept confidential and will be stored in the Chiropractic Day Clinic for 5 years, after which it will be disposed of. The results of the study will be made available at the Durban University of Technology Library for educational purposes, but no patient information will be revealed.

Persons to contact in the event of any problems or queries:
Contact the Health Research Ethics Committee administrator, Miss. L Deonarain on 0313732900.

Statement of agreement to participate in the research study:
I,…..... (subject's full name), ID number…….....…., have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by Quintin de Beer to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study.

Subject's name (print) ……
Subject's signature:…….……..…….. Date:……..…
Researcher's name (print) signature: ……...
Researcher's signature:…… ……..Date:.....
Witness name (print) signature: …….……...
Witness signature: ……...…….....Date:……..……

Appendix J: Chi-Square Test Results for the ODI

According to the research statistician Dr Hammond, in an e-mail communication, the chi-sq test (below) showed that there is a significant difference for all comparisons, but it was not the ideal test to use. Instead the t-test for paired samples gives a more accurate result.

Patient No	Group	Chi-sq	Patient No	Group	Chi-sq	Patient No	Group	Chi-sq
36	1	0	33	2	2	64	3	0
60	1	1.6	22	2	1	7	3	0.7
57	1	0.4	58	2	8	43	3	6.5
13	1	4	51	2	1.6	11	3	14
44	1	5.3	5	2	5.3	39	3	10.3
47	1	15.4	42	2	1.1	19	3	4.6
38	1	11.4	12	2	0.3	23	3	0.9
41	1	0	48	2	4	40	3	4.1
18	1	5.6	21	2	0	3	3	1.8
32	1	2	61	2	20	59	3	14.7
53	1	3.2	25	2	1.8	34	3	6.5
20	1	0.8	10	2	0.8	26	3	5.6
50	1	0	55	2	6.5	30	3	0.2
16	1	0.2	31	2	1.6	35	3	3.3
1	1	16.4	45	2	4.2	52	3	21.3
24	1	1.8	8	2	0.2	46	3	26.5
27	1	6.7	17	2	19.2	15	3	9.5
29	1	0	2	2	12.5	56	3	23.7
9	1	4	63	2	1.8	62	3	36.1
65	1	0.7	37	2	1	49	3	12.1
		79.5			**92.9**			**202.3**