THE EFFECT OF A SACROILIAC JOINT MANIPULATION ON HIP ROTATION RANGES OF MOTION IN PATIENTS SUFFERING WITH CHRONIC SACROILIAC SYNDROME.

BY

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I, Gregory Bisset do hereby declare that this dissertation represents my own work in both completion and execution.

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DEDICATION

I dedicate this work to my parents, Raymond and Roswin Bisset, whose unconditional love and support always enabled me to follow my dreams. Words can never say thank-you enough for all that you have sacrificed. I will always love you and it is a great honor to be your son.

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ABSTRACT

Mechanical low back pain is one of the most common clinical disorders that most people seek help for (Painting et al. 1998:110). Epidemiological studies indicate a lifetime prevalence of low back pain ranging from 60 to 80% with an annual incidence of approximately 30% (Mosheni-Bandepi et al., 1998). The Sacroiliac (S.I.) joint is a significant source of pain in patients with chronic low back pain and it therefore warrants further study (Schwarzer et al. 1995:31).

S.I. syndrome is defined as pain over the S.I. joint in the region of the posterior superior iliac spine, which may be accompanied by referred pain over the buttock, greater trochanter, groin, posterior thigh, knee, and occasionally to the postero-lateral calf, ankle and foot (Kirkaldy-Willis, 1992:123).

Research indicates that there seems to be a correlation between low back pain, more specifically S.I. pain and hip rotation (Ellison et al. 1990, Cibulka et al. 1999, Fairbank et al. 1984). Cibulka et al. (1998) found that patients with lower back pain who were classified as having signs suggestive of S.I. regional pain had significantly more external rotation than internal rotation on the posterior innominate side i.e. side of S.I. dysfunction (approximately a 20° difference).

Manipulation is recognised as an effective means of treating mechanical low back pain, with respect to both Lumbar Facet Joint Syndrome and S.I. Joint Syndrome (Assendelft et al. 1992 and Koes et al. 1996). Kirkaldy- Willis (1992:123) states that manipulation is the most certain way of relieving the symptoms of S.I. syndrome.

This investigation aimed to determine the effect of a sacroiliac joint manipulation on hip rotation ranges of motion (active and passive motion) in patients with chronic sacroiliac syndrome in terms of objective measures.

The study design chosen was a short term, prospective clinical study consisting of one group of sixty patients. All patients were: between 18-49 years, suffering with chronic S.I. syndrome and presented with either a decrease in the normal active and/or passive range of motion of the hip and/or with an asymmetrical range of motion of the hip. Initially goniometer and inclinometer readings were taken of active and passive hip rotation on both sides. Then a side posture sacroiliac manipulation was given to the side of the sacroiliac syndrome. Readings were again taken of the hip rotation (bilaterally) ten minutes and one week following the manipulation.

This study therefore only consisted of objective data consisting of goniometer and inclinometer readings of hip rotation taken prior, ten minutes after and one week after a manipulation to the involved sacroiliac joint. Intra-group comparisons were be made using the paired t - test. The level of significance was set at 0.05 and p-values were used for comparison purposes.

The results indicated that a S.I. manipulation has an effect on hip rotation on the side of S.I. syndrome. A statistically significant increase in hip active and passive internal rotation was found 10 minutes and 1 week following a manipulation to the involved S.I. joint. No statistically significant difference was found in hip active and passive external rotation following a manipulation to the side of S.I. syndrome.

Interestingly, the results also showed that that a S.I. manipulation has an effect on hip rotation on the opposite side to the side of S.I. syndrome (manipulated side). When looking at the data means of active and passive hip rotation on the uninvolved side there was an gradual increase found in hip active and passive rotation in all the readings following a manipulation to the involved (opposite) S.I. joint. When looking at statistically significant results it would appear that a S.I. manipulation causes an increase in active internal and external hip rotation on the uninvolved side.

In conclusion this study strengthens the argument for the use of manipulation in sacroiliac syndrome due to the fact that this study indicates that in chronic sacroiliac syndrome a manipulation appears to have an effect on the noted hip restrictions found with sacroiliac syndrome. Furthermore when treating hip pathology this study also indicates that both S.I. joints should be assessed and if deemed necessary treatment of these joints should be included in any treatment protocol for the hip. Finally it seems exceedingly more likely that a manipulation does indeed have a biomechanical, neurological and physiological effects on both local and more distant structures related to the innervation at the level of the manipulation.

However more studies are needed with larger sample sizes, a placebo group, a more homogenous population and a more frequent treatment protocol; to study the dynamics and significance of the relationship between the hip joint and sacroiliac syndrome. This study lends supports to Cibulka (1999:600) when he claims that the lower limb should always be assessed when treating lower back complaints.

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Definition of Terms:

Adjustment:

The chiropractic adjustment is a specific form of direct articular manipulation using either long or short lever techniques with specific contacts and is characterized by a dynamic thrust of controlled velocity, amplitude and direction (Gatterman 1990:405).

Biomechanics:

The application of mechanical laws to living structures. The study and knowledge of biological function obtained from application of mechanical principles (Gatterman 1990:406).

Chiropractic:

Chiropractic is a discipline of the scientific healing arts concerned with the pathogenesis, diagnostic, therapeutics and prophylaxis of functional disturbances, pathomechanical states, pain syndromes, and neurophysiological effects related to the statics and dynamics of the locomotor system, especially the spine and pelvis (Gatterman 1990:406).

Contraindication:

Any condition, especially any disease condition, that renders one particular line of treatment improper or undesirable (Gatterman 1990:407).

Manipulation:

It is a passive manual maneuver during which a synovial joint is carried suddenly beyond the normal physiological range of movement without exceeding the boundaries of anatomical integrity. The usual characteristic is a thrust or a brief, sudden, and carefully administered impulsion that is given at the end of the normal passive range of movement. It is usually accompanied by a cracking noise (Sandoz in Kikaldy-Willis and Burton 1992:283).

Mechanical low back pain:

This is defined as pain resulting from the inherent susceptibility of the spine to static loads due to muscle, gravity forces and to kinematic deviation from the normal function (Gatterman 1990:129).

Motion palpation:

Palpatory diagnosis of passive and active segmental joint ranges of motion (Gatterman 1990:406).

Sacroiliac syndrome:

Pain over the sacroiliac joint in the region of the posterior superior iliac spine, which may be accompanied by referred pain over the buttock, greater trochanter, groin, posterior thigh, knee, and occasionally to the postero-lateral calf, ankle and foot (Kirkaldy-Willis 1992:123).

Range of motion:

The difference between the two points of physiologic extent of movement (Schafer and Faye 1990).

CHAPTER ONE

INTRODUCTION

1.1 The Problem and it's Setting

Mechanical low back pain is one of the most common clinical disorders that most people seek help for (Painting et al. 1998:110). In this respect, the Sacroiliac (S.I.) joint is a common cause of low back pain but is frequently overlooked (Cibulka and Koldehoff, 1999; Frymoyer et al. 1991:2114).

A study by Bernard and Kirkaldy-Willis (1987:2107-2130) showed that the S.I. joint was the primary source of low back pain in 22.5% of 1293 patients presenting with low back pain. Based on a review of clinical records, Daum (1995:475) stated that as many as 40% of patients who presented with back complaints included S.I. joint pathology.

However despite this high incidence, controversy exists over the exact nature and mechanics of the S.I. joints and it is still commonly viewed as an "enigma" by medical practitioners (McCulloch and Transfeldt, 1997:180). What is clear is that the S.I. joint is a significant source of pain in patients with chronic low back pain and it therefore warrants further study (Schwarzer et al. 1995:31).

S.I. syndrome is defined as pain over the S.I. joint in the region of the posterior superior iliac spine, which may be accompanied by referred pain over the buttock, greater trochanter, groin, posterior thigh, knee, and occasionally to the postero-lateral calf, ankle and foot (Kirkaldy-Willis, 1992:123).

Furthermore research has shown that there seems to be a correlation between low back pain, more specifically S.I. pain and hip rotation. Ellison et al. (1990:541) compared a group of 50 healthy subjects to 50 patients with low back dysfunction. They (Ellison et al., 1990:541) found that a higher proportion of patients than healthy subjects demonstrated greater external hip rotation than internal hip rotation. Fairbank et al. (1984:461-464) found limited hip rotation in students with back pain more often than students without back pain.

More specifically in a study by Cilbulka et al. (1998:1014) it was found in a group of 100 patients that those with low back pain without evidence of S.I. regional pain had more external rotation than internal rotation bilaterally (approximately a 10° difference). However those patients with lower back pain who were classified as having signs suggestive of S.I. regional pain had significantly more external rotation than internal rotation on the posterior innominate side i.e. side of S.I. dysfunction (approximately a 20° difference). Reid (1992:662) also states that in the older individual decreased rotation at the hip may also add additional stress on the S.I. joint.

Manipulation is recognised as an effective means of treating mechanical low back pain, with respect to both lumbar facet joint syndrome and S.I. joint syndrome (Assendelft et al. 1992 and Koes et al. 1996). Gatterman (1990:49) defines chiropractic manipulation as a high velocity; low amplitude thrust which restores articular mobility. Hendler et al. (1995:173) revealed that symptoms arising from S.I. subluxations are reduced with manipulation. Kirkaldy- Willis (1992:123), similarly, states that manipulation is the most certain way of relieving the symptoms of S.I. syndrome. Kirkaldy-Willis (1992) reports that this is achieved by reducing hypertonicity in the posterior muscles that maintain the joint in a state of fixation, as well as restoring the joint movement.

Mosheni-Bandpei et al. (1998:194) conducted a review of 25 randomised controlled clinical trials between the periods 1985 - 1997. The authors (Mosheni-Bandpei et al.,1998:194) concluded that manipulation was found more effective than other interventions (placebo therapy, medical interventions and exercise) in the treatment of low back pain, both in short and long term effects.

Thus it has been established from the above that low back pain is common within society and S.I. syndrome forms a major percentage of lower back pain (Painting et al. 1998, Cibulka and Koldehoff 1999, Frymoyer et al. 1991, Bernard and Kirkaldy-Willis 1987, Daum 1995). Also it has been established through research that particularly patients with S.I. joint pain have a reduced internal hip rotation on the side of their fixation (Cibulka et al. 1998). Furthermore it has been shown that manipulation is the treatment of choice for many patients with low back pain (Twomey and Taylor, 1995).

Therefore further research in this respect has shown, that in a case report by Cibulka (1992:598), he found that stretching the hip lateral rotator muscles in a patient with S.I. dysfunction and asymmetric hip rotation ROM, as an effective form of treatment. However, no known research or clinical trial has been conducted to observe what affect a S.I. manipulation has on the observed hip restrictions.

Therefore this study will attempt to establish what effect a S.I. manipulation will have on any active and passive restrictions in hip rotation in patients suffering with S.I. syndrome.

1.2. Objectives of the Study

The purpose of this study is to determine the effect of a sacroiliac joint manipulation on hip rotation ranges of motion (active and passive motion) in patients with chronic sacroiliac syndrome in terms of objective measures.

1.3. Hypotheses

1.3.1. The First Hypothesis

It is hypothesised that a sacroiliac joint manipulation will correct changes found in hip rotation ranges of motion (active and passive motion) in patients with chronic S.I. syndrome in terms of objective measures.

1.4. The Benefits of the Study

This research project aims to evaluate the effect of a sacroiliac joint manipulation on hip rotation ranges of motion (active and passive motion) in patients with chronic sacroiliac syndrome in terms of objective measures.

This should enhance future treatment of this commonly treated condition by increasing practitioner's awareness of the relationship between S.I. syndrome and movements of the hip. It will also lend further understanding to the effects of a S.I. joint manipulation.

Research has shown that patients suffering with chronic sacroiliac syndrome have a higher degree of external hip rotation compared to internal hip rotation (Fairbank et al. 1984, Ellison et al.1990, Cibulka et al. 1998). Furthermore a S.I. joint manipulation has been shown to be an effect treatment for sacroiliac syndrome (Mosheni-Bandpei et al. 1998:185). However, no research has been conducted to observe what effect a S.I. manipulation has on this observed hip restriction. Therefore this research will attempt to establish what effect a manipulation will have on this hip restriction.

It is not possible at this stage to establish whether this reduction in the range of motion of the hip is as a result of the S.I. syndrome or is a causative factor in this syndrome. If the decreased internal rotation of the hip is not changed by the S.I. manipulation then the hip should be treated by practitioners as both a treatment and preventative measure when presented with S.I. syndrome. On the other hand if the hip restrictions are corrected by the manipulation this would lend further support for using manipulation in the case of S.I. syndrome.

Thus although the etiology of sacroiliac syndrome is likely to be multifactorial, by assessing the hip pre and post adjustment, this may assist chiropractors and other manual therapists in their management of this complex condition.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

The review of the related literature will describe:

2.2. The anatomy of the S.I. joint

2.2.1 Ligamentous anatomy

2.2.2. Muscles of the sacroiliac joint

2.2.3. Innervation of the sacroiliac joint

2.2.4. Biomechanics of the sacroiliac joint

2.2.5. Functions of the sacroiliac joint

2.3. The incidence and prevalence of low back

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2.5. The definition of S.I. syndrome

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2.7. The anatomy of the hip

2.7.1. Muscles of the hip

2.7.2. Innervation of the hip

2.7.3. Movements of the hip

2.7.4. Clinical presentation of hip pathology

2.7.5. Summary linking the commonalties between S.I. joint and the hip joint.

2.8. Research linking restrictions in hip range of motion in relation to low back pain and S.I. syndrome,

2.9. The treatment of S.I. syndrome

2.10. Manipulation for low back pain and S.I. syndrome

2.11. Summary of literature review and hypothesized effect of manipulation on hip restrictions

2.2 Anatomy of the Sacroiliac Joint

The S.I. joint is a true synovial (diarthrodial) joint in that it has a joint cavity containing synovial fluid, and adjacent bones are connected by ligamentous structures. It also has an outer fibrous joint capsule with an inner synovial lining, and cartilaginous surfaces allowing motion (Bernard and Cassidy 1991:2109 and Moore and Dalley, 1999:340).

Moore and Dalley (1999:340) state the following about the anatomy of the S.I. joints:

- The S.I. articulations are between the articular surfaces (alae) of the sacrum and ilium.
- These surfaces have irregular elevations and depressions, which result in the partial interlocking of the bones.
- The strong articular capsule is attached close to the articulating surfaces of the sacrum and ilium.
- The sacrum is suspended between the iliac bones, and the bones are firmly held together by the posterior and interosseous S.I. ligaments. These are the strongest ligaments in the body.

The stability of these joints is maintained by this significant complex of ligaments that are thicker posteriorly and function like the various cables of a suspension bridge (Daum 1995:476).

2.2.1. Ligamentous Anatomy

Moore (1992:251), Moore and Dalley (1999:340 and 550) and Harrison, Harrison and Troyanovich (1997:609) describe the ligaments and accessory ligaments of the S.I. joint as the following:

1. The anterior S.I. ligament is an anterior inferior thickening of the joint capsule. It covers the abdominopelvic surface of this articulation. This ligament opposes translation of the sacrum up or down and separation of the joint surfaces. This ligament thus also resists forward movement of the sacral promontory (i.e. anterior to posterior and posterior to anterior motion).

2. The interosseous S.I. ligaments are massive, very strong ligaments that unite the iliac and sacral tuberosities. They fill the irregular spaces posterior and superior to the joint, are the largest syndesmosis in the body and the strongest connection in this region. These ligaments strongly resist joint separation and translations along the y and z axes (vertical and anteroposterior movements).

3. The posterior S.I. ligaments cover the interosseous ligaments and together they make up the posterior two thirds of the S.I. connections. These ligaments are composed of:

    (a) strong, short transverse fibers joining the ilium and the first and second tubercles of the lateral crest of the sacrum and

    (b) long, vertical fibers uniting the third and fourth transverse tubercles of the sacrum to the posterior iliac spines.

The sacrotuberous, iliolumbar, sacrospinous and pubis symphysis ligaments are accessory ligaments of the S.I. joints:

1. The sacrotuberous ligament fibres pass from the anterolateral border of the sacrum and run inferolaterally to attach to the ischial tuberosity. It functions to oppose sacral rotation around the x-axis (flexion).

2. The iliolumbar ligament is a strong triangular ligament that runs from the transverse processes of L4 and L5 to the iliac crest posteriorly. It is important because it limits rotation and anterior gliding of L5 vertebra on

the sacrum. It functions to limit all motions between the distal lumbar spine and sacrum.

3. The sacrospinous ligament is a thin triangular ligament that extends from the lateral margin of the sacrum and coccyx to the ischial spine. It also functions to counteract a rotation around the x and y -axes.

4. The pubic symphsis is composed of three ligaments: the superior pubic, arcuate pubic and interpubic. It resists shear stresses, y-axis rotation of the sacrum and joint separations.

Willard (1995:340) explains that this complicated ligamentous structure plays a key role in the self-bracing mechanism of the pelvis, a mechanism that maintains the integrity of the low back and pelvis during transfer of energy from the spine to the lower extremities.

2.2.2. Muscles of the Sacroiliac joint.

Harrison et al. (1997:610) are of the opinion that there is not one single muscle group or muscle that crosses the S.I. joint and acts as a primary mover of this articulation.

Walker (1992:904) also states that the S.I. joint is not crossed by any muscles however she states that all the adjacent muscles – i.e.:

- Quadratus Lumborum,
- Erector Spinae,
- Gluteus Maximus,
- Gluteus Minimus,
- Piriformis,
- Iliacus muscle
- and even the Latissimus Dorsi muscle

have fibrous expansions that blend with the anterior and posterior S.I. joint ligaments.

Heller (2003:46) claims that the piriformis muscle is the only muscle that crosses the S.I. joint and therefore acts on this joint.

The piriformis together with the other musculature stated above contribute to the strength of the joint capsule and ligaments and thus to the joint's stability (Moore and Dalley, 1999:550-551 and Walker, 1992:904), as fibrous / muscular extensions of the anterior and posterior S.I. ligaments. Harrison et al. (1997:610) claim that the ligaments and fascia as described above are the primary attachment sites for the main movers and stabilizers of the spine and lower extremity. The muscles through their attachment to the ligaments create a self-bracing mechanism that is necessary for the stability of the S.I. joints. The muscle's resting and active contraction causes compression of the S.I. joint surfaces. Harrison et al. (1997) go further to state that the major muscles and fascia that are involved include the:

- Gluteus Maximus and Medius,
- Lattismus Dorsi,
- Multifidus,
- Biceps Femoris,
- Psoas,
- Piriformis,
- Obliquus and Transversus Abdominis and
- the Thoracolumbar Fascia.

Bernard and Cassidy (1991:216) state that although displaying "no direct influence", muscles do indeed play an important role in S.I. joint motion. Walker (1992:304) concludes that the muscle activity is likely to increase any symptoms arising from S.I. joint pathology.

2.2.3. Innervation of the Sacroiliac Joint.

According to (Moore 1992:252) the articular branches to the S.I. joints are derived from the superior gluteal nerves, the sacral plexus: the dorsal rami of S1 and S2 nerves. The S.I. joint has extensive sensory innervation (Daum 1995: 476). Hilton's law states that a joint may receive innervation from any nerve that crosses it and therefore the S.I. joint may be innervated from as cephalad as L2 to as caudad as L3 or L4 (Bernard and Cassidy 1991:2111). Therefore it would appear from the above two references that the S.I. joint is innervated from L2 to S2. Furthermore Bernard and Cassidy (1991) feel that this extensive innervation explains the multiple manifestations of S.I. pain, including groin and / or leg pain. Willard (1995) states that the ligaments and muscles surrounding the S.I. articulation are richly innervated and this explains why this area is capable of producing pain.

2.2.4. Biomechanics of the Sacroiliac Joint.

Walker (1992:911-913) concluded that there is no single, simple axis for S.I. joint motion; rather it occurs as a coupling in 6 degrees of freedom. Furthermore after a review of 96 articles her conclusion was that motions are very small, "a few degrees (of rotation) or millimeters (of translation) at best".

In a review of biomedical literature of 14 articles which looked at motions occurring at the S.I. joints, Harrison et al. (1997:615) concurred with Walker (1992:911-913), concluding that S.I. joint motion is a simultaneous combination of rotation and translation and does not occur around a simple axis. Furthermore these motions are small, not exceeding 2-3mm or 1-2mm.

Sturesson (1997:174) described roentgen stereophotogrammetric analysis (RSA) as having "taken the role as the gold standard in determining mobility in orthopaedic research concerning growth, small movements in joints, and micromotion of arthroplasties." RSA is a computerised system for the exact radiographic localisation of landmarks in the human body (Sturesson 1997:174). He (Sturesson 1997:174) used RSA in a study on twenty-five patients, with S.I. joint disorders, to demonstrate mobility in the S.I. joints.

The RSA results revealed the following (Sturesson 1997:174) and concurred with Harrison et al. (1997:615) and Walker (1992:911-913), in that:

a) S.I. joint motions were very small, with average rotations of 2.5° and translation of 0.7mm.
b) S.I. joint mobility in men was on average 30-40% less than in women.
c) Small differences occurred between patients unilateral and patients with bilateral pain.

In a study by Smidt et al. (1997:2073-2081) they placed fresh cadavers in different hip positions and obtained S.I. motion measurements. Radiopaque markers were placed in the sacrum and each innominate bone of five fresh cadavers and computer tomography scans were taken. Smidt et al. (1997) found that the largest amount of S.I. motion occurred in the sagittal plane (7° on left and 8° on the right with a range of 3° to 17°). Also definite trends in the direction of angular S.I. motion occurred with respect to the hip joint positions. The translation or linear motion of the posterior superior iliac spines with respect to the sacrum ranged from 4 to 8mm. Due to the fact that considerable angular and linear motion was found in this study they (Smidt et al.1997:2073-2081) concluded, " it appears that extreme hip positions are necessary to elucidate full range of motion at the S.I. joint. The magnitude and direction of demonstrated S.I. motion appears to be sufficient to complement hip joint motion and influence hip joint motion and influence motion at the lumbosacral junction and, thus, low back pain in both the direct and indirect sense."

2.2.5. Functions of the Sacroiliac Joint.

According to Porterfield and De Rosa (1991:553) the hub of weight bearing in the human body for both static and dynamic activities is the lumbopelvic region. It is a key region of extraordinary stability due to the fact that the trunk and ground forces converge in this region. Furthermore the two S.I. joints form an integral part of this lumbopelvic unit (Porterfield and De Rosa,1991:553).

Mior, Ro and Lawrence (1999:221) state that the S.I. joint's position as a link in the kinetic chain between the spine and the legs, makes it fundamental that it has stability, mobility and able to withstand the considerable forces acting on it.

Norkin and Levangie (1992:157-8) describe the functions of the S.I. joint as follows:

- Stability of the S.I. joint is very important because it supports a large portion of the body weight.
- In normal posture the weight of the body is transmitted through the fifth lumbar vertebra and lumbosacral disc to the first sacral segment.
- This force tends to separate the sacrum from the ilia and tends to force the first sacral segment into flexion.
- The S.I. ligaments form the main bond that keeps the ilia and sacrum in close approximation.

- Tension that develops in the sacrotuberous, sacrospinous, and anterior S.I. ligaments counteract this downward and forward movement of the sacrum.
- The S.I. joints and symphysis pubis are closely linked functionally to the hip and intervertebral joints and therefore affect and are affected by movements of the trunk and lower extremities.

The S.I. joint's specific location makes it susceptible to large downward shear loads ranging from 300 to 1750 N during daily activities (Miller, Schultz and Anderson, 1987:92).

2.3. The Incidence and Prevalence of Low Back Pain.

According to Mosheni-Bandepi et al. (1998:185) low back pain (LBP} is one of the most common causes of disability and working days lost in industrialized countries. Furthermore they (Mosheni-Bandepi et al., 1998:185) state that epidemiological studies indicate a lifetime prevalence of LBP ranging from 60 to 80% with an annual incidence of approximately 30%. In support of these findings Manga et al. (1993:221) say that LBP afflicts at least 80% of the population at some time during their lives and estimates that people actually suffering with LBP at any one time ranges from 5 to 30%.

Likewise figures in Southern Africa seem to show similar trends. In a study by Worku (2000) the incidence of LBP was analysed in a random sample of 4001 mothers in the Maseru district in Lesotho. At the time of data collection a total of 405 (10.12%) had severe LBP, 513 (12.82%) had moderate LBP and 1422 (35.54%) had mild back pain. Further studies (Docrat, 1999 and van der Meulen, 1997) in South Africa have shown that that the lifetime incidence of low back pain is 78.2% in Indians and 76.8% in Coloureds, and the prevalence was 45% and 32.6% respectively (Docrat, 1999). Van der Meulen (1997) found that in the formal black settlement of Chesterville the prevalence of low back pain was 53.1%, while the lifetime incidence was 57.6%. No epidemiological study was found that investigated the incidence or prevalence of low back pain in the white or Caucasian population in South Africa however these figures could also be assumed to be as found in other industrialised countries i.e. prevalence of approximately 80% and incidence of approximately 5 to 30% (McGregor et al. 1998; Manga et al.1993; Mosheni-Bandepei et al.1998; Foster 1998).

2.4. The Incidence and Prevalence of S.I. syndrome in Low Back Pain.

The S.I. joint is a common cause of low back pain but is frequently overlooked (Cibulka and Koldehoff, 1999; Frymoyer et al. 1991:2114). Daum (1995:475) supports this claim stating that the S.I. joint is underappreciated in generating pain in the low back, pelvis and proximal lower extremities. Based on individual clinical experience, Daum (1995) found that as many as 40% of patients who presented with back complaints included S.I. joint disease.

A retrospective review by Bernard and Kirkaldy - Willis (1987) showed that the S.I. joint was the primary source of low back pain in 22.5% of 1293 patients presenting with back pain.

In a cross-sectional analytical study by Schwarzer, April and Bogduk (1995:31-37) they found that the S.I. joint is a significant source of pain in patients with chronic low back pain (13 out of 43 patients with a p value of 0.004). The S.I. joint was considered to be the source of pain if the patients showed a 75% reduction in pain after the intra-articular administration of 2% lignocaine (diagnostic block). Only patients with unilateral pain were considered for this analysis and the side of referred pain had to coincide with the side of injection. With 30% of patients obtaining gratifying relief of their pain they state that the S.I. joint warrants further study.

In a study by Gemmel and Jacobson (1990:63-66) they investigated the incidence of low back pain and S.I. joint dysfunction in a sample of 83 physically fit college students in the United States. In this blinded study it was found that 26.5% indicated a history of low back pain and 19.3% demonstrated S.I. joint dysfunction either unilaterally or bilaterally. Also within the group indicating low back pain, 27.3% were diagnosed as having S.I. joint dysfunction. Furthermore in a study by Delitto, Cibulka, Erhard et al. (1993:216-222), which investigated 39 patients with low back syndrome, it was found that 24 patients (61.5%) displayed S.I. joint regional pain using a cluster of four S.I. tests.

In a study by Toussaint et al. (1999:134) on 480 construction workers they found a prevalence of 29% for S.I. dysfunction. Toussaint et al. (1999) also state that in the medical literature the prevalence of S.I. dysfunction is between 19.3% to 47.9%. However, this study did not demonstrate any statistical association between low back pain and S.I. dysfunction.

Based on the above studies it would seem likely that S.I. syndrome is the source of low back pain in about 22 - 60% of cases. No studies are available to indicate what the prevalence of S.I. syndrome is within the South Africa population. But with such a high prevalence of low back pain in Southern Africa (Worku 2000, van der Meulen 1997, Docrat 1999), it would seem likely that S.I. syndrome contributes significantly to this problem. Hence further research is needed into all aspects of this condition.

2.5. Definition of sacroiliac syndrome.

S.I. syndrome is defined as pain over the S.I. joint in the region of the posterior superior iliac spine, which may be accompanied by referred pain over the buttock, greater trochanter, groin, posterior thigh, knee, and occasionally to the postero-lateral calf, ankle and foot (Kirkaldy-Willis 1992:123).

S.I. syndrome is often referred to as S.I. dysfunction, which Hendler et al. (1995:171) describes as a subluxation, which occurs when the ilium “slips” on the sacrum. Hendler et al. (1995) state that an irregular prominence of one articular surface becomes wedged upon the prominence of an opposed articular surface. Also the ligaments become taut, there is reflex muscle spasm and the pain is intense, severe and continuous.

Dreyfuss et al. (1994:1138) goes further to say that S.I. dysfunction is a state of relative hypomobility within a portion of the joint's range of motion with subsequent altered structural (positional) relationships between the sacrum and ilium.

2.6. Diagnosis of sacroiliac syndrome.

The lack of a "gold standard" or a pathognomonic sign makes the diagnosis of S.I. syndrome difficult (Cibulka and Koldehoff 1999:83 and Dreyfuss et al. 1994:1138). Imaging studies such as plain radiography, computed tomography (CT) and magnetic resonance imaging (MRI) do not demonstrate pain, and no feature evident on these studies has been shown to correlate with pain from the S.I. joint (Schwarzer et al. 1995:31).

For the above reason the diagnosis of S.I. syndrome has traditionally been based on a quality history and manual examination (Dreyfuss et al. 1994:1138).

2.6.1 History

Most often the history will reveal that patients have pain or tenderness directly over the posterior S.I. joint. In addition, some discomfort usually radiates into the buttock as well as diffusely into the posterior proximal thigh region (Kirkaldy-Willis 1992:123 and Daum 1995:476). Schwarzer et al. (1995:35) found buttock pain, thigh pain, calf pain and foot pain in patients with S.I. joint dysfunction. Dreyfuss et al. (1996) found diverse pain patterns and went on, to state that the only distinguishing feature was a lack of pain above the L5 level.

Bernard and Cassidy (1991:2107) feel that the typical patient is a middle-aged woman with no history of specific inciting trauma. Also Bernard and Cassidy (1991) indicate that there are rarely associated neurological symptoms of weakness, paraesthesias or dysaethesias. Harrison et al. (1997:614) agree with Bernard and Cassidy (1991: 2107), in that they have found, that most patients with S.I. syndrome seem to present with spastic or hyperactive muscles which leads to increased pain and inflammation.

Daum (1995:477) indicates that the symptoms of S.I. dysfunction are generally exacerbated by the activities of daily living that may load the pelvis asymmetrically (for example stair climbing or bicycle riding). Daum (1995) indicates that when sitting symptomatic patients frequently favor the uninvolved side. Hendler et al. (1995:171) claims that bearing weight or lying on the affected side often increases pain and external rotation of the hip sometimes reproduces the pain. In addition to this Hendler et al. (1995) state that the presentation is rarely acute and mostly subacute or chronic.

To summarise the typical S.I. patient will present as follows (Kirkaldy-Willis 1992, Schwarzer et al. 1995, Daum 1995, Hendler et al. 1995, Bernard and Cassidy 1991, Dreyfuss et al. 1996, Harrison et al. 1997):

- Pain directly over the posterior S.I. joint.
- Referral of pain to the buttock, anterior groin, back of the thigh to the knee and occasionally to the calf and foot.
- No pain above L5.
- No neurological signs.
- Middle-aged woman.
- Often no history of significant trauma.
- Pain exacerbated by daily activities such as stair-climbing, bicycle riding and sitting or lying on affected side.
- Sub-acute or chronic.
- Spastic or hyperactive muscles in region of S.I. joint.

2.6.2. Examination

In a study to establish whether the S.I. joint is a source of low back pain, Schwarzer et al. (1995:36) used S.I. joint blocks on 43 patients. It was found that no conventional clinical features were predictive of S.I. joint pain except that "groin pain was strongly associated although not absolutely". They (Schwarzer et al., 1995:36) do state that diagnostic blocks could be used as a "criterion standard" to detect painful S.I. joints, however it would be difficult to use these in a clinical setting.

Walker (1992:71-84) did a literature review of S.I. joint dysfunction tests performed by manual therapists and described two types:

- Palpation of bony landmarks and
- Pain provocation tests.

She concluded that only pain provocation tests seem to demonstrate reliability and suggested that tests that claim to isolate motion of the S.I. joint should be viewed with "extreme caution". She claims that the minimal range of motion present in most of the population casts doubt on whether therapists can detect 1° to 3° or 1 to 3 mm of motion occurring specifically at the S.I. joint (Walker, 1992:81).

This is supported by another literature review by Harrison et al. (1997:607-617) that concluded that motion palpation of the S.I. joints is insufficient in the diagnosis of dysfunctions in this region. Potter and Rothstein (1985) used therapists experienced in orthopaedic manual therapy and S.I. joint examination to examine 13 common S.I. tests on 17 patients. They found that agreement was below 70% in 11 tests that used palpation, this led to these tests being classified as unreliable. Further support is added to these views by a study done by Dreyfuss et al. (1994:1138) who investigated the standing flexion, seated flexion and Gillet tests in 101 asymptomatic subjects. This study found that 20% of these asymptomatic individuals had positive findings in one or more of these tests. They (Dreyfuss et al., 1994:1138) concluded therefore that clinicians should not rely on them solely to diagnose S.I. dysfunction.

Potter and Rothstein (1985:1671-5) have reported that individual tests for the S.I. joint generally yield poor inter-tester reliability. Therefore, Cibulka and Koldehoff (1999:83) in a study on 219 subjects concluded that a cluster of S.I. tests could be "clinically useful method" in identifying S.I. joint dysfunction in patients with low back pain. In this study S.I. joint dysfunction was considered present if at least 3 of 4 commonly used S.I. joint tests were positive. Cibulka and Koldehoff (1999) results indicated a finding of 0.82 for sensitivity and 0.88 for specificity of the cluster of tests. To obtain some measure of reliability, Dellito et al. (1995:475-85) also used a battery of four tests to diagnose S.I. joint dysfunction. Dreyfuss et al. (1994:1142) state that the greater number of physical examination tests that implicate the S.I. joint as symptomatic, the greater the likelihood that the conclusion is valid.

Four common pain provocation tests used to diagnose S.I. syndrome (Moodley 2002, Bekker-Smith 2002 and Marzalek 2002) are:

- ❖ Patrick Faber test (Kirkaldy-Willis, 1992:123-124),
- ❖ Gaenslen"s test (Kirkaldy-Willis, 1992:123-124),
- ❖ Yeoman's test (Kirkaldy-Willis, 1992:123-124) and
- ❖ The posterior shear test (Laslett and Williams, 1994).

These tests were also used in this study to diagnose S.I. syndrome and they will therefore be discussed here.

1) Posterior shear (POSH) or "thigh thrust test"

The patient is positioned supine. The examiner is positioned on the opposite side to the suspected S.I. syndrome. The opposite hip and knee is flexed and slightly adducted. The examiner places a hand under the S.I. joint while exerting a posterior shearing force downward on the adducted knee through the femur. The examiner also feels for motion at the S.I. joint. A positive test is recorded if this position elicits pain over the suspected S.I. joint (Laslett and Williams, 1994:1244). Lewitt and Rosina (1999:155) explain further that for a "technically accurate performance" the examiner

(a) has to turn the bent knee towards themselves only to the point where the PSIS just starts to rise above the table, and

(b) to exert very slight pressure on the patient's knee exactly in the direction of the thigh to take up the slack.

Only then should springing be carried out in the direction of the bent thigh.

2) Gaenslen's test

The patient is positioned supine. The examiner flexes the patient's left knee and hip, while pressing downward over the right thigh to hyperextend the right hip. A positive test is recorded if this position elicits pain over the right S.I. joint (Kirkaldy-Willis, 1992:125). For further accuracy the extended thigh can be dropped over the edge of the examining table (Daum, 1995:477).

Laslett and Williams (1994:1247) studied the inter-examiner reliability of Gaenslen's and the POSH test on 51 patients and found an agreement of 88.2% and 94.1% respectively. Laslett and Williams (1994) concluded that pain provocation tests have substantial inter- therapist reliability. Hendler et al. (1995:171) states that Gaenslen's test is frequently positive in the clinical presentation of S.I. joint disease.

3) Patrick Faber test

The patient is positioned supine. The right leg is flexed, abducted, externally rotated and the right ankle is placed above the knee on the left thigh. The examiner places his right hand over the patient's left iliac crest (ASIS), while the left hand pushes downward on the medial aspect of the right knee. A positive test is recorded if this pressure elicits pain over the area of the right S.I. joint (Kirkaldy-Willis, 1992:125).

Broadhurst and Bond (1998:341-345) performed a double-blinded clinical trial to evaluate the sensitivity and specificity of Patrick Faber test, the POSH test and the Resisted Abduction test (not described here) following a S.I. joint block against a criterion of 70-100%. They found that Patrick Faber test had a sensitivity of 77%, the POSH test had a sensitivity of 80% and they both had a specificity of 100%. Broadhurst and Bond (1998) therefore concluded that these tests were reliable enough to be used in a clinical setting and that, in their opinion, the use of other pain provocation tests in conjunction with these would "add to the physicians diagnostic capabilities".

4. Yeoman's (Erickson's) test.

The patient is placed prone and the examiner places one hand under the thigh above the knee on the suspected side and extends the hip. With the other hand the examiner presses downward over the crest of the ilium on the same side. A positive test elicits pain in the S.I. joint to which pressure is applied (Kirkaldy-Willis, 1992:125). Kirkaldy –Willis and Burton (1992) feel that this is the most specific and reliable test.

Van der Wurff, Hagmeijer and Meyne (2000:30-36) performed a methodological review concerning the reliability of eleven clinical tests of the S.I. joint. The authors concluded that there was no evidence to support the use of mobility tests for the diagnosis of S.I. syndrome, but accepted the reliability of both

Gaenslen’s and Erickson's (Yeoman’s) tests to demonstrate provocation of S.I. joint pain.

2.7. Anatomy of the hip

The hip joint is the articulation between the head of the femur and the acetabulum of the pelvis (Palastanga et al. 1998:404).

The acetabulum is formed by the union of the three bones of the pelvis:

- The pubis forms one fifth of the acetabulum,
- The ischium two fifths, and
- The ilium the remainder

(Norkin and Levangie 1992:303). The close anatomic relationship between the hip and S.I. joint sharing one bone creates a likely kinesiologic dependence that is still not completely understood (Cibulka 1999:600).

It is a synovial ball and socket joint, and permits a wide range of movements compatible with a wide range of locomotor activities (Palastanga et al. 1998:404). The articular surfaces are made more congruent by the triangular fibrocartilage in the acetabulum (Reid 1992:601-602). Palastanga et al. (1998) describes the capsule as strong, dense and it is attached to the margins of the acetabulum, and it thickens around the neck of the femur by encircling fibers that form a collar called the zona orbicularis. A ring of wedge-shaped fibrocartilage called the acetabular labrum (Norkin and Levangie 1992:304) rims the entire periphery of the acetabulum. This acetabular labrum deepens the socket, increases the concavity of the acetabulum through its triangular shape and grasps the head of the femur to maintain contact with the acetabulum (Norkin and Levangie 1992:304).

Palastanga (1998:404) explains that the hip joint connects the lower limb to the trunk and is involved in the transmission of weight and must therefore possess great strength and stability, even at the expense of limitation of range of movement.
According to Palastanga (1998:404) the stability of the joint is determined by:

- The shape of the articular surfaces,
- The strength of the joint capsule and associated ligaments, and
- The insertion of muscles crossing the joint.

Moore (1992:474) also agrees that the range of movement of the hip joint is decreased somewhat to provide stability and strength.

2.7.1. Muscles of the hip

The following muscles all surround, attach to and produce movement at the hip joint (Moore 1992:476; Moore and Dalley 1999:612; Reid 1992:606):

- Iliopsoas – Iliacus and psoas major,
- Tensor fasciae latae,
- Rectus femoris,
- Pectineus,
- Sartorius,
- Adductor muscles – adductor magnus, longus and brevis,
- Gluteus maximus, Gluteus medius, Gluteus mimimus,
- Hamstring - semitendinosus, semimembranosus, biceps femoris,
- Piriformis,
- Obturator externus and obturator internus and
- Gracilis

As described earlier the hip joint and S.I. joint therefore have the following muscles in common:

- ✓ Gluteus maximus, gluteus minimus, gluteus medius,
- ✓ Piriformis,
- ✓ Iliopsoas – psoas and iliacus,
- ✓ Biceps femoris.

According to Porterfield and De Rosa (1991:558) in a closed kinetic chain the hip muscles exert forces on the pelvis, due to the fact that the femoral attachment of these muscles becomes the fixed point of origin while the pelvic bones become the moveable insertion. Decreases in the length or strength of these muscles, caused by adaptive shortening and / or afferent / efferent neuromusculature imbalances, can thus alter normal pelvic biomechanics (Porterfield and De Rosa 1991).

2.7.2. Innervation of the hip

The nerve supply to the hip is from the lumbar plexus by twigs from the femoral and obturator nerves, and from the sacral plexus from the superior gluteal nerve and the nerve to the quadratus femoris muscle, with a root value of L2 to S1 (Palastanga et al. 1998:414). Palastanga et al. (1998) also say that this is a typical example of articular innervation, in that the nerve supply to the joint is derived from the same nerves that supply the musculature crossing the joint. The innervation to the hip joint (L2 to S1) is thus very similar to the innervation of the S.I. joint (L2 to S2) [Moore and Dalley 1999: 613].

2.7.3. Movements of the hip

Moore (1992) and Moore and Dalley (1999:613) describes the movements of the hip as follows:

- Flexion and extension,
- Abduction and adduction,
- Internal rotation and external rotation and
- Circumduction.

Due to the fact that this study is investigating the effect of a S.I. manipulation on hip rotation, the movements of internal and external rotation will be more closely inspected and elaborated on.

The normal values for internal and external hip rotation ROM vary among different reports (Ellison et al. 1990:537). Reid (1992:609) states that in the hip there is approximately 45 degrees of both internal and external rotation with the thigh in either flexion or extension. This agrees with Roach and Miles (1991:657) who reviewed 7 sources and found that there was good agreement with respect to hip internal and external rotation (being about 45 degrees). However Roach and Miles (1991) did note that these sources did not indicate if this value represented active range of motion or passive range of motion.

Cibulka et al. (1998:1009) explain that despite differences (active or passive range of motion) in internal and external hip rotation range of motion symmetry usually exists between the left and right sides. Palastanga et al. (1998:420) and Reid (1992) both feel that external rotation is normally the more powerful movement when compared to internal rotation.

External rotation:

Six short muscles have external rotation as their primary function (Norkin and Levangie 1992:322) these are:

- Obturator internus and externus,
- The gemellus superior and inferior,
- Quadratus femoris and
- The piriformis muscle

Other muscles that may assist external rotation in certain positions are the posterior fibres of the gluteus medius and minimus and superior fibers of the gluteus maximus (Norkin and Levangie 1992:322, Moore 1992:476, Reid 1992:610).

The obturator internus and externus, the gemellus superior and inferior and quadratus femoris all originate in the region of the ischial spine and obturator foramen and insert in the vicinity of the greater trochanter of the femur. These muscles do not have a close anatomical arrangement to the S.I. joints or its ligaments (Moore and Dalley 1999) but it is interesting to note that their innervation is from L3 to S1, which is very similar to the innervation of the S.I. joint (Reid 1992:610).

DeFranca (1996:38) describes the muscles causing external rotation as numerous and powerful and that the most important of these is the piriformis muscle. The piriformis muscle attaches from the anterior surface of the sacrum and sacrotuberous ligament to the superior border of the greater trochanter of the femur (Moore 1992:417). Also, as explained before it has been described as the only muscle that crosses and acts on the S.I. joint (Heller 2003:46) and yet also has a function in the movement of the hip joint (Norkin and Levangie 1992:322). Therefore this muscle has an effect on both the hip and S.I. joint.

Kesson and Atkins (1998:285), Moore and Dalley (1999:551) and Palastanga et al. (1998:314) describe the attachments and innervation of the gluteal muscles as in the table below:

Muscles	Proximal attachment	Distal attachment	Innervation
Gluteus Maximus	External surface of the ala of ilium, including iliac crest, dorsal surface of sacrum and coccyx. Also to the sacropinous and sacrotuberous ligaments.	Most superficial fibres end in the iliotibial tract. The deeper fibres form a broad aponeurosis that attaches to the gluteal tuberosity of the femur.	Inferior gluteal nerve. L5-S2
Gluteus Medius	External surface of ilium between the posterior and anterior gluteal lines.	Lateral surface of greater trochanter of femur.	Superior gluteal nerve. L5-S1
Gluteus Minimus	External surface of ilium between the anterior and posterior gluteal lines.	Anterosuperior aspect of greater trochanter of femur.	Superior gluteal nerve. L5-S1

Thus the gluteus maximus, medius and minimus muscles all attach proximally in the region of the S.I. joint and blend with the ligaments of the S.I. joint and attach distally across the hip joint. As described earlier with S.I. syndrome the ligaments become taut and there is reflex muscle spasm (Hendler et al. 1995:171). It has been reported that shortening of the piriformis muscle can produce excessive external rotation and restrict internal rotation, which may produce S.I. joint problems (Woerman, 1989).

If the above statement can be applied to the gluteal muscles as well as the piriformis muscle then one could hypothesize that if the above muscles (piriformis, gluteus maximus, medius and minimus) are in spasm this would cause increased external rotation of the hip.

Internal rotation:

There are no muscles with the primary function of producing internal rotation of the hip joint (Norkin and Levangie 1992:323). The main muscles that are seen to be responsible for internal rotation (Reid 1992:610; Moore 1992:476) are the:

- anterior fibers of the gluteus medius and gluteus minimus and
- The tensor fascia lata

Again it can be seen that the gluteus medius and minimus attach in the region of the S.I. joint and across the hip joint therefore in the case of S.I. syndrome it is again hypothesized that these muscles could have an effect on hip internal rotation.

Furthermore, Palastanga et al. (1998:420) states that internal rotation is limited by tension in the external rotator muscles.

2.7.4. Clinical Presentation

2.7.4.1. History

According to Reid (1992:614) hip pain: is felt mainly in the groin and anteromedial thigh. Hertling and Kessler (1990) also say that pain arising in the hip joint itself is often felt in front, or in the groin, it radiates to the thigh and knee, which sometimes are the only painful sites. The pain is typically however, described as deep and it frequently refers to the knee but rarely past it (Reid, 1992:614).

To complement this, DeFranca (1996:95) describes the common presentation of hip joint problems as follows:

- Late middle aged or older individual suffering from chronic hip or groin pain of gradual onset.
- Acute exacerbations typically occur after prolonged sitting postures.
- Pain can progress into a dull ache that radiates from groin into anterior thigh.
- A patient who does unaccustomed activities e.g. long walks, gardening can easily trigger pain and stiffness in the hip joint.
- Walking and stair climbing may be difficult. The person may lean or lurch over the involved side to reduce pain.
- Mid and lower lumbar levels and the S.I. joint can refer pain to the hip joint. Therefore hip joint pain necessitates investigation of the lumbar spine, S.I. joints as well as the hip joint.

2.7.4.2. Examination

A hip regional examination usually involves the following physical examination (Hertling and Kessler 1990:282-288, Reid 1992:614-626):

1. **Standing**

    a) Observation eg. gait, posture alignment, muscle wasting.
    b) Examination: Trendelenburg's test, forward flexion to touch toes, ability to squat and duck waddle.

2. **Sitting**

a) Examination: Tripod test, ability to cross leg over opposite thigh, hip flexor and knee extensor strength, reflexes, sensory testing.

3. Supine

a) Examination: active, passive and resisted isometric testing of the following ranges of motion: flexion, abduction, adduction, internal and external rotation.
b) Special tests: Joint play and motions, quadrant tests e.g. quadrant scouring, hip compression test (Keesson and Atkins, 1998), straight leg raising, Thomas test, Rectus Femoris test, Patrick Faber test, leg length measurements, Noble's compression test and specific palpation of structures (Reid 1992:618-626).

4. Prone

a) Examination: active, passive and resisted testing of hip extension and hip internal and external rotation.
b) Special tests: Ely test of rectus femoris tightness.

5. Side Lying

a) Examination: active, passive and resisted hip abduction and adduction.
b) Special tests: Ober's test of iliotibial band tightness.

Thus from the above examination it can be stated that the S.I. joint and the hip joint have two similar orthopaedic tests (Reid 1992:619 and Keesson and Atkins 1998):

- ✓ Patrick Faber test and Hip compression test

The method of performing the Patrick Faber test is described under the section on examination of S.I. syndrome however this test also places maximum stress on the hip joint because it is flexed, abducted and externally rotated (Gerard and Kleinfield, 1993). Furthermore, adding downward pressure will exacerbate pain in the hip joint and a positive test would be pain within the hip joint, especially at the hip flexor attachment (Gerard and Kleinfield, 1993). Thus with this test, pain or loss of joint play at the hip indicates a hip lesion, as opposed to S.I. involvement, which is indicated by pain localised usually to the ipsilateral S.I. joint (Gatterman, 1990). However, pain in the groin can come from both hip and S.I. joint problems (DeFranca, 1996:205).

Keesson and Atkins (1998:295) describe the hip compression test as follows: The patient is supine and the hip is flexed, adducted and compressed along the shaft of the femur. Thus this test is very similar to the posterior shear test described under the examination of S.I. syndrome (Laslett and Williams 1994).

To distinguish between hip and S.I. pain with this test the following is noted:

- If there is restricted hip adduction and pain within the hip joint or groin then the hip joint is suspected (DeFranca, 1996:208).
- While if pain is experienced in the buttock, posterior thigh, or lateral thigh with the hip flexed more than 90° then it is usually from the S.I. joint (DeFranca 1996:208).
- However neither of these presentations are exclusive to pathology in the "other" joint.

2.7.4.3. Treatment of the hip

Treatment of the hip is determined by the specific condition that is being treated but will usually involve a combination of the following procedures (Reid 1992:627-661, De Franca 1996, Hertling and Kessler 1990:292-295, Kesson and Atkins 1998:296-310): Rest, ice, non-steroidal anti-inflammatory drugs, steroid injections muscle relaxants, physiotherapeutic modalities such as ultrasound, stretch techniques for tight muscles, cross frictions, trigger point therapy, mobilisation and manipulation of relevant joint dysfunctions.

Surgery should be considered in patients with severe degree of pain or disability or who fail to respond to conservative treatment. Total hip replacement is seen to be the treatment of choice in older patients (Hertling and Kessler, 1990:293-4).

2.7.5. Summary linking the commonalities between the S.I. joint and the hip.

<u>Based on the preceding cited references:</u>

	<u>Sacroiliac Joint</u>	**<u>Hip Joint</u>**
Anatomy:	Articulation between the sacrum and the ilium.	Articulation between the head of the femur and acetabulum of pelvis. Two-fifths of acetabulum made up of the ilium.
Muscles:	Gluteus maximus, gluteus minimus, gluteus medius, piriformis, iliopsoas, biceps femoris and iliacus in common.	Gluteus maximus, gluteus minimus, gluteus medius, piriformis, iliopsoas, biceps femoris and Iliacus in common.
Innervation:	L2 to S2	L2 to S1
Function:	The hub of weight bearing in the human body for both static and dynamic activities is the lumbopelvic region. It is a key region of extraordinary stability due to the fact that the trunk and ground forces	The hub of weight bearing in the human body for both static and dynamic activities is the lumbopelvic region. It is a key region of extraordinary stability due to the fact that the trunk and ground forces

	converge in this region. The two S.I. joints form an integral part of this lumbopelvic unit. The S.I. joint's position as a link in the kinetic chain between the spine and the legs, makes it fundamental that it has stability, mobility and able to withstand the considerable forces acting on it.	converge in this region. The two hip joints form an integral part of this lumbopelvic unit. Connects the lower limb to the trunk and is involved in the transmission of weight and must therefore possess great strength and stability, even at the expense of limitation of range of movement.
	Sacroiliac Joint	**Hip Joint**
Movement of hips: External rotation	Muscles in common: Piriformis, gluteus maximus, minimus and medius. Also innervation of above muscles L5 to S2. Other primary external rotators: obturator internus and externus, the gemellus superior and inferior, quadratus femoris have similar innervation L3 to S1 as S.I. joint L2 to S2.	Muscles in common: Piriformis, gluteus maximus, minimus and medius. Also innervation of above muscles L5 to S2. Other primary external rotators: obturator internus and externus, the gemellus superior and inferior, quadratus femoris have similar innervation L3 to S1 as S.I. joint L2 to S2.
Movement of hip: Internal rotation	Muscles in common: anterior fibers of gluteus medius and minimus. Limited by tension in the external rotator muscles.	Muscles in common: anterior fibers of gluteus medius and minimus. Limited by tension in the external rotator muscles.
S.I. joint Bio-Mechanics	Extreme hip positions are necessary to elucidate full range of motion at the S.I. joint. The magnitude and direction of S.I. motion appears to be sufficient to complement hip joint motion and influence hip joint motion.	Extreme hip positions are necessary to elucidate full range of motion at the S.I. joint. The magnitude and direction of S.I. motion appears to be sufficient to complement hip joint motion and influence hip joint motion.

	Sacroiliac Joint	**Hip Joint**
History	Middle aged woman Pain over posterior S.I. joint. Referred to buttock, anterior groin, back of thigh to knee and occasionally to calf and foot. Aggravated by daily activities such as stair climbing and sitting. May refer pain to the hip.	Middle aged or older patient. Pain over hip joint. Referred to groin and anterior thigh and frequently to the knee but rarely past it. Aggravated by sitting, stair climbing and unaccustomed activities such as long walks and gardening May be due to referral pain from mid and lower lumbar spine or the S.I. joint
Examination	Patrick Faber test Posterior oblique Shear test	Patrick Faber test Hip Compression test
Treatment	Rest, ice, non-steroidal anti-inflammatory drugs, steroid injections muscle relaxants, physiotherapeutic modalities such as ultrasound, stretch techniques for tight muscles, cross frictions, trigger point therapy, mobilisation and manipulation of relevant joint dysfunctions. Surgery should be considered in patients with severe degree of pain or disability or who fail to respond to conservative treatment.	Anti-inflammatory medication, ice, ultrasound, TENS and interferential current therapy, mobilisation, S.I. belt, analgesia, bed rest, education and S.I. joint injections. Inconsistent results with the use of surgery; it should only be used after all other therapeutic modalities have failed. Manipulation might be more effective than other interventions in the treatment of low back pain both in short and long term effects.

2.8. Research linking restrictions in hip range of motion in relation to low back pain and S.I. syndrome

Research has shown that there seems to be a correlation between low back pain, more specifically S.I. pain, and hip passive rotation.

In this respect Fairbank et al. (1984:461-464) found limited hip rotation (internal and external rotation bilaterally) in students with back pain more often than students without back pain. Mellin (1988:668-670) measured the mobility of the hips and lumbar spine in 301 men and 175 women who suffered with chronic back pain. Mellin (1988) found a significant ($p < 0.01$) correlation between limited hip internal rotation (active movement) and the degree of low back pain in men. Interestingly Mellin (1988) also found a significant correlation between limited hip flexion and extension with the degree of low back pain in the men and women groups.

Ellison et al. (1990:541) went on to compare a group of 100 healthy subjects to 50 patients with low back dysfunction. While (Ellison et al., 1990:541) they found much variation in hip rotation range of motion, they did find that a higher proportion of patients (48%) than healthy subjects (27%) demonstrated greater passive external hip rotation than internal hip rotation. They conclude that this imbalance of hip rotation in which internal rotation is less than external rotation, may predispose a person to back pain or may be a result of back pain, or both (Ellison et al.1990:541).

More specifically in a study by Cilbulka et al. (1998:1014) it was found in a group of 100 patients that those with low back pain without evidence of S.I. regional pain also had more external rotation (passive) than internal rotation (passive) bilaterally (approximately a 10° difference). However in those patients with lower back pain who were classified as having signs suggestive of S.I. regional pain they had significantly ($P < 0.05$) more external rotation than internal rotation (approximately a 20° difference) on the posterior innominate side (i.e. side of S.I. dysfunction). They concluded that clinicians should consider evaluating unilateral hip rotation range of motion in patients with low back pain and this may furthermore assist in diagnosing S.I. joint regional pain (Cilbulka et al., 1998:1014).

It was evident from this study that passive hip internal and external rotation measurements were taken by a blinded examiner, who was not responsible for the evaluation and diagnosis of patients for signs and symptoms suggestive of S.I. joint dysfunction. This procedural approach resulted in more accurate and reliable data being obtained however only hip passive rotation was measured and there was no comparison to active rotation. Due to the fact that active rotation can be seen as a more reliable guide of an individual's daily movements; it would have been more relevant to note if similar results were achieved with active hip rotation movements (Shaik, 2002).

In a case report by Cibulka (1992:917) in which he treated a patient with S.I. joint dysfunction, excessive right hip external rotation and limited right hip internal rotation. Cibulka (1992) found that by treating the S.I. joint and restoring symmetrical hip rotation, the patient no longer complained of low back pain. While this case report does suggest that asymmetrical hip rotation may contribute to the S.I. joint component of low back pain, this was a study in isolation and further studies such as clinical trials are necessary to confirm the relationship between the hip and the S.I. joint. Unfortunately no larger clinical trials were found in the literature to support these findings.

To explain the relationship between back pain and hip mobility Mellin (1988:669) suggested that the following factors might contribute:

1. Back pain may cause restriction of hip movements because of a decrease in general physical activity (Mellin 1988:669).

2. Back pain and spinal pathology, through neurological reflexes may cause spasm in muscles and changes in movement patterns of the spine, pelvis and hips (Mellin 1988:669).

3. The psoas muscle is regarded as having a stabilizing effect on the lumbar spine. Back pain may provoke spasm in this muscle with shortening and due to the fact that the psoas is a hip flexor, this may explain the strong correlation of hip extension with low back pain found in Mellin's study (1988:669).

4. Restrictions of hip mobility may put excessive load on the spine, as has been described for arthrosis of the hip (Offierski and Macnab 1983:321).

5. Hip stiffness may be etiologically associated with the development of low back trouble, which is indicated by the restrictions of hip joint mobility found in adolescents and young adults with a history of low back pain (Fairbank et al. 1984).

Finally Woerman (1989) and Porterfield and DeRosa (1991) have postulated that hip rotation asymmetry develops because of muscular imbalances between the hip rotator muscles. As described before it has been reported that shortening of the piriformis muscle can produce excessive external rotation and restrict internal rotation, which may produce S.I. joint problems (Woerman, 1989).

2.9. Treatment of sacroiliac syndrome

Allopathic treatment:

The allopathic treatment of mechanical low back pain relies on two basic elements: analgesia and education. It was found that there is limited evidence to support the use of muscle relaxants such as diazepam, cyclobenzapine, corisprodol and methacarbanol and was also stated that corticosteroid injections into the facet joints are ineffective for chronic low back pain (Hellman and Stone 2000:819).

Reid (1992:662) states that for S.I. "sprains" or sacroillitis treatment that involves anti-inflammatory medication, ice, ultrasound, TENS and interferential current therapy are helpful. He also explains that mobilisation of the joint should be considered and that sometimes a S.I. belt resolves all symptoms (Reid, 1992:662).

Twomey and Taylor (1995:615) indicate that bed rest and analgesics remain the treatment prescribed by most physicians for managing low back pain. This is despite the lack of evidence that prolonged bed rest or the avoidance of movement reduces back pain. Research (Deyo et al. 1986) shows that, apart from a brief period of rest immediately after the onset of acute pain, bed rest has no effect on the natural history of back pain. Furthermore well-designed exercise and movement programs should play an important role in the treatment of acute and chronic low back pain syndromes (Twomey and Taylor 1995).

Surgery and S.I. joint injection:

Daum (1995:478) reported that in the case of S.I. syndrome surgical fusion has been recommended however he indicates that there are inconsistent results with the use of surgery. Daum (1995) states that it should only be used after all other therapeutic modalities have failed. Cull and Will (1995:867) inidcated that surgery was required in less than 1% of patients with low back pain and Bernard (1992:154) recommends that S.I. joint injections are used to treat S.I. joint syndrome when exercise, joint mobilization or joint manipulation fails to break the cycle of pain.

Conservative treatment and Manipulation:

Van Toulder, Koes and Bouter (1997:2128) assessed the effectiveness of the most common conservative types of treatment for patients with acute and chronic non-specific low back pain. The authors above looked at 28 randomized controlled trials on acute low back pain and 20 on chronic low back pain that met a methodological standard and were considered to be of high quality. It was concluded that for acute low back pain strong evidence was found for the effectiveness of muscle relaxants and non-steroidal anti-inflammatory drugs and the ineffectiveness of exercise therapy. However, for chronic back pain, strong evidence was found for the effectiveness of manipulation, back schools and exercise therapy (Van Toulder, Koes and Bouter 1997:2128).

In a review of the literature from 1985-1997 (Mosheni-Bandepi 1998:187) found that, in the 25 trials that met their methodological criteria, 17 (68%) reported better results in favor of manipulation compared with the reference treatment. Of these 17 there were 12 (48%) that presented with a positive effect in favour of manipulation in all subjects. The reference treatments in these studies were mainly "physiotherapy" interventions: Short Wave Diathermy, Ultrasound, Exercise, Infra Red Radiation, Corset, Massage, non-steroidal anti-inflammatory drugs and placebo therapy. Mosheni-Bandepi (1998) therefore concluded that manipulation might be more effective than other interventions in the treatment of low back pain both in short and long term effects.

2.10 Manipulation for Low back Pain and Sacroiliac syndrome

The definition of manipulation given by Sandoz in Kikaldy-Willis and Burton (1992:283) is a follows:

> "It is a passive manual maneuver during which a synovial joint is carried suddenly beyond the normal physiological range of movement without exceeding the boundaries of anatomical integrity. The usual characteristic is a thrust or a brief, sudden, and carefully administered impulsion that is given at the end of the normal passive range of movement. It is usually accompanied by a cracking noise."

In a study by Manga et al. (1993:221-229) they reviewed 31 clinical trials, several case-control studies as well as meta-analysis and descriptive studies. It was found that in the "bulk" of the methodologically sound clinical studies that spinal manipulation applied by chiropractors is more effective than many alternative treatments for low back pain. There is no evidence that demonstrates or even implies that chiropractic spinal manipulation is unsafe in the treatment of low back pain. Furthermore, traditional medical therapies for low back pain have questionable efficacy, effectiveness and adequacy, sometimes resulting in severe iatrogenic complications for patients. In the authors opinion on the literature it is felt that "chiropractic manipulation is (at least) as safe and many times safer than medical management of low back pain" (Manga et al. 1993:221-229).

In a randomised controlled trial, Meade et al. (1990) and Meade et al. (1995) compared chiropractic and hospital outpatient treatment of mechanical low back pain. Meade et al. (1990,1995) assessed the long-term effectiveness, over a three-year period, of chiropractic and hospital outpatient management of low back pain. In the trial, 741 men and women between the ages of 18 and 64 were randomly allocated to hospital outpatient or chiropractic care. The results of the study left the authors to conclude that for patients with low back pain in whom manipulation is not contra-indicated, chiropractic treatment offers worthwhile, long-term benefits in comparison to hospital outpatient management (Meade et al. 1990,1995). In a literature review of randomised clinical trials on spinal manipulation between 1966-1990, Assendelft et al. (1992:492) concluded that chiropractic seems to be an effective treatment of back pain.

Cassidy and Mierau (1992) state that the treatment of choice for S.I. subluxation syndrome is specific manipulative therapy directed at the S.I. articulations. Also that prospective clinical studies reviewed by Cassidy and Mierau (1992) have shown a successful response in more than 90% of patients receiving daily manipulation over a 2 to 3 week period in the case of chronic disabling S.I. syndrome.

According to Kirkaldy-Willis and Burton (1992:248) that for S.I. syndrome a manipulation for 3 to 4 days often relieves pain and restores the joint movement. Kirkaldy-Willis and Burton (1992) also feel that this modality is "by far the most certain way of relieving the patient's pain". In a report recording the treatment of 100 patients with S.I. subluxation with manipulation (Xiadong and Yongang 1994:194), it was found that there was a cure rate of 100% and over 90% of the cases were cured after one treatment. Hendler et al. (1995:169) in a review article on the diagnosis and management of S.I. joint disease states that manipulation provides "dramatic relief" in cases of S.I. subluxation or syndrome. Also, in a clinical trial on 10 patients with chronic S.I. joint syndrome it was found that short-lever instrument (activator) adjusting may beneficially alter the natural course of chronic S.I. joint syndrome (Osterbauer et al.1993:86). In addition to this, this study found that patients experienced clearly significant relief from what had been chronic, almost continuous pain.

Herzog et al. (1991:104-109) compared the effects of spinal manipulative therapy (SMT) given by a chiropractor to back school therapy (BST) given by a physiotherapist, on gait symmetry on patients with S.I. joint pain. The results of the study showed that the BST was more effective in terms of subjective measurements. However what may have biased this result is the fact that subjects receiving BST underwent a longer treatment period, which may have influenced their subjective responses. Objective measurements showed that the SMT group had better results. They concluded that SMT was more effective than BST in restoring normal gait symmetry in chronic S.I. joint patients (Herzog et al. 1991:104-109).

In a critical review of the literature on the S.I. joint, Walker (1992:914) states that it is plausible that slight shifting of one articular surface in relation to the other may minimally disturb the alignment of the interlocking surfaces and this may respond to manual therapy procedures i.e. manipulation. Harrison et al. (1997:614) concur, saying that because most patients with S.I. joint dysfunctions present with spastic or hyperactive muscles, this could potentially create uneven or increased stress at the S.I. region, leading to pain and inflammation. Harrison et al. (1997:614) states that in these cases manipulation seems to be a logical treatment of choice. They also concluded that S.I. manipulation may control pain and have influences over the excitability of motor neurons (Harrison et al. 1997:614).

According to Shakelle (1994:858-861) manipulation is performed to restore joint play to dysfunctional joints. He states that manipulation is thought to work by one or a combination of the following:

releasing of entrapped synovial folds or plica,
relaxation of hypertonic muscles and
disruption of articular or periarticular adhesions.

Joint mechanoreceptors are also thought to be stimulated during manipulation and this in turn creates reflexogenic muscle tone changes in the muscles that surround the joint (DeFranca 1996:295). Indahl et al. (1997:2834-2840)

postulated that spinal manipulation might produce a stretch reflex from joint capsules that may lead to inhibition of muscle spasm.
In a study by Murphy et al. 1995, they administered prone drop table thrusts to the S.I. joints of asymptomatic volunteers and the Hoffman reflex was monitored in the legs bilaterally. Murphy et al. 1995, found a significant decrease in reflex excitability of the ipsilateral leg after adjustment but not in the control group receiving a sham adjustment. Murphy et al. 1995 conclude that "this indicates that thrusts exerted over the S.I. joint may have influences over the excitability of motor neurons; beneficial effects on pain and muscle spasm occur as well".

Kirkaldy-Willis and Burton (1992:250) state that manipulation probably relieves pain by reducing hypertonicity or spasm in the posterior muscles that maintain the joint in a state of fixation. They also hypothesize that the treatment may also result in restoring movement by shifting the ilium 1 to 2 mm on the sacrum (Kirkaldy-Willis and Burton 1992:250).

The above studies (Manga et al. 1993; Meade et al. 1990,1995; Assendelft et al. 1992:492; Cassidy and Mierau 1992; Kirkaldy-Willis and Burton 1992; Hendler et al. 1995; Osterbauer et al.1993; Herzog et al. 1991; Walker 1992; Harrison et al. 1997; Shakelle 1994; DeFranca 1996:295; Indahl et al. 1997; Murphy et al. 1995) therefore validate and support the use of adjustments in cases of S.I. syndrome.

2.11. Summary of Literature Review and Hypothesized Effect of Manipulation on Hip Restrictions

Van Winegarden et al. (1995) indicate that the spine, pelvis, and lower extremities are fully coupled -

Anatomically

Biomechanically and

Neurophysiologically

In this chapter the S.I. joint and hip joint were looked at and it was found that they have many things in common. Epidemiological studies indicated a lifetime prevalence of LBP ranging from 60 to 80% with an annual incidence of approximately 30%(Manga et al. 1993:221 and Mosheni-Bandepi et al., 1998:185).

Also it was shown that S.I. syndrome is the source of LBP in about 22 - 60% of cases (Daum 1995, Bernard and Kirkaldy-Willis 1987, Toussaint et al. 1999, Schwarzer,April and Bogduk 1995) . No studies were found that described the incidence or prevalence of hip pain. The definition and diagnosis of S.I. syndrome in relation to the hip were looked at to gain more understanding of this condition.

When comparing the hip and the S.I. joint it was noted that they have a close anatomic relationship as the share one bone (i.e. ilium) and this creates a likely kinesiologic dependence (Cibulka 1999). Also they share a similar innervation i.e. hip joint – L2 to S1 (Palastanga et al. 1998:414) and S.I. joint L2 to S2 (Moore and Dalley 1999, Daum 1995, Bernard and Cassidy 1991). Also functionally they shared a similar role in that they are both a link in the kinetic chain between the spine and the legs and both need stability, mobility and be able to withstand the considerable forces acting on them (Mior, Ro and Lawrence 1999, Palastanga 1998). In addition to this the biomechanics of the S.I. joint indicated that extreme hip positions are necessary to elucidate full range of motion at the S.I. joint and that the magnitude and direction of S.I. motion appears to be sufficient to complement hip joint motion and influence hip joint motion (Smidt et al.1997:2073-2081).

The clinical presentation of hip pathology was looked at and again similarities were found in the history, examination and treatment (see summary 2.7.5.) when compared to S.I. syndrome.

This study therefore addresses the effect of a S.I. manipulation on hip external and internal rotation. Thus when looking at these movements it is of interest to note the following:

- External rotation: (Norkin and Levangie 1992, Moore 1992, Reid 1992, DeFranca 1996, Heller 2003, Hendler et al. 1995).

    - The primary external rotators: obturator internus and externus, the gemellus superior and inferior, quadratus femoris have similar innervation L3 to S1 as S.I. joint L2 to S2.
    - The other primary external rotator the piriformis is seen by some as the only muscle to cross the S.I. joint and also has an anatomical attachment to the hip joint. Also, It has been reported that shortening of the piriformis muscle can produce excessive external rotation and restrict internal rotation, which may produce S.I. joint problems (Woerman, 1989).
    - The other secondary external rotators the gluteus maximus, mininmus and medius all attach in the region of the S.I. joint and to the hip joint. Again the innervation of the above muscles is similar to that of the S.I. joint. Thus it is hypothesized that if these muscles are in state of spasm, that can occur with S.I. syndrome, the hip could be in a state of increased external rotation.

- Internal rotation: (Reid 1992, Moore 1992, Moore and Dalley 1999; Palastanga 1998, DeFranca 1996)

- The S.I. joint and the hip joint have the anterior fibres of gluteus medius and minimus in common anatomically and again they have a similar innervation.
- However internal rotation is also limited by tension in the external rotator muscles. External rotation is also seen as the more powerful movement and again both these above muscles are also external rotators.
- Therefore it is hypothesized that in S.I. syndrome internal rotation may be decreased when these muscles in the region of the S.I. joint are in spasm.

The above hypotheses are confirmed by research studies (Fairbank et al. 1984, Mellin 1988, Ellison et al. 1990, Cibulka 1992, Cibulka et al. 1998) linking restrictions in hip range of motion in relation to low back pain and S.I. syndrome. Here it was indicated that patients with lower back pain who were classified as having signs suggestive of S.I. regional pain had significantly ($P < 0.05$) more external rotation than internal rotation (approximately a 20° difference) on the side of S.I. dysfunction (Cilbulka et al. 1998:1014).

The treatment of S.I. syndrome was looked at and it was seen that the majority of methodologically sound clinical studies found that spinal manipulation applied by chiropractors is more effective then many alternative treatments for low back pain (Manga et al. 1993, Mosheni-Bandepei 1998). The definition of manipulation was looked at and it was seen as the treatment of choice by chiropractors for low back pain and S.I. syndrome (Cassidy and Mierau 1992, Kirkaldy-Willis and Burton 1992, Hendler et al. 1995).

Thus if manipulation is the treatment of choice for S.I. syndrome and patients with S.I. syndrome appear to have restrictions in their hip rotation (i.e. increased external rotation and limited internal rotation) what effect would a S.I. manipulation have on these noted hip restrictions?

Therefore it is hypothesized that manipulation could:

- ❖ Reduce hypertonicity or spasm in the posterior muscles (Kirkaldy-Willis and Burton 1992) and
- ❖ Relaxes hypertonic muscles (Shakelle 1994).

    - o If this is the case it is thought by the researcher that a manipulation of the involved S.I. joint in S.I. syndrome will relax the muscles in that area and due to their anatomical arrangement, as described above, will restore normal rotation movements back to the involved hip joint.

- ❖ Stimulate joint mechanoreceptors and this in turn creates reflexogenic muscle tone changes in the muscles that surround the joint (DeFranca 1996:295).
- ❖ Influence the excitability of motor neurons and it was shown that the S.I. joint and hip joint have a similar innervation.
    - o Also the muscles that the S.I. joint and hip joint have in common, that are involved in hip rotation, have a similar innervation (Murphy et al. 1995).
    - o Therefore, the researcher also hypothesizes that a S.I. manipulation through neurological feedback may have an effect on the hip and the common muscles and this may also restore normal rotation back to the involved hip joint.

Mellin (1988:670) states that it seems possible that, in chronic low back pain patients, correlations between hip mobility back pain and spinal mobility might be worthy of investigation. Therefore this study attempted to establish what effect a S.I. manipulation will have on active and passive restrictions in hip rotation in patients suffering with S.I. syndrome.

CHAPTER THREE

MATERIALS AND METHODS:

3.1 Introduction

This chapter gives a detailed description of the primary and secondary data the subjects, inclusion and exclusion criteria, ethical consideration, the method, measurements used and the interventions utilized. Statistical evaluation is also discussed.

3.2. The Data

The data consisted of the primary and secondary data.

3.2.1. Primary Data

This data is gained from:

1. The case history (appendix A), limited physical examination (appendix B), lower back regional examination (appendix C), hip regional examination (appendix D), Soape note (appendix E).
2. The Orthopaedic Rating scale consisting of four S.I. pain provocation tests (appendix F).
3. The subject's objective goniometer and inclinometer measurements (appendix G).

3.2.2. Secondary data

The secondary data consisted of data obtained from various sources such as journal articles, books and the internet (using Medline and Pubmed search engines)

3.3. The Subjects

3.3.1. Advertising:

This study drew on subjects from Durban and surrounding areas. Pamphlets and advertisements (Appendix H) were placed at the Durban Institute of Technology Chiropractic Day Clinic, Durban Institute of Technology Campus, local sports clubs, gyms, health shops and supermarkets. Adverts were also placed on the internal mail system of the Durban Institute of Technology and on the web site of a local radio station.

3.3.2. Sample size and homogeneity

Sixty subjects were selected from those who responded and no stratification of the patients took place. The subjects were accepted regardless of gender, occupation, race, severity or chronicity of the condition.

3.3.3. Participant screening

Initially a telephonic interview (Appendix I) was conducted with potential subjects to determine their suitability for this study. At this stage subjects were excluded if they did not fit the age criteria, had undergone recent lumbar spinal surgery, had acute low back pain and if they had been diagnosed with a recent hip condition.

All accepted subjects then underwent a consultation in which they were more fully assesses in terms of a case history (Appendix A), the relevant physical examination (as indicated by patient presentation) (Appendix B), low back regional examination (Appendix C), hip regional examination (Appendix D) and orthopaedic S.I. joint tests (Appendix F).

A letter of information (Appendix J) describing the study was given to the subject, after they had been screened and participation in the study was possible. The subject and researcher signed a letter of informed consent (Appendix K), if the subject decided to participate in the study.

3.3.4. Inclusion and exclusion criteria:

The successful subjects were screened for suitability as research participants based on the following inclusion and exclusion criteria:

Inclusion Criteria:

1. Subjects had to be between the ages of 18 and 49 years. In a study by Roach and Miles (1991:656), on normal hip and knee active range of motion and it relationship to age (1892 subjects); it was concluded that, at least to age 74 years, any substantial loss of joint mobility should be viewed as abnormal and not be seen as a natural consequence of aging. Kirkaldy-Willlis and Burton (1992:123) concurs with this statement but is more cautious in his estimates that after the sixth decade fibrosis within the S.I. joint can result in fibrous ankylosis, and rarely bony ankylosis. Calliet (1988) states that after age 45 it has been demonstrated that 35 percent of the population has ossified S.I. joints. There is much discrepancy in the literature regarding the age of ossification of the S.I. joints. For this reason and for the

purpose of homogeneity of the research group, the age group of 18 to 49 years was used as indicated in other research (Sawyer, 2000).

2. The subjects had to be diagnosed with S.I. syndrome. The diagnosis of S.I. syndrome was based on an orthopaedic rating scale as used in the studies by Moodley (2002), Bekker-Smith (2002) and Marszalek (2002). Potter and Rothstein (1985:1671-5) have reported that individual tests for the S.I. joint generally yield poor inter-tester reliability. In a study involving 219 patients Cibulka and Koldehoff (1999:83-92) found that a cluster of tests appeared to be a clinically useful method in identifying S.I. joint dysfunction in patients with low back pain. Laslett and Williams (1994:1248) found that pain provocation tests of distraction, compression, posterior glide and pelvic torsion have substantial inter-therapist reliability.

In this study the orthopaedic rating scale was made up of the following tests:

- The posterior shear test (Laslett and Williams, 1994);
- Gaenslen's test (Haldeman, 1992:292);
- Patrick Faber test (Magee, 1997:343) and
- Yeomann's test (Haldeman, 1992:292).

Further reasons for using these tests and their reliability, validity, sensitivity and specificity were discussed in the literature review in Chapter 2. However, the method of doing these tests will be described again in this section.

- The **Patrick Faber test** is carried out with the subject lying supine. The examiner positions the subject’s test leg so that the foot is on top of the knee of the opposite straight leg. The examiner then slowly lowers the test leg in abduction with hand pressure towards the examining table, while the opposite hand stabilises the pelvis at the anterior superior spine (Magee, 1997:473). A true positive is when the subject experiences pain in the S.I. joint with abduction of the test knee.

- In **Gaenslen’s test** the subject is positioned supine. The examiner flexes the subject's left knee and hip, while pressing downward over the right thigh to hyperextend the right hip. A positive test is recorded if this position elicits pain in the right S.I. joint (Kirkaldy-Willis, 1992:125). For further accuracy the extended thigh can be draped over the edge of the examining table (Daum, 1995:477).

- The subject lies prone for the **Yeomann’s test.** The examiner applies a firm pressure over the subject’s S.I. joint with one hand, whilst the other hand is placed under the thigh above the knee on the same side. The examiner then hyperextends the thigh by lifting the knee off the examining table. If pain is increased in the S.I. area, it indicates a positive result (Schafer and Faye, 1990:271).

- The **Posterior Shear test** requires the subject to be supine. The hip is flexed and adducted while the examiner applies a force by pushing posteriorly along the line of the femur, thus stressing the S.I. joint. The test is positive when there is pain over the S.I. joint or a reproduction of the subject’s symptoms (Laslett and Williams, 1994).

These tests were be used to determine the presence of S.I. syndrome as indicated in more recent research where the same battery of tests were used (Moodley 2002, Bekker-Smith 2002 and Marszalek, 2002). Each test was given a score of two with the exception of the posterior shear test that was given a score of four due to its apparent sensitivity (Laslett and Williams, 1994). Only subjects with a score of 6 out of 10 were accepted into this study (Appendix F).

3. All subjects had to have lower back pain that had been present for 4 weeks or longer. In this research, if the subjects fulfilled the other requirements this was deemed to be chronic S.I. syndrome (Palmer, 1996). This was to ensure homogeneity of the research group and thereby to aid the validity of this research (Myburgh, 2002). Furthermore, Meade et al. (1990:1437) found that the benefits of chiropractic manipulation are mainly in those patients with chronic or severe pain.

4. All subjects must have presented with either a decrease in the normal active and / or passive range of motion of the hip and / or with an asymmetrical range of motion of the hip. Normal values for internal and external hip rotation ROM vary among different reports (Ellison et al. 1990:537). Reid (1992:609) states that in the hip there is approximately 45 degrees of both internal and external rotation with the leg in either flexion or extension. This agrees with Roach and Miles (1991:657) who reviewed 7 sources and found that there was good agreement over hip internal and external rotation being about 45 degrees. However Roach and Miles (1991) did note that these sources did not indicate if this value represented active ROM or passive ROM.

Cibulka et al. (1998:1009) state that despite differences in internal and external hip rotation ROM in subjects, who are symptomatic for low back pain, symmetry usually exists between the left and right sides. Cibulka and Cromer (1998) concluded that unilateral limitation of hip rotation, in which a specific movement such as external rotation is unequal between the left and right sides, has been observed in patients with disorders of the S.I. joint. According to Ellison et al. (1990:539) a difference of greater than 10 degrees between the total internal rotation or external rotation when comparing sides or when comparing individual movements on each side is “clinically meaningful”.

Therefore in this study subjects were included if they had one or a combination of the following:

- difference in 10 degrees when comparing sides
- internal or external rotation 10 degrees less or more than 45 degrees
- a difference of 10 degrees when comparing internal to external rotation on the involved side.

5. Associated conditions to the S.I. syndrome (e.g. lumbar facet syndrome/ myofascial component) did not exclude subjects from this study, although these conditions were not treated.

6. All subjects had to have read a letter of information (Appendix J), regarding the study and have signed an informed consent form (Appendix K).

Exclusion Criteria:

1. Subjects were excluded if they received any form of therapy, manual or medicinal, for their S.I. syndrome during the course of the research period.

   In particular the use of anti-inflammatory or analgesic medication lead to exclusion from the study. This is due to the fact that this may have altered the diagnosis of S.I. syndrome and / or may alter their hip rotation ranges of motion. Any participant who was on any oral non-steroidal anti-inflammatory drug was required to participate in a three-day washout period prior to entering the study (Poul et al. 1993).

2. Subjects with a history of low back fracture, dislocation, surgery, peripheral neuropathy, nerve root entrapment, disc bulge were excluded from the study. Due to the fact that the clinical picture of peripheral neuropathy, nerve root entrapment and disc bulge can present in a similar manner to S.I. syndrome (Kirkaldy- Willis and Burton, 1992) the clinician arbitrated whether the particular case was in fact a S.I. syndrome.

3. Subjects with a history of hip fracture, dislocation, surgery, pathology or any other condition causing a reduction in their hip ROM were excluded from this study. This was due to the fact that this study is looking at the effect of a S.I. joint manipulation on hip rotation and it is thought that the above conditions may artificially effect hip rotation measurements.

4. Subjects suffering from systemic disease, such as metabolic arthritides, causing back pain were excluded from the study.

5. Subjects who had absolute contraindications to manipulative therapy as stated by Kirkaldy-Willis and Burton (1992:291) and Bergmann, Peterson and Lawrence (1993:133) were excluded from the study i.e.aortic aneurysm, fracture or dislocation; disc prolapse with neurologic deficit, bone tumuors and bone infections. Also subjects who had relative contraindications to manipulation were excluded i.e. atherosclerosis, anticoagulant therapy, advanced osteoarthritis, inflammatory arthritis, ankylosing spondylitis, joint instability, severe sprains, osteomyelitis, osteoporosis, severe sacral nerve root compression, pain intolerance, space-occupying lesion, malingering, hysteria and hypochondriasis (Bergmann, Peterson and Lawrence 1993:133).

6. Subjects were asked not to change their lifestyle, daily activities, and regular medication or exercise programs in any way to avoid being excluded from the study.

3.3.5. The Sample Group.

The sample for this group consisted of 60 subjects, selected according to the criteria described above. In this study there was only one sample group and every participant received a manipulation of the symptomatic S.I. joint as determined by the orthopaedic rating scale. The aim of this study was to determine the effect of a sacroiliac joint manipulation on hip rotation ranges of motion (active and passive motion) in patients with chronic sacroiliac syndrome in terms of objective measures.

3.4. Intervention.

Subjects all received manipulation to the restricted S.I. articulation as determined by the orthopaedic rating scale (i.e. a score greater than 6 out of 10). Once the above scale determined the involved side, motion palpation was used to determine what the specific manipulation was on that affected side. As stated in the literature review (Walker 1992, Harrison et al. 1997, Potter and Rothstein 1985, Dreyfuss et al. 1994) there is much controversy over the use of motion palpation. However, according to Panzer and Gatterman (1995:456) the manipulable S.I. subluxation is best detected through motion palpation. Motion palpation of the S.I. joint was conducted using the Gillet method, as described by Cassidy and Mierau (1992:220).

Gatterman (1990:12) describes manipulation to be a manual procedure that involves a directed thrust to move a joint past the physiological ROM, without exceeding the anatomic limit. There are many different techniques available to manipulate the S.I. joint, but the side posture technique was found to be the most effective and common method (Cassidy and Mierau 1992:221; Cooperstein et al. 2001). As stated in the literature review there is much support for the use of manipulation in the treatment of chronic S.I. syndrome (Kirkaldy-Willis and Burton 1992:249; Panzer and Gatterman 1995:464; Cooperstein et al. 2001:407-424; Salter 1999:88). Therefore in this study every subject received a side posture manipulation on the fixated area of the relevant S.I. joint as determined by the orthopaedic rating scale and motion palpation findings. A record was kept of the motion palpation findings (as recorded in the statistics section) and the applicable manipulation delivered.

A manipulation was deemed successful by the examiner if an audible release was heard (i.e. a cracking noise) and / or there was an improvement in the motion palpation findings following the manipulation.

3.5. Measurements

This study only consisted of objective data. Objective data was obtained by using a digital inclinometer and goniometer to measure hip external and internal active and passive rotation (Appendix G).

3.5.1. Measurement Instruments

3.5.1.1. The Goniometer

Roach and Miles (1991:657) state that goniometry is the most widely used method of measuring range of motion. Ellison et al. (1990:538) established the intra-rater and inter-rater reliability for goniometric measurements of hip rotation ROM on 22 healthy volunteers as well as on 15 patients with low back dysfunction. Cibulka et al. (1998:1011) also established the intra-rater reliability for goniometric measurements by measuring hip rotation ROM on a sample of 29 patients. Boone et al. (1978) suggest that the precision of goniometric measurement was such that a change of more than 6 degrees was required to accurately detect a real change in range of motion.

3.5.1.2. The Inclinometer

The inclinometer used in this trial was the Dualer Electronic Inclinometer (Jtech Medical Industries 4314 ZEVEX Park Lane, Salt Lake City, UT 84123 USA, tel 801/264-1001). The electronic inclinometer is the preferred method for measuring mobility of the spine and for measurements of the large extremities inclinometers are more accurate than goniometers for measuring range of motion (The Dualer instruction manual 1992:3). Ellison et al. (1990:538) also established the intra-rater and inter-rater reliability of fluid -filled inclinometer measurements of hip rotation ROM on 22 healthy volunteers as well as on 15 patients with low back dysfunction. Ellison et al. (1990) are of the opinion that inclinometer was easier to use than the goniometer and its measurements were more reliable.

3.5.2. Measurement procedure

The procedure used by Cibulka et al. (1998) and by Ellison et al. (1990) to measure hip rotation ROM was used in this study. Subjects were placed in the prone position on the treatment table. This is due to the fact that hip rotation ROM measurements are presumably more reliable because of better pelvic stabilisation (Cibulka et al. 1998:1011). All subjects wore non-restricting clothing. The hip to be measured was placed in 0 degrees of abduction while the contra-lateral hip was abducted to approximately 30 degrees. The affected side's knee was flexed to 90 degrees and the leg was actively and passively moved to produce hip rotation. A strap was placed around the posterior superior iliac spines to prevent movement of the pelvis. Active ROM was measured at the limit of the individual's hip rotation. Passive ROM was stopped when the examiner felt a firm feeling of resistance. The goniometer was aligned vertically along the shaft of the tibia. The inclinometer was attached by a velcro strap just below the ankle and also aligned with the shaft of the tibia. Before taking readings it was ensured that the tibia was aligned at 90 degrees and the electronic inclinometer was zeroed in this position.

3.5.3. Measurement number and interval

Measurements of hip rotation ROM were taken on all subjects suffering with S.I. syndrome before the S.I. manipulation. They all received a side posture S.I. manipulation. After a period of 10 minutes the measurements were then taken again. It is not known whether changes in hip rotation ROM are immediate or not and therefore a further set of measurements were taken a week later, as set out above. This second reading also established whether any changes, detected at the first visit, were still present or not.

3.6. Ethical considerations

- The rights and welfare of the subjects were protected
- Informed consent was obtained from the patient (Appendix J).
- Subjects were not coerced into participating in the study.

- Information was given to the subjects in a letter of information (Appendix I) and in an understandable language where possible.
- The research involved no more than minimal risk.
- Confidentiality of subjects was maintained.
- Participation was voluntary and did not involve financial benefit.
- The subjects were free to withdraw from the study at any time.

3.7.Statistical analysis:

The SPSS statistical package (as supplied by SPSS Inc. Marketing Department, 444 north Michigan Avenue, Chicago Illinois, 606110) was utilized to analyze the objective data. The statistical evaluation was aimed at measuring any significant change occurring between the first and second readings, the second and third readings and the first and third readings. The measurements involved were the goniometer and inclinometer readings of active and passive hip rotation.

Intra-group comparisons were be made using the paired t - test. The level of significance was set at 0.05 and p-values will be used for comparison purposes. The p-value is a probability, with a value ranging from zero to one.

3.7.1. Hypothesis testing and the decision rule.

The null hypothesis (Ho) in each case states that there is no significant difference in hip rotation, within the group, between the first and the second, between the second and third and between the first and third readings.

The alternative hypothesis (Ha) states that there is a significant difference in hip rotation between the above readings.

Paired T-Test:

The statistical structure of all the above Hypotheses Tests is outlined below:

H_0 : $\mu_1 = \mu_2$

H_1 : $\mu_1 \neq \mu_2$

$\alpha = 0.05$

Note: α = probability of rejecting H_o when is true (Type 1: error)

The test is two tailed and the test statistic is:

$$\text{T Test Statistic} = \frac{\sqrt{(n-1)}\Sigma d}{\sqrt{n\Sigma d^2 - (\Sigma d)^2}}$$

Where d = the difference between the 2 columns.

And n = the number of pairs.

We get the tabulated value from T Tables.

Note: The p – value = The probability of H_o being true.

For the 2-tailed non-directional Paired t-test, where there is no clear indication whether the data is going to increase or decrease the decision rule is as follows:

Decision rule:

For a two – tailed test

$\propto = 0.05$ = level of significance

Reject Ho if $P < \alpha/2 = 0.05/2 = 0.025$

Accept Ho if $P \geq \alpha/2 = 0.05/2 = 0.025$

The reason for the above parametric hypothesis test namely the paired t-test, is due to the central limit theorem which states that for sample sizes bigger than 30 that our sampling distribution of means follows a normal distribution. The results are displayed in table form for interpretation. Summary statistics including the means, standard deviations and relevant p-values were obtained to establish more information about the data.

CHAPTER FOUR

RESULTS:

4.1. Introduction:

The first part of this chapter contains the demographic data of all the subjects included in the study. There was one group of sixty subjects. The second part of this chapter contains the statistical analysis of the objective data obtained from the subjects. The objective data consists of goniometer and inclinometer readings of active and passive, hip external and internal rotation. The results are tabulated to display the mean, the standard deviation and the probability value (p-value). The p-value is compared to the level of significance, which is set at α = 0.05 for all one tailed tests.

4.2. Demographic data.

4.2.1. Gender Distribution

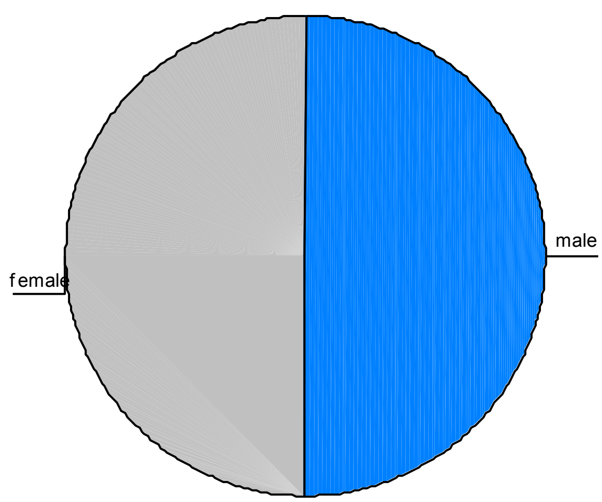

Figure 1: Male to Female Ratio within the sample population (n=60)

4.2.2. Age Prevalence and Distribution.

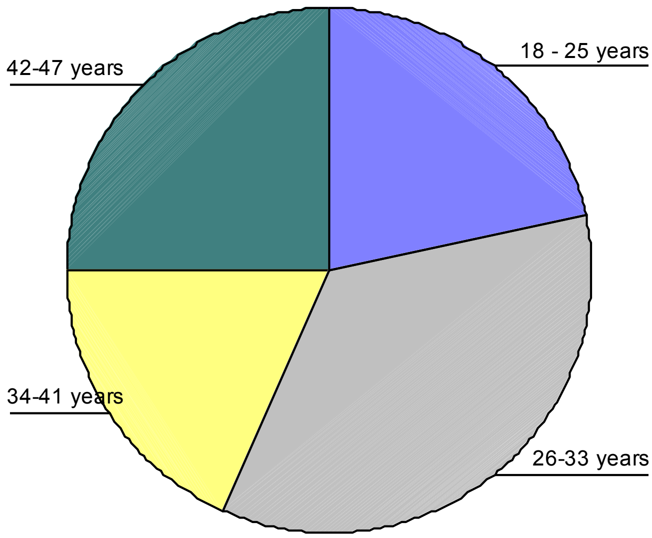

Figure 2: Age Prevalence and Distribution within the sample population

4.2.3. Racial Distribution

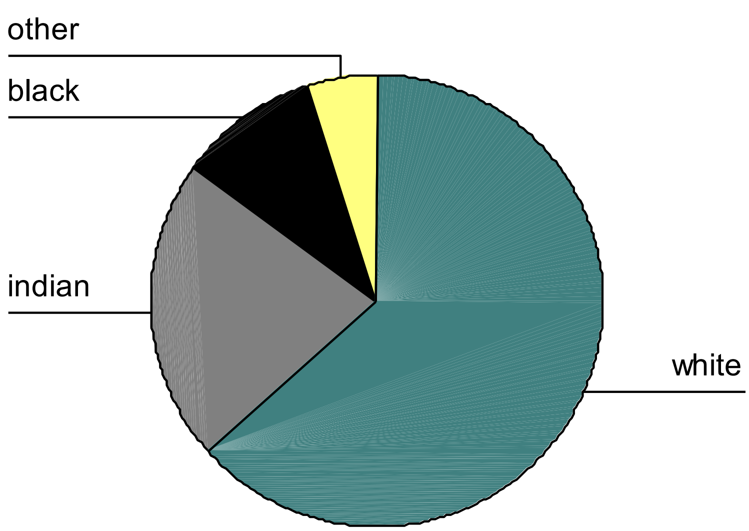

Figure 3: Racial Distribution within the sample population.

4.2.4. Motion Palpation Findings

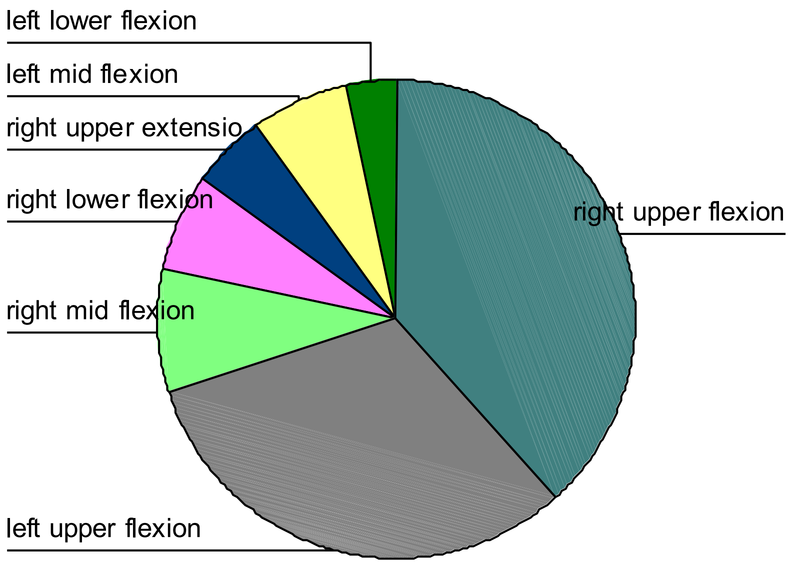

Figure 4: Motion Palpation Findings within the sample population

4.2.5. Aetiology of Sacroiliac Syndrome (traumatic or non – traumatic)

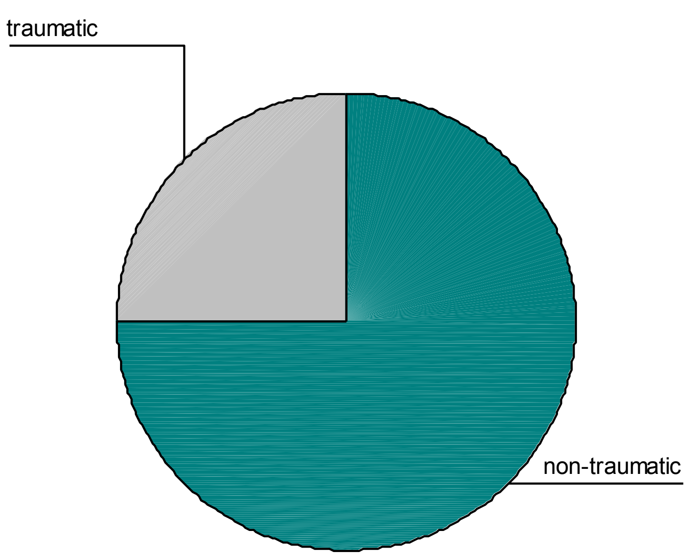

Figure 5: Aetiology of Sacroiliac syndrome within the sample population

4.3. INTRA – GROUP ANALYSIS OF OBJECTIVE DATA.

4.3.1. GONIOMETER RESULTS: Paired T-Test

4.3.1.1. Active Internal Hip Rotation on Side of S.I. Manipulation.

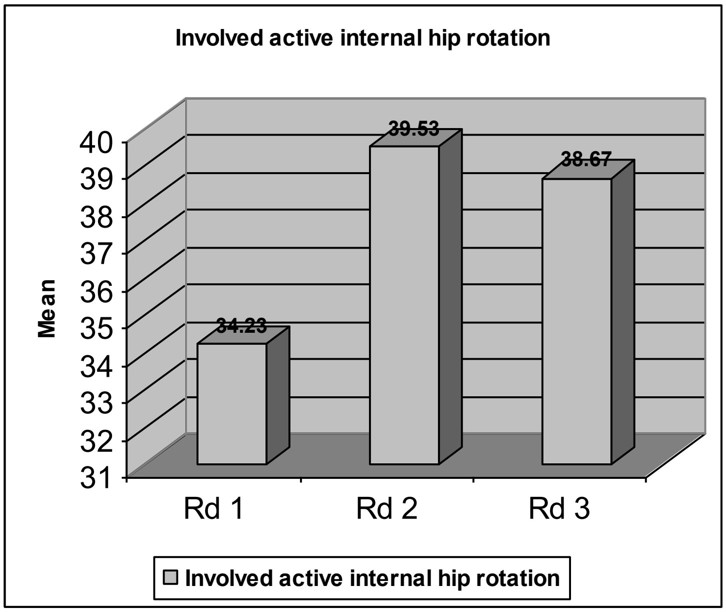

Figure 6: Goniometer mean readings of active internal hip rotation on side of S.I. manipulation

Table 1: The results of the Paired T-test comparing readings one, two and three of active hip internal rotation on the involved side i.e. manipulated S.I. joint.

	Involved Active Hip Internal Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	34.23	9.39	**0.000**
	Reading 2	39.53	9.78	
Pair 2	Reading 2	39.53	9.78	**0.388**
	Reading 3	38.67	9.71	
Pair 3	Reading 1	34.23	9.39	**0.000**
	Reading 3	38.67	9.71	

For the above readings the null hypothesis is accepted when comparing readings 2 and 3, which indicates that at α = 0.025 level of significance there is statistically no significant difference when comparing reading 2 and 3.

The alternate hypothesis is accepted when comparing readings 1 and 2 and readings 1 and 3, which indicates that at $\alpha = 0.025$ level of significance there is a statistically significant difference between 1 and 2 and 1 and 3.

4.3.1.2. Active External Hip Rotation on Side of S.I. Manipulation.

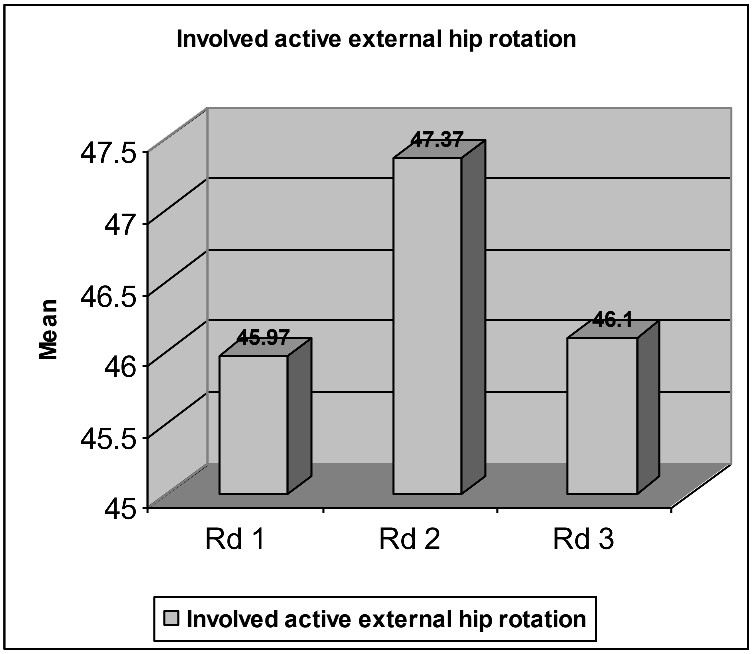

Figure 7: Goniometer mean readings of active external hip rotation on side of S.I. manipulation.

Table 2: The results of the Paired T-test comparing readings one, two and three of active hip external rotation on the involved side i.e. manipulated S.I. joint.

	Involved Active Hip External Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	45.97	9.29	**0.059**
	Reading 2	47.37	10.12	
Pair 2	Reading 2	47.37	10.12	**0.240**
	Reading 3	46.10	9.67	
Pair 3	Reading 1	45.97	9.29	**0.893**
	Reading 3	46.10	9.67	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2, 2 and 3 and 1 and 3 which indicates that at α = 0.025 level of significance there is no statistically significant difference when comparing these readings.

4.3.1.3. Passive Internal Hip Rotation on Side of S.I. Manipulation.

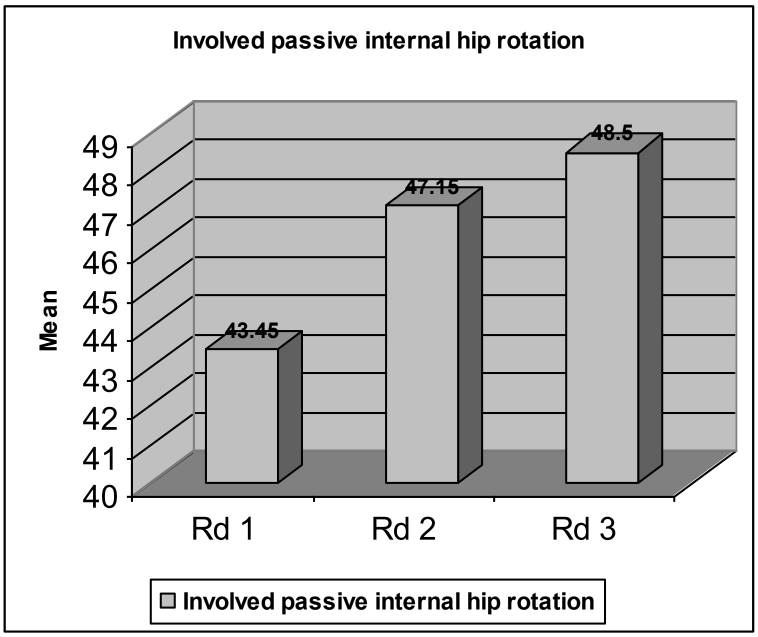

Figure 8: Goniometer mean readings of passive internal hip rotation on side of S.I. manipulation.

Table 3: The results of the Paired T-test comparing readings one, two and three of passive hip internal rotation on the involved side i.e. manipulated S.I. joint.

	Involved Passive Hip Internal Rotation	Mean	Standard Deviation	P-Value
Pair 1	Reading 1	43.45	8.27	**0.000**
	Reading 2	47.15	8.61	
Pair 2	Reading 2	47.15	8.61	**0.135**
	Reading 3	48.50	9.42	
Pair 3	Reading 1	43.45	8.27	**0.000**
	Reading 3	48.50	9.42	

For the above readings the null hypothesis is accepted when comparing readings 2 and 3, which indicates that at α = 0.025 level of significance there is statistically no significant difference when comparing reading 2 and 3.
The alternate hypothesis is accepted when comparing readings 1 and 2 and readings 1 and 3, which indicates that at α = 0.025 level of significance there is a statistically significant difference between 1 and 2 and 1 and 3.

4.3.1.4. Passive External Hip Rotation on Side of S.I. Manipulation.

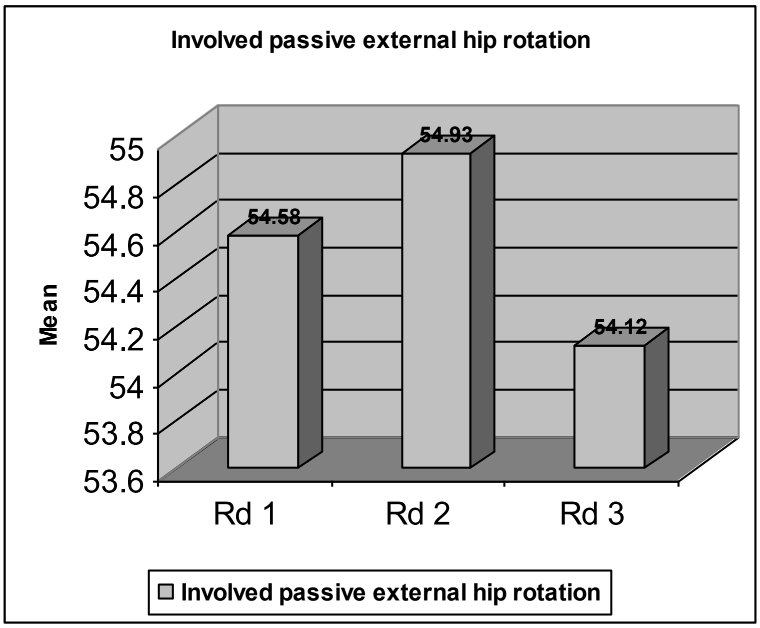

Figure 9: Goniometer mean readings of passive external hip rotation on side of S.I. manipulation.

Table 4: The results of the Paired T-test comparing readings one, two and three of passive hip external rotation on the involved side i.e. manipulated S.I. joint.

	Involved Passive Hip External Rotation	Mean	Standard Deviation	P-Value
Pair 1	Reading 1	54.58	7.33	**0.593**
	Reading 2	54.93	7.68	
Pair 2	Reading 2	54.93	7.68	**0.283**
	Reading 3	54.12	7.70	
Pair 3	Reading 1	54.58	7.33	**0.577**
	Reading 3	54.12	7.70	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2, 2 and 3 and 1 and 3 which indicates that at α = 0.025 level of significance there is statistically no significant difference when comparing theses readings.

4.3.1.5. Active Internal Hip Rotation on Side Not Manipulated

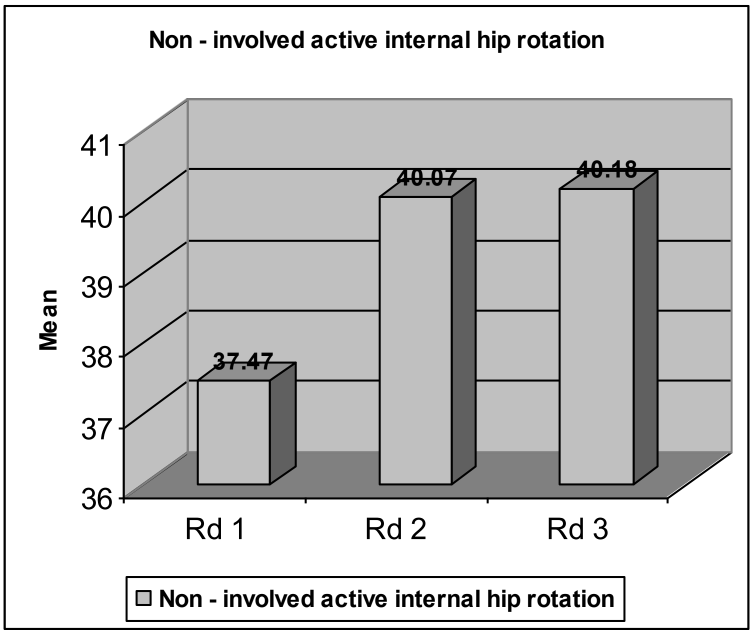

Figure 10: Goniometer mean readings of active internal hip rotation on side not manipulated.

Table 5: The results of the Paired T-test comparing readings one, two and three of active hip internal rotation on the non - involved side i.e. not manipulated.

	Non – Involved Active Hip Internal Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	37.47	10.54	**0.005**
	Reading 2	40.07	10.19	
Pair 2	Reading 2	40.07	10.19	**0.899**
	Reading 3	40.18	10.82	
Pair 3	Reading 1	37.47	10.54	**0.017**
	Reading 3	40.18	10.82	

For the above readings the null hypothesis is accepted when comparing readings 2 and 3 which indicates that at α = 0.025 level of significance there is no statistically significant difference when comparing readings 2 and 3.
The alternate hypothesis is accepted when comparing readings 1 and 2 and readings 1 and 3, which indicates that at α = 0.025 level of significance there is a statistically significant difference when comparing reading 1 and 2 and 1 and 3.

4.3.1.6. Active External Hip Rotation on Side Not Manipulated.

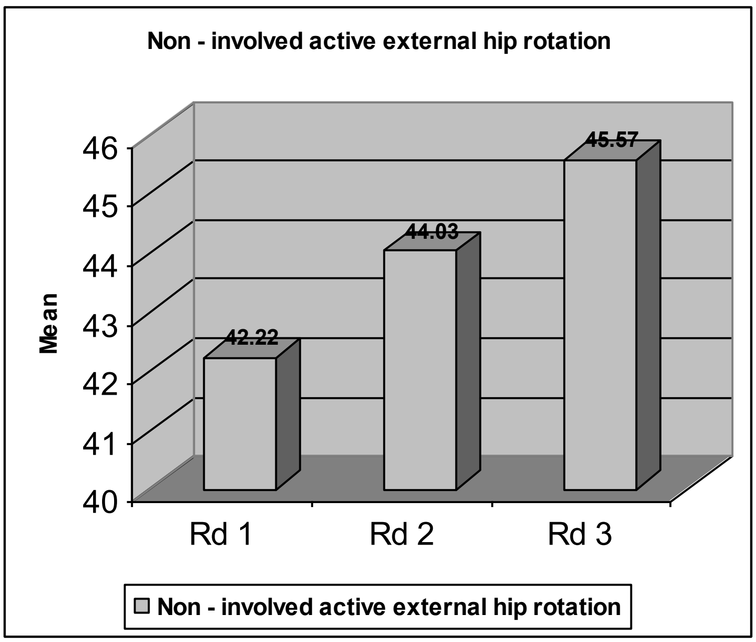

Figure 11: Goniometer mean readings of active external hip rotation on side not manipulated.

Table 6: The results of the Paired T-test comparing readings one, two and three of active hip external rotation on the non - involved side i.e. not manipulated.

	Non – Involved Active Hip External Rotation	Mean	Standard Deviation	P-Value
Pair 1	Reading 1	42.22	8.99	**0.056**
	Reading 2	44.03	9.17	
Pair 2	Reading 2	44.03	9.17	**0.067**
	Reading 3	45.57	9.34	
Pair 3	Reading 1	42.22	8.99	**0.001**
	Reading 3	45.57	9.34	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2 and readings 2 and 3 which indicates that at $\alpha = 0.025$ level of significance there is no statistically significant difference when comparing readings 1 and 2 and 2 and 3.

The alternate hypothesis is accepted when comparing readings 1 and 3, which indicates that at $\alpha = 0.025$ level of significance there is a statistically significant difference when comparing reading 1 and 3.

4.3.1.7. Passive Internal Hip Rotation on Side Not Manipulated.

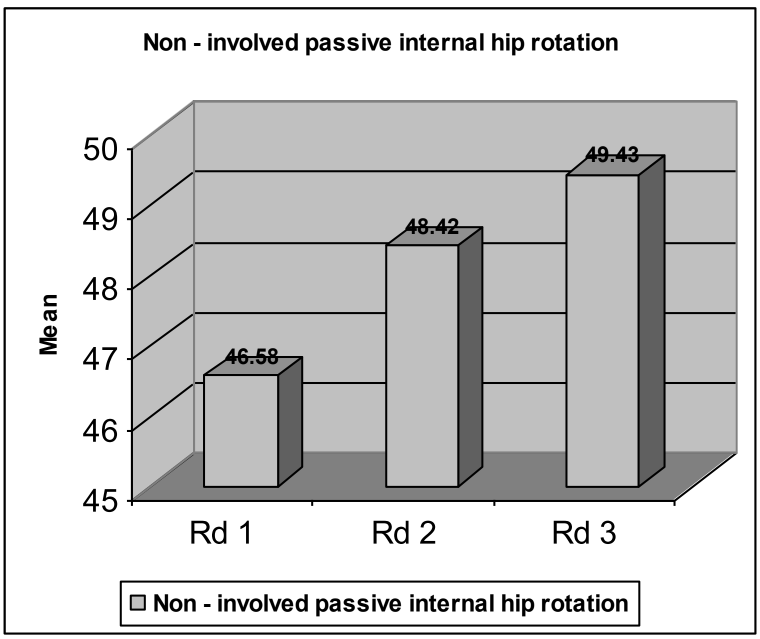

Figure 12: Goniometer mean readings of passive internal hip rotation on side not manipulated.

Table 7: The results of the Paired T-test comparing readings one, two and three of passive hip internal rotation on the non - involved side i.e. not manipulated.

	Non - Involved Passive Hip Internal Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	46.58	9.40	**0.003**
	Reading 2	48.42	9.16	
Pair 2	Reading 2	48.42	9.16	**0.121**
	Reading 3	49.43	9.44	
Pair 3	Reading 1	46.58	9.40	**0.001**
	Reading 3	49.43	9.44	

For the above readings the null hypothesis is accepted when comparing readings 2 and 3, which indicates that at α = 0.025 level of significance there is statistically no significant difference when comparing reading 2 and 3.

The alternate hypothesis is accepted when comparing readings 1 and 2 and readings 1 and 3, which indicates that at α = 0.025 level of significance there is a statistically significant difference between 1 and 2 and 1 and 3.

4.3.1.8. Passive External Hip Rotation on Side Not Manipulated.

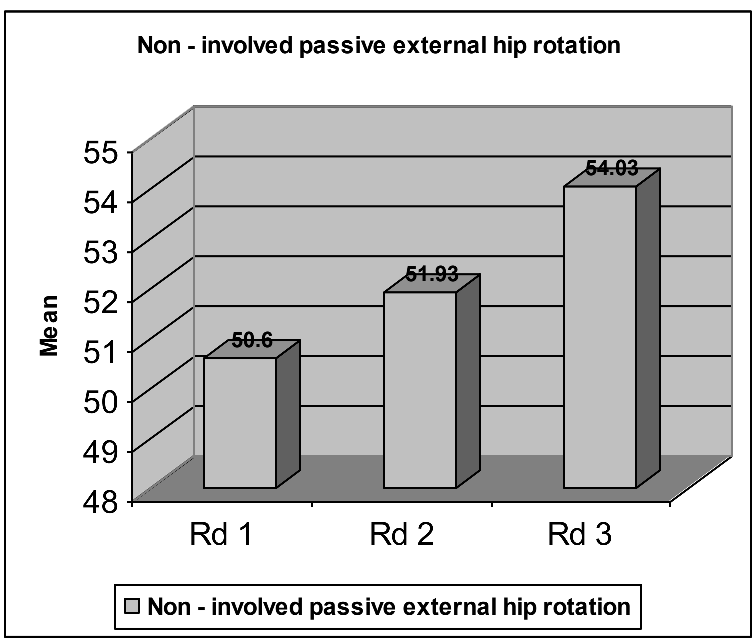

Figure 13: Goniometer mean readings of passive external hip rotation on side not manipulated.

Table 8: The results of the Paired T-test comparing readings one, two and three of passive hip external rotation on the non - involved side i.e. not manipulated.

	Non - Involved Passive Hip External Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	50.60	8.32	**0.073**
	Reading 2	51.93	8.08	
Pair 2	Reading 2	51.93	8.08	**0.007**
	Reading 3	54.03	7.49	
Pair 3	Reading 1	50.60	8.32	**0.000**
	Reading 3	54.03	7.49	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2, which indicates that at $\alpha = 0.025$ level of significance there is statistically no significant difference when comparing readings 1 and 2.

The alternate hypothesis is accepted when comparing readings 2 and 3 and readings 1 and 3, which indicates that at $\alpha = 0.025$ level of significance there is a statistically significant difference between 1 and 2 and 1 and 3.

4.3.2. INCLINOMETER RESULTS: Paired T-Test

4.3.2.1. Active Internal Hip Rotation on Side of S.I. Manipulation.

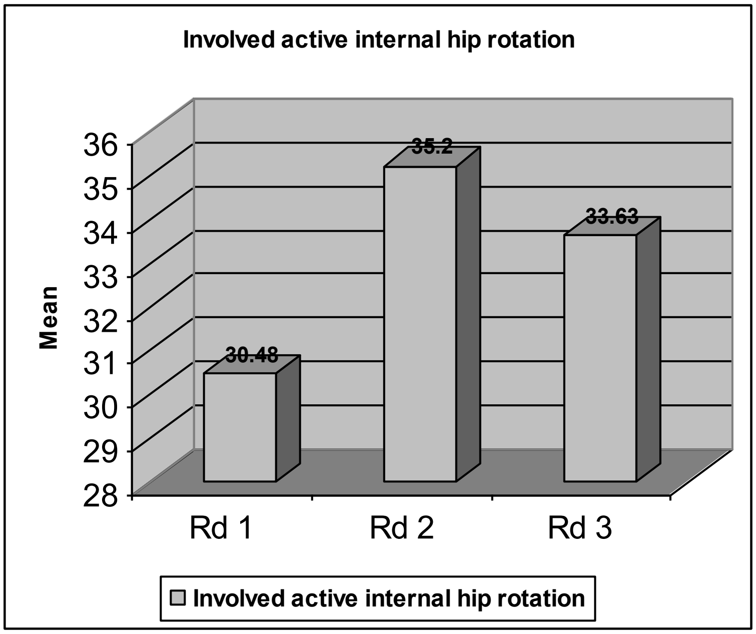

Figure 14: Inclinometer mean readings of active internal hip rotation on side of S.I. manipulation.

Table 9: The results of the Paired T-test comparing readings one, two and three of active hip internal rotation on the involved side i.e. manipulated S.I. joint.

	Involved Active Hip Internal Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	30.48	9.16	**0.000**
	Reading 2	35.20	9.77	
Pair 2	Reading 2	35.20	9.77	**0.135**
	Reading 3	33.63	10.06	
Pair 3	Reading 1	30.48	9.16	**0.002**
	Reading 3	33.63	10.06	

For the above readings the null hypothesis is accepted when comparing readings 2 and 3, which indicates that at $\alpha = 0.025$ level of significance there is statistically no significant difference when comparing readings 2 and 3.

The alternate hypothesis is accepted when comparing readings 1 and 2 and readings 1 and 3, which indicates that at α = 0.025 level of significance there is a statistically significant difference between 1 and 2 and 1 and 3.

4.3.2.2. Active External Hip Rotation on Side of S.I. Manipulation.

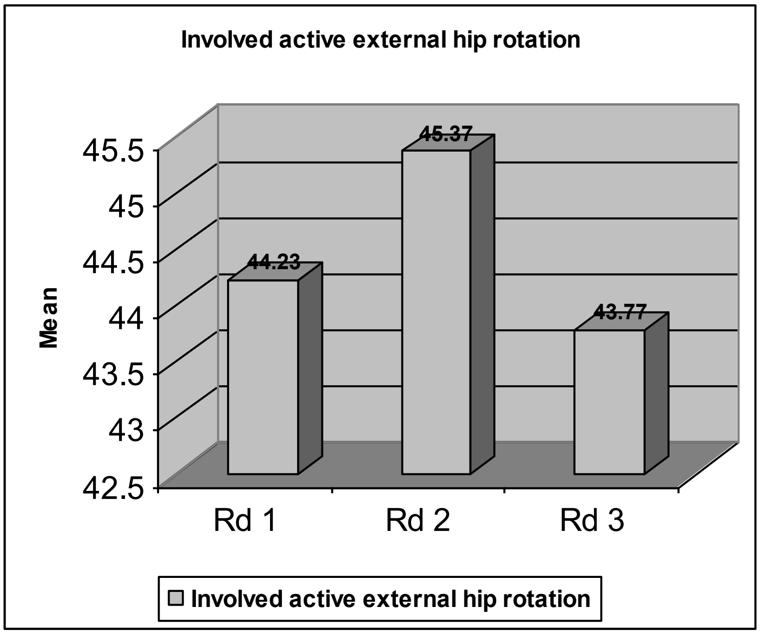

Figure 15: Inclinometer mean readings of active external hip rotation on side of S.I. manipulation.

Table 10: The results of the Paired T-test comparing readings one, two and three of active hip external rotation on the involved side i.e. manipulated S.I. joint.

	Involved Active Hip External Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	44.23	10.58	**0.209**
	Reading 2	45.37	10.73	
Pair 2	Reading 2	45.37	10.73	**0.173**
	Reading 3	43.77	11.21	
Pair 3	Reading 1	44.23	10.58	**0.666**
	Reading 3	43.77	11.21	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2, 2 and 3 and 1 and 3 which indicates that at α = 0.025 level of

significance there is statistically no significant difference when comparing theses readings.

4.3.2.3. Involved Passive Internal Hip Rotation on Side of S.I. Manipulation.

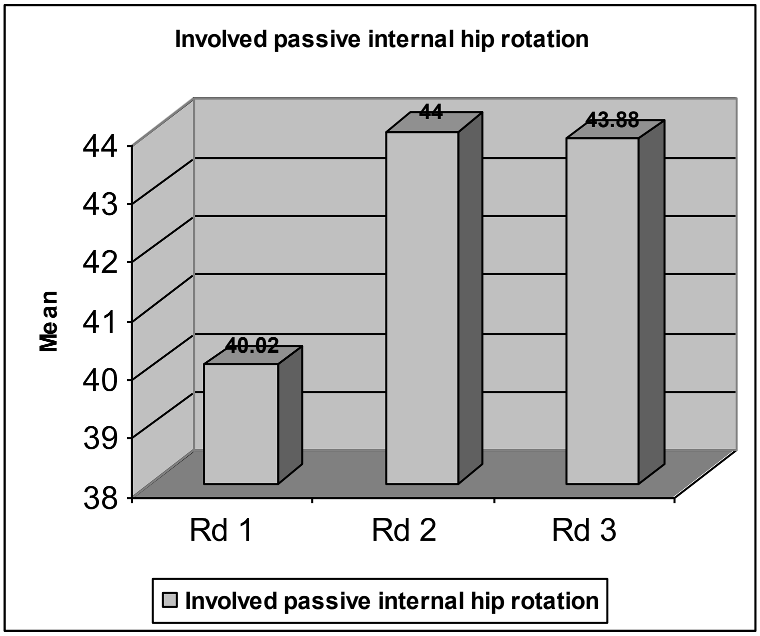

Figure 16: Inclinometer mean readings of passive internal hip rotation on side of S.I. manipulation.

Table 11: The results of the Paired T-test comparing readings one, two and three of passive hip internal rotation on the involved side i.e. manipulated S.I. joint.

	Involved Passive Hip Internal Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	40.02	8.13	**0.000**
	Reading 2	44.00	8.08	
Pair 2	Reading 2	44.00	8.08	**0.891**
	Reading 3	43.88	7.90	
Pair 3	Reading 1	40.02	8.13	**0.000**
	Reading 3	43.88	7.90	

For the above readings the null hypothesis is accepted when comparing readings 2 and 3, which indicates that at $\alpha = 0.025$ level of significance there is statistically no significant difference when comparing readings 2 and 3.

The alternate hypothesis is accepted when comparing readings 1 and 2 and readings 1 and 3, which indicates that at α = 0.025 level of significance there is a statistically significant difference between 1 and 2 and 1 and 3.

4.3.2.4. Involved Passive External Hip Rotation on Side of S.I. Manipulation.

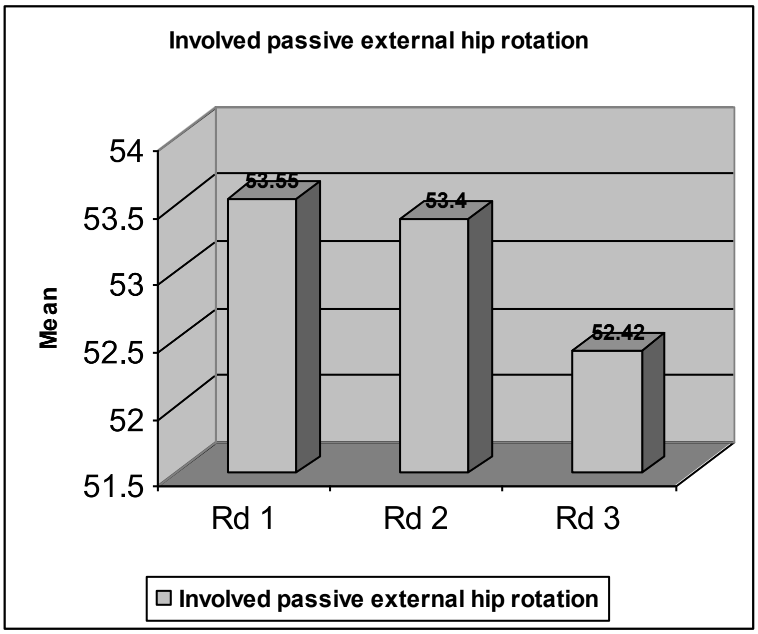

Figure 17: Inclinometer mean readings of passive external hip rotation on side of S.I. manipulation.

Table 12: The results of the Paired T-test comparing readings one, two and three of passive hip external rotation on the involved side i.e. manipulated S.I. joint.

	Involved Passive Hip External Rotation	Mean	Standard Deviation	P-Value
Pair 1	Reading 1	53.55	9.45	**0.855**
	Reading 2	53.40	8.94	
Pair 2	Reading 2	53.40	8.94	**0.250**
	Reading 3	52.42	9.52	
Pair 3	Reading 1	53.55	9.45	**0.271**
	Reading 3	52.42	9.52	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2, 2 and 3 and 1 and 3 which indicates that at α = 0.025 level of

significance there is statistically no significant difference when comparing theses readings.

4.3.2.5. Active Internal Hip Rotation on Side Not Manipulated.

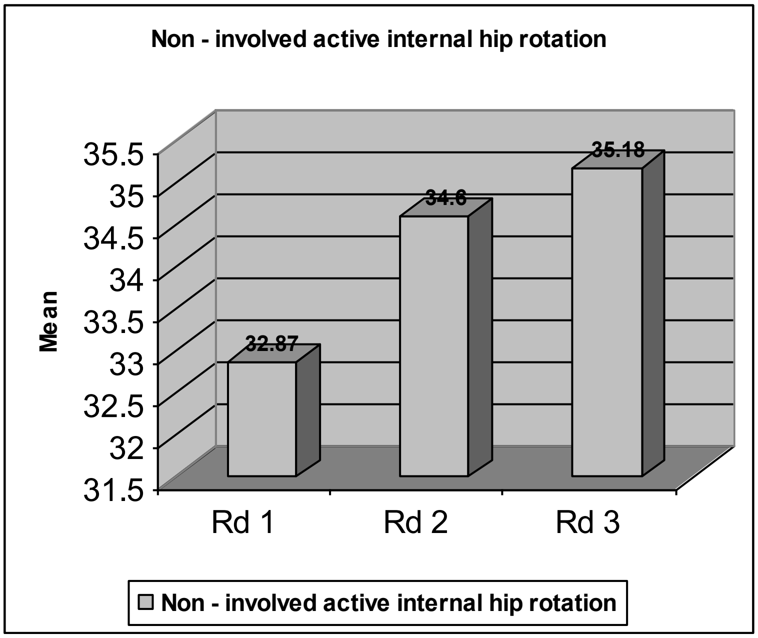

Figure 18: Inclinometer mean readings of active internal hip rotation on side not manipulated.

Table 13: The results of the Paired T-test comparing readings one, two and three of active hip internal rotation on the non - involved side i.e. not manipulated.

	Non - Involved Active Hip Internal Rotation	Mean	Standard Deviation	P-Value
Pair 1	Reading 1	32.87	10.16	**0.027**
	Reading 2	34.60	11.12	
Pair 2	Reading 2	34.60	11.12	**0.566**
	Reading 3	35.18	9.70	
Pair 3	Reading 1	32.87	10.16	**0.024**
	Reading 3	35.18	9.70	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2 and 2 and 3, which indicates that at $\alpha = 0.025$ level of significance there is statistically no significant difference when comparing readings 1 and 2 and 2 and 3. The alternate hypothesis is accepted when comparing readings 1 and 3, which indicates that at α = 0.025 level of significance there is statistically a significant difference between 1 and 3.

4.3.2.6. Active External Hip Rotation on Side Not Manipulated.

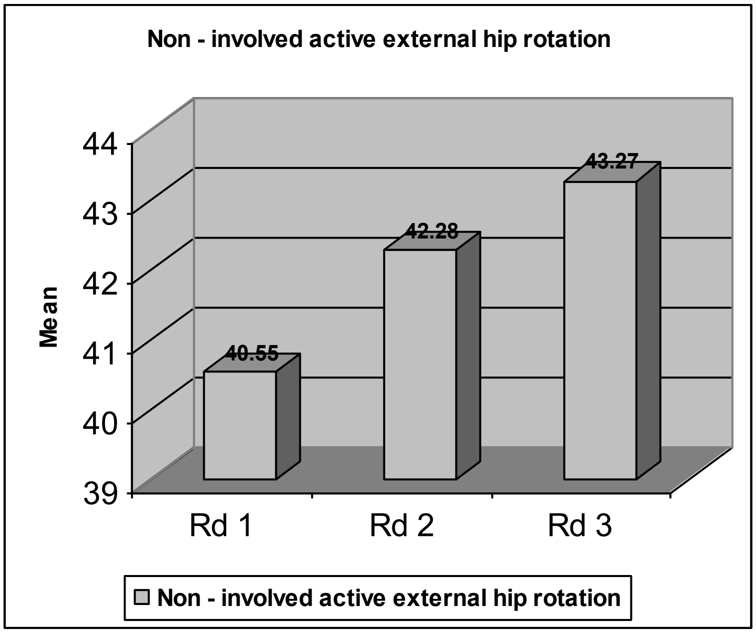

Figure 19: Inclinometer mean readings of active external hip rotation on side not manipulated.

Table 14: The results of the Paired T-test comparing readings one, two and three of active hip external rotation on the non - involved side i.e. not manipulated.

	Non - Involved Active Hip External Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	40.55	10.87	**0.098**
	Reading 2	42.28	10.89	
Pair 2	Reading 2	42.28	10.89	**0.262**
	Reading 3	43.27	10.41	
Pair 3	Reading 1	40.55	10.87	**0.002**
	Reading 3	43.27	10.41	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2 and 2 and 3, which indicates that at α = 0.025 level of significance there is statistically no significant difference when comparing readings 1 and 2 and 2 and 3. The alternate hypothesis is accepted when comparing readings 1 and 3, which indicates that at α = 0.025 level of significance there is statistically a significant difference between 1 and 3.

4.3.2.7. Passive Internal Hip Rotation on Side Not Manipulated.

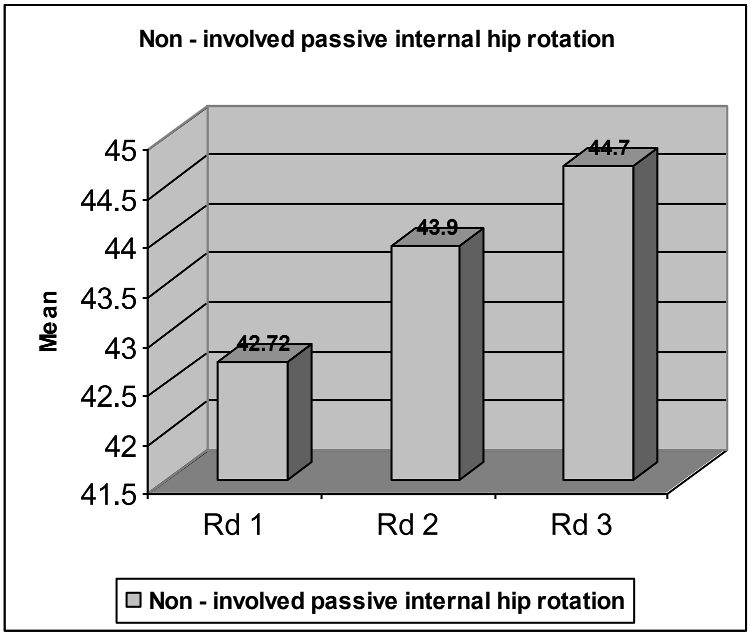

Figure 20: Inclinometer mean readings of passive internal hip rotation on side not manipulated.

Table 15: The results of the Paired T-test comparing readings one, two and three of passive hip internal rotation on the non - involved side i.e. not manipulated.

	Non - Involved Passive Hip Internal Rotation	Mean	Standard Deviation	P-Value
Pair 1	Reading 1	42.72	9.24	**0.057**
	Reading 2	43.90	8.25	
Pair 2	Reading 2	43.90	8.25	**0.362**
	Reading 3	44.70	8.83	
Pair 3	Reading 1	42.72	9.24	**0.055**
	Reading 3	44.70	8.83	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2, 2 and 3 and 1 and 3 which indicates that at α = 0.025 level of

significance there is statistically no significant difference when comparing theses readings.

4.3.2.8. Passive External Hip Rotation on Side Not Manipulated.

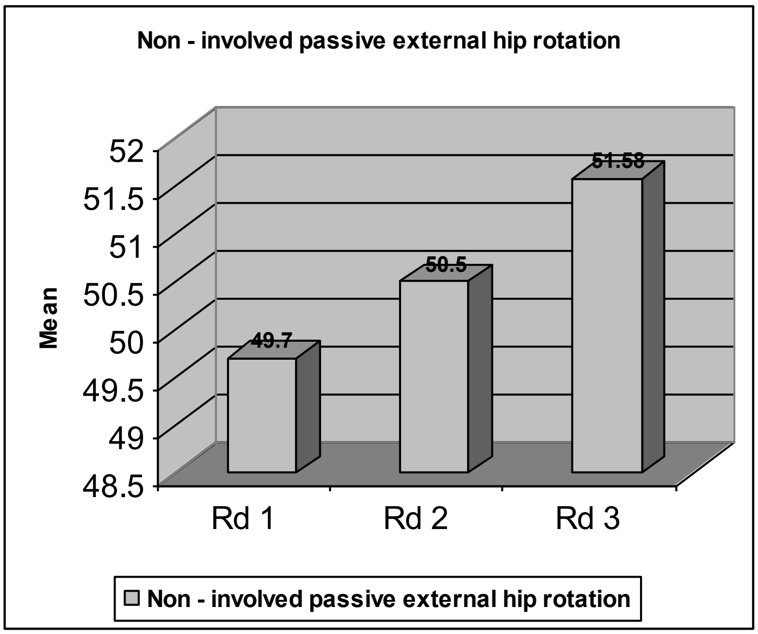

Figure 21: Inclinometer mean readings of passive external hip rotation on side not manipulated.

Table 16: The results of the Paired T-test comparing readings one, two and three of passive hip external rotation on the non - involved side i.e. not manipulated.

	Non - Involved Passive Hip External Rotation	**Mean**	**Standard Deviation**	**P-Value**
Pair 1	Reading 1	49.70	9.45	**0.353**
	Reading 2	50.50	8.25	
Pair 2	Reading 2	50.50	8.25	**0.191**
	Reading 3	51.58	8.46	
Pair 3	Reading 1	49.70	9.45	**0.040**
	Reading 3	51.58	8.46	

For the above readings the null hypothesis is accepted when comparing readings 1 and 2, 2 and 3 and 1 and 3 which indicates that at α = 0.025 level of significance there is statistically no significant difference when comparing theses readings.

CHAPTER FIVE

DISCUSSION OF RESULTS:

5.1. Introduction

This chapter will discuss all the demographic data and objective results of the goniometer and inclinometer readings, all of which have been presented in chapter four.

Intragroup Analysis – The evaluation of the intragroup data results from the first, second and third readings represent the effect of a S.I. manipulation on hip rotation ranges of motion (active and passive rotation).

5.2. Demographic Data

5.2.1. Gender Distribution:

The gender distribution within the sample group of sixty subjects (Table 1) was identical (30 females and 30 males). This study is therefore in contrast to other studies (Schwarzer et al. 1995, Bernard and Cassidy 1991, Cibulka and Koldehoff (1999) which indicate that they found a higher proportion of pain of S.I. origin amongst females rather than males. A study by Cibulka and Koldehoff (1999) revealed a relatively higher ratio of females (46 female to 40 male) with S.I. joint dysfunction when compared to the ratio of male to female patients with low back pain. However in both the studies of Schwarzer et al. (1995) and Cibulka and Koldehoff (1999) the difference between females and males was not large and therefore it is hypothesised that if this study had a larger sample group, gender differences may have been more apparent.

5.2.2. Age Distribution:

The average age (Table 2) distribution of the sample group was relatively similar: 18-25 years was 21.6%, 26-33 years was 33.3%, 34-41 years was 20% and 42-49 years was 25%. Bernard and Casssidy (1991:2107) claim that S.I. syndrome presents commonly amongst the middle age group, however they do not indicate what the age range for the miidle age group was. In a similar study (Moodley 2002) on S.I. syndrome, with a sample size of 60 patients, it was found that the average age was 38.08 years however this study included patients from 18 –65 years. The present study was limited to an 18- 49 year age group and therefore the average age of 33.3 years may be slightly lower than what is reported in the literature above.

5.2.3. Ethnic Distribution:

The ethnic distribution (Table 3) within the sample group showed a higher proportion of white subjects (63.3%) than the other race groups: Indian (21.6%), indigenous African (10%) and other (5%). This is in keeping with the ethnic distribution of other research studies that have been performed at the Chiropractic Clinic (Bekker-Smith 2002, Moodley 2002, Marszalek 2002). Contributing factors to the above racial distribution were the following:

- adverts were in English only
- adverts were distributed in mostly “white areas”
- chiropractic is a relatively unknown profession in the indigenous African community
- the majority of patients attending the chiropractic clinic are white

Due to the above reasons this study is not a true representation of the local population, which is unfortunate because it was shown that indigenous Africans and Indians represent a significant proportion of low back pain sufferers in Kwa-Zulu Natal (Van der Meulen 1997, Docrat 1999). In Southern Africa, Worku (2000) analyzed a sample of 4001 mothers in Lesotho and found a total of 405 (10.12%) had severe LBP, 513 (12.82%) had moderate LBP and 1422 (35.54%) had mild back pain. Which lends further support to the above research that low back pain is very prominent in the indigenous African population in Southern Africa.

5.2.4. Motion palpation findings:

The following motion palpation (Table 4) findings were found in this study:

- right upper flexion 38.3%,
- left upper flexion 31.6%,
- right mid flexion 8.3%,
- left middle flexion 6.6%,
- right lower flexion 6.6%,
- left lower flexion 3.3% and
- right upper extension 5%.

This study therefore revealed a right - sided predominance of S.I. syndrome: right S.I. (58.3%) and left S.I. (41.6%). This is in keeping with a research study by Moodley (2002:87) that also found a right side predominance of S.I. syndrome. Toussaint et al. (1999) support the above findings in that they found a ratio of 60:40 right side predominance of S.I. syndrome in 480 construction workers.

No literature studies were found that investigated the proportion of motion palpation findings in S.I. syndrome. However from this study it appears that the most common motion palpation findings in S.I. syndrome are upper flexion restrictions. Furthermore this study indicates that motion palpation findings of extension restriction are not common (5% in this study). As described in the literature review there is much controversy over the use of motion palpation, it has been described as insufficient in the diagnosis of dysfunctions in the S.I. region and as unreliable (Walker 1992, Harrison et al. 1997, Potter and Rothstein 1985 and Dreyfuss et al. 1994). Therefore the motion palpation findings of this study should be viewed with scepticism. It is suggested that if further studies look at the incidence and prevalence of motion palpation findings in S.I. syndrome that they use multiple examiners and a large battery of motion palpation tests.

5.2.5. Etiological factors in S.I. joint dysfunction:

Finally, the etiology of S.I. syndrome (Table 5) was found to be mostly due to non-traumatic reasons (75%) as compared to traumatic reasons (25%). This present study upholds authors, Bernard and Kirkaldy-Willis (1987) and Bernard and Cassidy (1991) who state that the typical patient with S.I. dysfunction presents with no history of specific inciting trauma. These results were also quite similar to a study by Cibulka and Koldehoff (1999:86) who found in a sample of 219 subjects that 83% had an insidious onset of low back pain while 17% reported an incident of bending, twisting or lifting injury. Some of the traumatic causes for S.I. syndrome in this study were as follows: falling down stairs, lifting heavy objects, carrying heavy objects, squatting exercises at gym, car accidents, a rugby injury and a horse riding accident.

5.3. Intragroup Analysis: Paired T-Test

Objective Measurements:

The paired t-test was carried out on the goniometer and inclinometer readings of active and passive internal and external hip rotation. The first reading was taken prior to manipulation of the S.I. joint on the involved side (side of S.I. syndrome), the second reading was taken 10 minutes after the manipulation and the third reading was taken one week later.

<u>5.3.1. Active internal hip rotation on involved side (side of manipulation).</u>

For the goniometer (Table 1) the mean difference between the 1st and 2nd readings was an increase of 5.3°, the 2nd and 3rd readings a decrease of 0.86° and between the 1st and 3rd readings an increase of 4.44°. For the inclinometer (table 9) the mean difference between the 1st and 2nd readings was an increase of 4.72°, the 2nd and 3rd readings a decrease of 1.57° and between the 1st and 3rd readings an increase of 3.15°.

For both the goniometer and the inclinometer readings the following was found:

- there was no statistically significant ($\alpha < 0.025$) difference between reading 2 and reading 3.
- There was a statistically significant difference ($\alpha < 0.025$) between reading 1 and 2 and between reading 1 and 3.

This indicates that following a S.I. manipulation there was a statistically significant difference in the hip active internal rotation on the side of S.I. syndrome at both a 10-minute and 1 week follow up.

There was also no statistically significant difference between the 10-minute and the 1-week follow up.

5.3.2. Active external hip rotation on involved side (side of manipulation).

For the goniometer (Table 2) the mean difference between the 1st and 2nd readings was an increase of 1.4°, the 2nd and 3rd readings a decrease of 1.27° and between the 1st and 3rd readings an increase of 0.13°. For the inclinometer (table10) the mean difference between the 1st and 2nd readings was an increase of 1.14°, the 2nd and 3rd readings a decrease of 1.6° and between the 1st and 3rd readings a decrease of 0.46°.

For both the goniometer and the inclinometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between readings 1and 2, 2 and 3 and 1 and 3.

This indicates that following a S.I. manipulation there was no statistically significant difference in the hip active external rotation on the side of S.I. syndrome at both a 10-minute and 1-week follow up and between the 10-minute and 1-week follow up.

5.3.3. Passive internal hip rotation on involved side (side of manipulation).

For the goniometer (Table 3) the mean difference between the 1st and 2nd readings was an increase of 3.7°, the 2nd and 3rd readings an increase of 1.35° and between the 1st and 3rd readings an increase of 5.05°. For the inclinometer (table 10) the mean difference between the 1st and 2nd readings was an increase of 3.98°, the 2nd and 3rd readings a decrease of 0.12° and between the 1st and 3rd readings an increase of 3.86°.

For both the goniometer and the inclinometer readings the following was found:

- there was no statistically significant ($\alpha < 0.025$) difference between reading 2 and reading 3.
- There was a statistically significant difference ($\alpha < 0.025$) between reading 1 and 2 and between reading 1 and 3.

This indicates that following a S.I. manipulation there was a statistically significant difference in the hip passive internal rotation on the side of S.I. syndrome at both a 10-minute and 1-week follow up. There was also no statistically significant difference between the 10-minute and the 1-week follow up.

5.3.4. Passive external hip rotation on involved side (side of manipulation).

For the goniometer (Table 4) the mean difference between the 1st and 2nd readings was an increase of 0.35°, the 2nd and 3rd readings a decrease of 0.81° and between the 1st and 3rd readings a decrease of 0.46 °. For the inclinometer (table12) the mean difference between the 1st and 2nd readings was a decrease of 0.15°, the 2nd and 3rd readings a decrease of 0.98° and between the 1st and 3rd readings a decrease of 1.13°.

For both the goniometer and the inclinometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between readings 1and 2, 2 and 3 and 1 and 3.

This indicates that following a S.I. manipulation there was no statistically significant difference in the hip passive external rotation on the side of S.I. syndrome at both a 10-minute and 1-week follow up and between the 10-minute and 1-week follow up.

5.3.5. Summary of results - on the side of manipulation:

In conclusion it would appear that a S.I. manipulation has an effect on hip rotation on the side of S.I. syndrome.

Both the goniometer and inclinometer readings showed that there was a statistically significant ($\alpha < 0.025$) increase in hip **active and passive internal rotation**, 10 minutes and 1 week following a manipulation to the involved S.I. joint.

There was no statistically significant difference in hip active and passive internal rotation between the 10-minute and one week follow up. This finding was to be expected because no treatment was given between these two readings.

Both the goniometer and inclinometer readings showed that there was not a statistically significant ($\alpha < 0.025$) difference in hip **active and passive external rotation** at both a 10-minute and 1-week follow up and between the 10-minute and 1-week follow up.

5.3.6. Discussion of Results – on the side of manipulation:

To explain the statistically significant ($\alpha < 0.025$) increase in hip **active and passive internal rotation** following a S.I. manipulation to the involved S.I. joint the literature review needs to be recalled.

Anatomy:

It was explained that shortening of the piriformis muscle can produce excessive external rotation and restrict internal rotation (Woerman, 1989). Also, that internal rotation is limited by tension in the other more powerful external rotator muscles (gluteus maximus, medius and minimus) [Reid 1992, Palastanga et al. 1998].

Therefore it was hypothesized that in S.I. syndrome internal rotation may be decreased when these muscles in the region of the S.I. joint are in spasm (Reid 1992, Moore 1992, Palastanga 1998, DeFranca 1996).

It was shown that the above muscles have a similar innervation to the S.I. joint. Also that S.I. joint and the hip joint have a similar innervation (Reid 1992, Moore 1992).

Manipulation:
Furthermore it was explained that a S.I. manipulation may reduce hypertonicity or spasm in the posterior muscles (Kirkaldy-Willis and Burton 1992) and relaxes hypertonic muscles (Shakelle 1994). Also a manipulation may stimulate joint mechanoreceptors and / or influence the excitability of motor neurons and this in turn creates reflexogenic muscle tone changes in the muscles that surround the joint (DeFranca 1996:295). This reflexogenic change in muscle tone may again change or reduce the hypertonicity in the muscles in the region of the S.I. joint (Korr 1994, Wyke 1967, Patterson and Steinmetz 1986). By stimulating joint mechanoreceptors, it is also hypothesised that a manipulation may lead to joint relaxation or normalization and due to the fact that the S.I. joint and hip joint have a similar innervation (Moore and Dalley 1999); it is thought that the manipulation may have lead to relaxation and normalization of the hip joint.

Therefore it is thought that the increase in hip internal active and passive rotation was due to the manipulation decreasing the muscle tone or spasm in the external hip rotators (piriformis, gluteus maximus, medius and minimus) either through:

- a direct affect on the muscles themselves or
- through a neurological feedback loop that caused a reflexogenic change in muscle tone, as described above (Korr 1994, Wyke 1967, Patterson and Steinmetz 1986)

If spasm in these muscles did restrict internal rotation of the affected hip then following relaxation after a manipulation the normal range of internal rotation was restored and hence an increase in active and passive internal rotation of the hip.

The increase in hip internal active and passsive rotation may also have been due to manipulation causing relaxation and normalization of the hip joint due to its effect on joint mechanoreceptors as described above.

There was no statistically significant ($\alpha < 0.025$) difference in hip **active and passive external rotation** following a S.I. manipulation to the involved S.I. joint. The researcher feels that this is due to the fact that the external rotator muscles on the side of the S.I. syndrome were in a state of spasm (Harrison et al. 1997 and Bernard and Cassidy 1991) as described above. Therefore the hip joint on that side was already in a state of almost maximum external rotation. Relaxation of these muscles as described above would not have changed the readings for the movement of external rotation to a great degree; this is due to the fact that the hip joint would still have been able to move to a maximum externally rotated position whether actively or passively in its contracted state. This is supported by the fact that when looking at the means there is a very small change (average change for both measuring instruments was 0.85°) when looking at active and passive external hip rotation.

5.3.7. Clinical significance of the Results – on the side of manipulation:

When looking at the literature it was shown that the normal values for internal and external hip rotation ROM vary among different reports (Ellison et al. 1990:537). However it seems that in the hip there should be approximately 45 degrees of both internal and external rotation (Roach and Miles 1991, Reid 1992). When looking at the goniometer mean readings it was shown that active internal rotation increased from 34.23° to 38.67° and the inclinometer mean reading for this measurement improved from 30.48° to 33.63°. Therefore both theses readings fell short of the approximate 45° benchmark. Furthermore, (Ellison et al. 1990) conclude that an imbalance of hip rotation in which internal rotation is less than external rotation, may predispose a person to back pain or may be a result of back pain, or both.

However when looking at the results and comparing internal and external rotation means a reasonably large difference between internal and external hip rotation was found at the final reading:

Goniometer:

Active internal hip rotation 38.67° versus Active external hip rotation 46.10°

Passive internal hip rotation 48.50° versus Passive external hip rotation 54.12°

Inclinometer

Active internal hip rotation 33.63° versus Active external hip rotation 43.77°.

Passive internal hip rotation 43.88° versus Passive external hip rotation 52.48°

This indicates clinically that while there was a statistically significant improvement in hip active and passive internal rotation, it does appear that particularly internal hip rotation was still restricted. Due to the fact that after only one manipulation there was a statistically significant effect in hip active and passive internal rotation it is hypothesized that further S.I. manipulations would improve the internal hip rotation restriction and the imbalances found above. It is suggested that further studies should follow a normal treatment protocol for the treatment of S.I. syndrome, which usually involves 6 to 8 treatments over a 4- week period (Kruger 2003). Measurements of hip rotation should be taken initially, during and following the treatment period to test the above hypotheses and establish whether a series of S.I. manipulations does in fact correct differences between active and passive hip rotation.

Clinically the fact that there was no statistically significant difference in hip active and passive internal rotation between the 10-minute and one week follow up. Indicates that the effects of the manipulation are achieved immediately and there is no further improvement. Again this indicates that more than one manipulation should be given to establish whether any further change in rotation could be achieved.

The fact that there was no statistically significant difference in active and passive external rotation indicates that following a manipulation there will not be a discernible clinical difference noted in this particular movement. Therefore when treating either the S.I. joint or the hip joint it is hypothesized that improvements in internal hip rotation should be concentrated on. Furthermore this research suggests that internal rotation improvements could be seen as one of outcome measures that should be assessed following a S.I. manipulation.

Finally another important clinical implication of the above results is that when treating hip pathology the S.I. joint should not be ignored. Particularly if when treating the hip joint, no further improvement can be achieved and a plateau is reached then it is suggested that a full treatment protocol of manipulations is given to the S.I. joint.

5.3.8. Active internal hip rotation on non - involved side (not manipulated).

For the goniometer (Table 5) the mean difference between the 1st and 2nd readings was an increase of 2.6°, the 2nd and 3rd readings an increase of 0.11° and between the 1st and 3rd readings an increase of 2.71°. For the inclinometer (table 13) the mean difference between the 1st and 2nd readings was an increase of 1.73°, the 2nd and 3rd readings an increase of 0.58° and between the 1st and 3rd readings an increase of 2.31°.

For the goniometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between reading 2 and reading 3.
- There was a statistically significant difference ($\alpha < 0.025$) between reading 1 and 2 and between reading 1 and 3.

For the inclinometer readings the following was found:

- There was no statistically significant difference between reading 1 and 2 (p-value was 0.027, significance level must be less than 0.025) and between reading 2 and 3.
- There was a statistically significance difference between 1 and 3

Therefore if what is common, between the two measuring instruments, is looked at then it would appear that following a S.I. manipulation there was a statistically significant difference in the hip active internal rotation on the opposite side of the S.I. syndrome at the 1-week follow up stage.

It would also seem likely that there may be a difference in hip active internal rotation on the opposite side to the S.I. syndrome due to the fact that the goniometer readings indicated this and the inclinometer reading was 0.002 short of being significant (i.e : p-value = 0.027).

There was also no statistically significant difference between the 10-minute and the 1-week follow up.

5.3.9. <u>Active external hip rotation on non - involved side (not manipulated).</u>

For the goniometer (Table 6) the mean difference between the 1st and 2nd readings was an increase of 1.81°, the 2nd and 3rd readings an increase of 1.54° and between the 1st and 3rd readings an increase of 3.35°. For the inclinometer (table14) the mean difference between the 1st and 2nd readings was an increase of 1.73°, the 2nd and 3rd readings an increase of 0.99° and between the 1st and 3rd readings an increase of 2.72°.

For both the goniometer and the inclinometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between readings 1and 2 and 2 and 3.
- There was a statistically significant ($\alpha < 0.025$) difference between readings 1 and 3.

This indicates that following a S.I. manipulation there was no statistically significant difference in the hip active external rotation on the opposite side of the S.I. syndrome 10 minutes following a S.I. manipulation and between the 10-minute and 1-week follow up.

There was a statistically significant difference found in the hip active external rotation on the opposite side of the S.I. syndrome 1-week following a S.I. manipulation.

5.3.10. Passive internal hip rotation on non - involved side (not manipulated).

For the goniometer (Table 7) the mean difference between the 1st and 2nd readings was an increase of 1.84°, the 2nd and 3rd readings an increase of 1.01° and between the 1st and 3rd readings an increase of 2.85°. For the inclinometer (table 15) the mean difference between the 1st and 2nd readings was an increase of 1.18°, the 2nd and 3rd readings an increase of 0.80° and between the 1st and 3rd readings an increase of 1.98°.

For the goniometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between reading 2 and reading 3.
- There was a statistically significant difference ($\alpha < 0.025$) between reading 1 and 2 and between reading 1 and 3.

For the inclinometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between readings 1and 2, 2 and 3 and 1 and 3.

Therefore if what is common, between the two measuring instruments, is looked at then this indicates that following a S.I. manipulation there was not a statistically significant difference in the hip passive internal rotation on the opposite side of the S.I. syndrome between the 10 minute reading and the 1 week follow up.

The goniometer readings indicate that there is a statistically significant difference found in hip passive internal rotation on the opposite side of the S.I. syndrome 10 minutes and 1 week following a S.I. manipulation.

However the inclinometer readings indicate that there is not a statistically significant difference found in hip passive internal rotation on the opposite side of the S.I. syndrome 10 minutes and 1 week following a S.I. manipulation.

5.3.11. Passive external hip rotation on non-involved side (not manipulated).

For the goniometer (Table 8) the mean difference between the 1st and 2nd readings was an increase of 1.33°, the 2nd and 3rd readings an increase of 2.1° and between the 1st and 3rd readings an increase of 3.43 °. For the inclinometer (table16) the mean difference between the 1st and 2nd readings was an increase of 0.80°, the 2^{nd} and 3^{rd} readings an increase of 1.08° and between the 1^{st} and 3^{rd} readings a decrease of 1.88°.

For the goniometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between reading 1 and reading 2.
- There was a statistically significant difference ($\alpha < 0.025$) between reading 2 and 3 and between reading 1 and 3.

For the inclinometer readings the following was found:

- There was no statistically significant ($\alpha < 0.025$) difference between readings 1and 2, 2 and 3 and 1 and 3.

Therefore if what is common, between the two measuring instruments, is looked at then this indicates that following a S.I. manipulation there was not a statistically significant difference in the hip passive external rotation on the opposite side of the S.I. syndrome in the reading 10 minutes after the manipulation.

The goniometer readings indicate that there is a statistically significant difference found in hip passive external rotation on the opposite side of the S.I. syndrome between the 10 minute reading and the 1 week follow up and between the 1^{st} reading and the 1 week follow up.

However the inclinometer readings indicate that there is not a statistically significant difference found in hip passive external rotation on the opposite side of the S.I. syndrome between the 10-minute reading and the 1-week follow up. Also between the 1^{st} reading and the 1-week follow up.

5.3.12. Summary of Results – for the side not manipulated

In conclusion when looking at the means it was interesting to note that for all the above movements on the non-involved side there was a gradual increase from the initial reading to the reading 10 minutes after manipulation and to the reading 1 week later. However as a whole these increases were smaller than those on the involved side.

When looking at the statistical significance of the above results it would appear that a S.I. manipulation has an effect on hip rotation on the opposite side to that of the S.I. syndrome. Both the goniometer and inclinometer readings showed that there was a statistically significant ($\alpha < 0.025$) increase in hip **active external rotation**, 10 minutes and 1 week following a manipulation to the involved S.I. joint. There was no statistically significant difference in hip active external rotation between the 10 minute and one week follow up. This finding was to be expected because no treatment was given between these two readings.

For hip **active internal rotation** it was found that for both the goniometer and inclinometer there was a statistically significant ($\alpha < 0.025$) increase between the first reading and the 1-week follow up after a manipulation to the opposite involved S.I. joint. It would also appear that there could be a statistically significant ($\alpha < 0.025$) increase (goniometer was significant $p = 0.005$, inclinometer almost significant $p = 0.027$) in hip active internal rotation between the first reading and the 10-minute following a manipulation to the opposite involved S.I. joint. Again there was no statistically significant difference in hip active internal rotation between the 10-minute and one week follow up. This finding was to be expected because no treatment was given between these two readings.

For **passive internal and external rotation** the goniometer and inclinometer readings indicated different things. The inclinometer readings indicated that there was no statistically significant ($\alpha < 0.025$) difference between any of the readings for hip passive internal and external rotation following a manipulation to the opposite involved S.I. joint. The goniometer readings indicated that there is a statistically significant ($\alpha < 0.025$) difference for passive internal rotation 10 minutes and 1 week following a manipulation to the opposite involved S.I. joint. Also that for passive external rotation there is a statistically significant ($\alpha < 0.025$) difference between the 10-minute reading and the 1 week follow up and between the 1st reading and the 1 week follow up.

5.3.13. Discussion of results – for the side not manipulated

It is more difficult to explain the changes that resulted in hip rotation on the opposite side to that of the S.I. syndrome following a S.I. manipulation.

There was a gradual increase in the means for all the hip rotation movements on the opposite side. It was explained above that a S.I. manipulation may reduce hypertonicity or spasm in the posterior muscles (Kirkaldy-Willis and Burton 1992) and relaxes hypertonic muscles (Shakelle 1994). Also a manipulation may stimulate joint mechanoreceptors and / or influence the excitability of motor neurons and this in turn creates reflexogenic muscle tone changes in the muscles that surround the joint (DeFranca 1996:295). This reflexogenic change in muscle tone may again change or reduce the hypertonicity in the muscles in the region of the S.I. joint (Korr 1994, Wyke 1967, Patterson and Steinmetz 1986). By stimulating joint mechanoreceptors, it is also hypothesised that a manipulation may lead to joint relaxation or normalization and due to the fact that the S.I. joint and hip joint have a similar innervation (Moore and Dalley 1999); it is thought that the manipulation may have lead to relaxation and normalization of the hip joint.

Therefore it appears that a S.I. manipulation either through:

- ❖ a direct affect on the muscles themselves (Kirkaldy-Willis and Burton 1992) or
- ❖ a neurological feedback to the muscles (De Franca 1996, Korr 1994, Wyke 1967, Patterson and Steinmetz 1986) or
- ❖ by leading to a hypothesised relaxation and normalization of the hip joint

may have an effect to increase the rotation movements of the hip on the other side to the side of S.I. syndrome (manipulated side).

When looking at the results from both measuring instruments it would appear likely that there is a statistically significant ($\alpha < 0.025$) increase in active internal and external hip rotation on the opposite side. Only the goniometer results indicate that there is a statistically significant ($\alpha < 0.025$) increase in passive internal and external hip on the opposite side.

To explain these results it is hypothesised by the researcher that there may also be a slight restriction (that is not reported in the literature) in rotation movements in the hip opposite to the side of S.I. syndrome. This may be due to muscle hypertonicity on that side or due to neurological feedback to that hip joint itself. Therefore it is hypothesized that following a manipulation to the side of S.I. syndrome this may have an effect to reduce muscle spasm in the posterior muscles (as described above) on the opposite side. Also through a neurological feedback (as described above) this may also have an effect to restore normal hip movement in the hip joint itself on the opposite side. Thus, this would explain the increases in the means that was noted as well as the significant results found.

5.3.14. Clinical significance of results – for the side not manipulated

When looking at the goniometer mean readings it was shown that active internal rotation increased from 37.47° to 40.18° and the inclinometer mean reading for this measurement improved from 32.87° to 35.18°. Therefore both theses readings fell short of the approximate 45° benchmark as described in the literature above. Furthermore, (Ellison et al. 1990) conclude that an imbalance of hip rotation in which internal rotation is less than external rotation, may predispose a person to back pain or may be a result of back pain, or both.

However when looking at the results and comparing internal and external rotation means a reasonably large difference between internal and external hip rotation was found at the final reading:

Goniometer:

Active internal hip rotation 40.18° versus Active external hip rotation 45.57°

Passive internal hip rotation 49.43° versus Passive external hip rotation 54.03°

Inclinometer

Active internal hip rotation 35.18° versus Active external hip rotation 43.27°

Passive internal hip rotation 44.70° versus Passive external hip rotation 51.58°

This therefore supports the hypotheses above that there may also be a slight restriction (that is not reported in the literature) in rotation movements in the hip opposite to the side of S.I. syndrome. Therefore, clinically while there was a statistically significant improvement in hip active and passive internal rotation on the side opposite to the S.I. syndrome (manipulated side), it does appear that particularly active internal hip rotation was still somewhat restricted. Due to the fact that after only one manipulation there was a statistically significant effect in hip active and passive internal rotation on the opposite side to the S.I. syndrome it is hypothesised that further S.I. manipulations would improve the internal hip rotation restrictions and the imbalances found above. It is suggested that further studies should look in more detail at this noted relationship between hip rotation movements on the side opposite to the side of S.I. syndrome. It is also suggested that such studies should follow a normal treatment protocol for the treatment of

S.I. syndrome, which usually involves 6 to 8 treatments over a 4- week period (Kruger 2003).

When looking at which results were clinically significant it was found that there was discrepancy between the goniometer and inclinometer readings for most movements. Therefore, again further research is needed to investigate the relationship between S.I. syndrome and hip rotation on the opposite side. As well as research on the effect of a S.I. manipulation(s) on the rotation movements of the opposite hip.

Again this study has implications for treating hip pathology in that when assessing or treating the hip joint the opposite S.I. joint should also not be ignored. Particularly if when treating the hip joint, no further improvement can be achieved and a plateau is reached then it is suggested that the opposite S.I. joint is assessed and a full treatment protocol of manipulations is given to that S.I. joint if deemed necessary.

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

6.1. Conclusion

The aim of this investigation was to determine the effect of a sacroiliac joint manipulation on hip rotation ranges of motion (active and passive motion) in patients with chronic sacroiliac syndrome in terms of objective measures.

At a 5% level of significance it was found that a S.I. manipulation has an effect on hip rotation on the side of S.I. syndrome. A statistically significant increase in hip active and passive internal rotation was found 10 minutes and 1 week following a manipulation to the involved S.I. joint. No statistically significant difference was found in hip active and passive external rotation following a manipulation to the side of S.I. syndrome.

At a 5% level of significance it was also found that a S.I. manipulation has an effect on hip rotation on the opposite side to the side of S.I. syndrome (manipulated side). When looking at the data means of active and passive hip rotation on the uninvolved side there was an gradual increase found in hip active and passive rotation in all the readings following a manipulation to the involved (opposite) S.I. joint. When looking at statistically significant results it would appear that a S.I. manipulation causes an increase in active internal and external hip rotation on the uninvolved side. The two measuring instruments produced conflicting results for the movements of passive internal and external hip rotation and thus no conclusive assumptions and / or recommendations can be made with respect to these particular movements.

In conclusion there is a great deal of literature and studies in support of the use of manipulation for low back pain and S.I. syndrome (Manga et al. 1993; Meade et al. 1990,1995; Assendelft et al. 1992; Cassidy and Mierau 1992; Kirkaldy-Willis and Burton 1992; Hendler et al. 1995; Osterbauer et al.1993; Herzog et al. 1991; Walker 1992; Harrison et al. 1997; Shakelle 1994; DeFranca 1996:295; Indahl et al. 1997; Murphy et al. 1995). Furthermore, research has shown that there seems to be a correlation between low back pain, more specifically S.I. pain and restrictions in hip rotation (Fairbank et al. 1984; Mellin 1988; Ellison et al. 1990; Cibulka et al. 1998; Cibulka 1992; Woerman 1989; Porterfield and DeRosa 1991).

This study gives an indication that manipulation appears to be the solution to the above noted hip restrictions. Although it was not known whether restrictions in hip rotation were a causative factor in S.I. syndrome or as a result of alterations due to the S.I. syndrome, findings suggest the S.I. manipulation improves (decreases) the presence of hip restrictions. Therefore when attempting to treat S.I. syndrome regardless of whether the hip restrictions are a cause or a result of the S.I. syndrome the fact that manipulation reduces these restrictions lends weight to the argument for the use of manipulation in the case of S.I. syndrome. Furthermore when treating hip pathology this study also indicates that both S.I. joints should be assessed and if deemed necessary treatment of these joints should be included in any treatment protocol for the hip.

Therefore the results of this study strengthen the argument for using manipulation particularly for the treatment of S.I. syndrome due to the fact that it does have an effect on hip rotation. Furthermore the practitioner should include S.I. manipulation in the treatment of hip conditions especially when the S.I. if untreated may not allow full resolution of the hip pathology. Furthermore when trying to explain these results it seems exceedingly more likely that a manipulation does indeed have a biomechanical, neurological and physiological effects on both local and more distant structures related to the innervation at the level of the manipulation.

While this study does indicate that in S.I. syndrome a manipulation does seem to have an effect on hip rotation bilaterally; more in depth, statistically significant research needs to be done to explore in more detail the dynamics of this relationship.

6.2. Recommendations

In South Africa there is a unique opportunity to do research with different ethic and economic groups and this should be utilised. South African studies should be a true reflection of the population demographics in order to understand which treatment protocols achieve the best outcomes within the different communities. In this study the ethnic demographics of the population of South Africa was not adequately reflected, therefore it is suggested that further studies through their patient recruitment ensure that these ethnic demographics of the population are adequately represented.

Due to the fact that the sample size in this study was relatively small and also that there has been no similar research found in this particular area, it is suggested that this research is a pilot study. Therefore further studies should use a larger sample size which would strengthen the conclusions made in this study. It would also ensure that subtle changes in the objective data are ascertained. Furthermore a larger sample size would minimise the chance of incorrectly accepting the null hypothesis (Type II error).

The undergraduate researcher has a lack of experience in both clinical expertise and in the dynamics of the research process. Thus it is suggested that their results may be deemed as less reliable than examiners who are experienced in private practice as well as in the research process. However due to the fact that this pilot study did find some statistically significant results it is suggested that any further research be carried out by experienced clinical and research practitioners.

To ensure more statistically significant results and homogeneity within the sample group, it is recommended that stratification be included in future studies. For example stratification could be employed with respect to age, gender, severity of complaint, race, type of motion palpation finding. Stratification would ensure that any results would be more statistically significant and also inferences could be drawn between any results and that particular stratified group.

While the goniometer and inclinometer gave similar readings in this study it is felt that the goniometer used in this study was a less reliable measuring tool. This could have been one of the reasons to explain why there was differences found in the hip measurements on the non-manipulated side. It is thought that the goniometer is less reliable due to the fact that the researcher had to use their vision to estimate when the arm of the goniometer was exactly in line with the tibia (as described in Chapter 3). This estimation could lead to possible examiner bias due to the fact that there is no definite reading given. In contrast the inclinometer gave a digital reading and it is thought that this should reduce the chance for error. If the goniometer is to be used again as a measuring tool this should only be done with neutral, blinded observers taking these readings. Through this process one may be able to measure inter-examiner reliability of the measuring instrument. To reduce error another option would be to take a number of hip measurement readings and take an average of these to get a more accurate result. However one problem with this method would be that a number of readings would have the undesired effect of mobilizing the hip joint, which could have a negative effect on the results.

In order to reduce examiner bias in a study such as this it is imperative that blinded, independent examiners record the objective measurements (i.e. the measurements are taken by examiners that have no knowledge of the particular research being undertaken). If these readings are blinded, this would lead to the results obtained being considered more statistically significant.

To lend further support to a study such as this a treatment group should be compared to a placebo group to ensure any changes observed in hip rotation are indeed due to the manipulation delivered. However there are methodological problems and ethical considerations in attempting to deliver a sham manipulation to a placebo group.

Due to the fact that a side posture S.I. manipulation does have an effect on the S.I. joint, the hip joint and on the muscles responsible for hip rotation it is suggested (Peers, 2003) that in future studies a S.I. manipulation is compared to a control group in which only the hip rotators are stretched. Then inter group results could be statistically assessed to determine the effect of a S.I. joint manipulation as compared to muscle stretching on hip rotation ranges of motion. Furthermore it has been suggested (Peers, 2003) that a S.I. joint manipulation other than a side posture movement such as a Thompson drop or toggle manipulation should have been used. These two procedures would negate the effects of stretching the hip rotator muscles that is inherent in the side posture manipulation. It could then be assessed if it is the actual manipulation that has an effect on hip rotation ranges of motion in patients suffering with chronic S.I. syndrome.

As a pilot study the subjects only received one manipulative treatment and the effects on hip rotation were noted. As discussed in Chapter 5 at the final reading it still appeared as if there were still hip restrictions present in both hips after a manipulation to the side of S.I. syndrome. When treating a chronic S.I. syndrome a chiropractor will usually give a patient a program of S.I. manipulations. This usually involves 6 to 8 manipulations over a 4-week period (Kruger 2003). Therefore it is suggested that if the true effect of S.I. manipulation on hip rotation, in chronic S.I. syndrome, is investigated then a usual program of manipulation should have been followed and the effects on hip rotation noted. It is hypothesized that this would lead to more statistically significant results and correction of any hip restrictions. Furthermore a one – month follow up should be included with a study such as this to determine the long-term effects of manipulation on hip rotation.

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APPENDIX A

CASE HISTORY

APPENDIX B

LIMITED PHYSICAL EXAMINATION FORM

APPENDIX C

LOWER BACK REGIONAL EXAMINATION

APPENDIX D

HIP REGIONAL EXAMINATION

APPENDIX E

SOAPE NOTE

APPENDIX F

THE ORTHOPAEDIC SACROILIAC RATING SCALE

PATIENT NAME:.................................. **DATE: ……………**

FILE NO.: ....

GAENSLEN'S TEST: ______/2

PATRICK FABER TEST: _____/2

YEOMANN'S TEST: ______/2

POSTERIOR SHEAR TEST: ______/4

TOTAL: ______/10

APPENDIX G

THE SUBJECTS OBJECTIVE GONIOMETER AND INCLINOMETER MEASUREMENTS

PATIENT NAME: .... DATE: ……………

FILE NO.: ....

GONIOMETER MEASUREMENT:

<u>Visit 1</u>
Active hip rotation:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

Reading 2: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

Passive hip rotation:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

Reading 2: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

<u>Visit 2</u>
Active hip rotation:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

Passive hip rotaion:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

INCLINOMETER MEASUREMENT:

Visit 1

Active hip rotation:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

Reading 2: Internal Rotation - Right ………… Left …………
External Rotation -Right ………… Left …………

Total Right: ………… Total Left: …………

Passive hip rotation:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

Reading 2: Internal Rotation - Right ………… Left …………
External Rotation -Right ………… Left …………

Total Right: ………… Total Left: …………

Visit 2

Active hip rotation:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

Passive hip rotation:

Reading 1: Internal Rotation - Right ………… Left …………
External Rotation - Right ………… Left …………

Total Right: ………… Total Left: …………

APPENDIX H

ADVERTISEMENT

Are you aged between 18 - 49 and suffering from

LOW BACK PAIN?

PARTICULARLY PAIN OVER THE BUTTOCK AREA

More effective forms of treatment are currently being researched at the Durban Institute of Technology Chiropractic Clinic.

Should you qualify for this chiropractic research, all consultations and treatment will be free of charge.

FREE TREATMENT

Contact Greg Bisset at the following numbers:

PH. 2042205 or 2042512 for more information

APPENDIX I

TELEPHONIC INTERVIEW

TELEPHONE QUESTIONS

1. What is your age?
2. Where is your pain located?
3. Does the pain progress to other areas? Y/N
4. How long have you been suffering with this pain?
5. Do you experience any weakness, numbness, tingling or pins and needles in your legs? Y/N
6. Have you had any lower back or hip surgery? Y/N
7. Have you ever been diagnosed by a medical professional with any sort of low back or hip condition? Y/N
8. Besides for the pain do you consider yourself well at the present? Y/N
9. Are you able to attend two consultations, over a one-week period at the Durban Institute of Technology, Berea campus? Y/N

APPENDIX J

LETTER OF INFORMATION

Dear Participant

Welcome to my research project.

Title of Research: The effect of a sacroiliac joint manipulation on the hip rotation ranges of motion in patients suffering with chronic sacroiliac joint syndrome.

NAME OF RESEARCH STUDENT
Greg Bisset Contact number: (031) 204-2205 or 204-2512

NAME OF RESEARCH SUPERVISOR
Dr C. Korporaal Contact number: (031) 204-2094 or 204-2611

You have been selected to take part in a clinical trial assessing the effect of a sacroiliac (S.I.) joint manipulation on the hip rotation ranges of motion in patients suffering with chronic sacroiliac syndrome.

Sacroiliac syndrome is a common and frequent cause of low back pain. S.I. syndrome is defined as pain over the joint between the lower spine and pelvis in the region of the upper buttock, which may be accompanied by referred pain over the buttock, side of the leg, groin, posterior thigh, knee, and occasionally to the calf, ankle and foot. Research has found that patients who suffer from sacroiliac syndrome have changes in their hip rotation range of motion. In healthy subjects it has been found that their hip rotation is equal on both sides. However in patients with S.I. syndrome it has been found that that they have more external hip rotation than internal hip rotation on the affected side. The aim of this study is to evaluate the effect of a chiropractic sacroiliac manipulation on these movements of the hip.

Patients selected for this study should benefit from the manipulation given in that they will experience reduced pain and discomfort in the lower back and may have the return of normal biomechanical functioning.

Sixty people will be required to complete this study. All participants will receive treatment. You will be required to attend two consultations over the period of one week. At the first consultation you will be screened for suitability as a participant using a case history, physical examination, low back and hip regional examination. If you are then found to be a suitable candidate, measurements will be taken of your hip active and passive rotation range of motion and treatment will be given. Treatment will consist of a chiropractic side posture manipulation to the affected sacroiliac joint(s). Following this adjustment further measurements of your hip will be taken. At the second visit measurements of the affected hip will be taken and then the patient will receive a normal chiropractic treatment for their low back condition.

If you are taking any medication, or undergoing any other form of treatment for you low back pain, or taking any medication that may have an effect on the symptoms of low back pain, you may be excluded from the study. However if you are taking medication and agree to a 48 hour " wash out" period before commencing the research then you will be eligible to participate. Please try not to alter your normal lifestyle or daily activities in any way as this could interfere with the results of this study.

All treatments will be performed under the supervision of a qualified Chiropractor and will be free of charge. The treatments are safe and are unlikely to cause any discomfort or adverse side-effects however following the manipulation some individuals do sometimes feel some mild discomfort in the lower back region but this is usually of a short-term duration. All patient information is confidential and the results of the study will be made available in the Durban Institute of Technology library in the form of a mini-dissertation and on request at the Chiropractic Depatment.

You are free to withdraw at any stage. Please don’t hesitate to ask questions on any aspect of this study. Your full co-operation will assist the Chiropractic profession in expanding its knowledge of this condition.

Thank you.

Yours sincerely,

Greg Bisset
(Chiropractic intern)

APPENDIX K

LETTER OF INFORMED CONSENT

INFORMED CONSENT FORM

Date………………….

TITLE OF RESEARCH

The effect of a sacroiliac joint manipulation on the hip rotation ranges of motions (active and passive motion) in patients suffering with chronic sacroiliac joint syndrome.

NAME OF RESEARCH STUDENT

Greg Bisset (contact numbers - 0721171691 or 2042205)

NAME OF RESEARCH SUPERVISOR

Dr C. Korporaal (contact numbers - 0832463562 or 2042611)

PLEASE CIRCLE THE APPROPRIATE ANSWER:

1. Have you read the research information sheet? YES /NO
2. Have you had the opportunity to ask questions regarding this study? YES / NO
3. Have you received satisfactory answers to your questions? YES / NO
4. Have you had an opportunity to discuss this study? YES / NO
5. Have you received enough information about this study? YES / NO
6. Who have you spoken to? ……………………………………
7. Do you understand the implications of your involvement in this study? YES / NO
8. Do you understand that you are free to withdraw from this study
    - a) at any time? YES / NO
    - b) without having to give a reason for withdrawing? YES / NO
    - c) without affecting your future health care? YES / NO
9. Do you agree to voluntarily participate in this study? YES / NO

Please ensure that the researcher takes you through each step of the covering letter in order that you understand everything before giving your consent.

PATIENT/SUBJECT

Name………………………. Signature……………………….

WITNESS

Name………………………. Signature……………………….

RESEARCH STUDENT

Name………………………. Signature……………………….

DATE: ……………………………….