

**THE RELATIVE EFFECTIVENESS OF MANIPULATION WITH
AND WITHOUT THE CRAC TECHNIQUE APPLIED TO THE
HAMSTRING MUSCLES IN THE TREATMENT OF
SACRO-ILIAC SYNDROME.**

BY

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the requirements for the Master's Degree in Chiropractic.*

I, Neil Matthew Salter, do declare that this dissertation is representative of
my own work.

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DEDICATION

To my parents, Jeremy and Denise Salter,
for their love and encouragement, which
inspires me to be the best I can be.

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ABSTRACT

Sacroiliac syndrome is a common condition causing low back pain (Mierau et al. 1984, Guo and Zhao 1994). It is a painful, debilitating condition that may cause considerable discomfort (Haldeman 1992:220). According to Frymoyer et al. (1991:2114), sacroiliac syndrome is a frequently overlooked source of low back pain as it may mimic other well known causes of low back pain.

According to McGill (1987), whether one considers sacroiliac syndrome an extensor muscle and aponeurotic insertional strain syndrome, joint disorder or referred pain syndrome, there is little doubt that the large mechanical forces placed on the sacroiliac joint during everyday activities may make this area a site of clinical pain. As long ago as 1905, Goldthwait and Osgood emphasised the mobility of the sacroiliac joint and suggested that an acute or chronic slip, or subluxation of the joint could cause pain and suggested that the variability of the symptoms may be attributable to differing degrees of mobility.

In the last few years the importance of sacroiliac syndrome in the causation of low back pain has gained increasing recognition (Giles

and Singer 1997 : 178). This is partly due to the clinical and radiological studies by Schmid (1980) who demonstrated an increased range of movement than was previously thought to exist. Shaw (1992) and Cibulka (1992) in two independent studies both concluded that the sacroiliac joint is a very common cause of low back pain.

Amongst many authors, the side posture adjustment seems to be the treatment of choice for sacroiliac syndrome (Schafer and Faye 1990:242 ; Bergman 1993:500 ; Gatterman 1990:117 ; Haldeman 1992:221). In addition some authors have found that hamstring spasm is associated with hypomobility of the sacroiliac joints (Travell and Simons 1992:325 ; Reid 1992:569 ; Hammer 1991:119). The latter two authors both recommend manipulation of the hypomobile sacroiliac joint or joints.

Few studies have been performed to determine the combined effects of spinal manipulative therapy with other modalities known to have beneficial physiological effects, especially in terms of mechanical low back pain (Ottenbacher and Difabio 1985). After a thorough literature search, no clinical trial has been performed to compare the effectiveness of hamstring stretch therapy in conjunction

with manipulation of the sacroiliac joint/s versus manipulation alone in the treatment of sacroiliac syndrome.

It was hypothesized that both treatments would be effective in the management of sacroiliac syndrome. It was further hypothesized that the two treatment groups would not be equally effective in terms of the patient's subjective and objective clinical findings. The objective of this study was thus to establish which of the two treatments is the most effective in the management of sacroiliac syndrome,

This study consisted of a controlled trial of a sample population diagnosed with sacroiliac joint dysfunction. Thirty-two subjects were randomly divided into two groups. The one group was treated with a side posture adjustment and the other group received a side posture adjustment in conjunction with the Contract-Relax-Antagonist-Contract (CRAC) technique of proprioceptive neuromuscular facilitation (P.N.F.) stretch therapy applied to the hamstrings.

All participants were subjectively assessed using the Oswestry Low Back Disability Index Questionnaire (Fairbank et al. 1980) and the Numerical Pain Rating Scale 101 (Jenson et al. 1986).

The objective responses to the treatment were recorded using the results of orthopaedic tests of the sacroiliac joint as well as

assessment of the participants' hamstring flexibility. The orthopaedic tests that were used on the sacroiliac joint included Gaenslen's, Erikson's, (Yeoman's) and Patrick Faber's (Kirkaldy-Willis and Burton 1992:124). The hamstring flexibility was assessed using the Active-Knee-Extension Test (Gajdosik and Lusin 1983).

Each participant was treated until clinically asymptomatic over a period of four weeks or for a maximum of six treatments, with a follow up evaluation one month after the final treatment. The results were statistically analysed using non-parametric test statistics, at a 95% confidence interval. The procedures of non-parametric tests for statistical data analysis (Fisher et al. 1993 : 315-319) used in this study were the Wilcoxon Sign Rank test, used to analyse data within each group and the Mann-Whitney test, used to analyse data between each group. Power tests related to the Mann-Whitney Unpaired tests were also performed to give an indication with regards to the likelihood of a Type II error being made (incorrectly accepting the null hypothesis).

The outcome of the statistical analysis indicated that the manipulation group (Group 1) showed significant improvement ($p < 0.025$) between the first and one month follow-up with respect to the Numerical Pain Rating Scale 101 (NRS 101) and the Oswestry

Low Back Pain Disability Index Questionnaire (OSW). During the same period the group receiving hamstring stretches in conjunction with manipulation (Group 2) showed significant improvement ($p < 0.025$) in terms of the Active-Knee-Extension test (AKE) and the NRS 101. Inter-group comparison of the results showed that there were no statistically significant differences in the effectiveness of the two treatment protocols in terms of objective and subjective clinical findings. The power tests for all readings was low, indicating the high possibility of a Type II error.

This study advocates the use of spinal manipulation in the treatment of sacroiliac syndrome and encourages further studies of this nature. Larger sample sizes with a more homogenous population, should be considered to allow for more accurate statistical data in order to identify the subtle variations in treatment outcomes. The validity of the results would therefore be strengthened, enabling chiropractors to institute a more effective treatment regime when dealing with sacroiliac syndrome.

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LIST OF ABBREVIATIONS

AKE	=	Active-Knee-Extension test
CRAC	=	Contract-Relax-Antagonist-Contract
Gr 1	=	group one (manipulation only)
Gr 2	=	group two (manipulation plus hamstring stretch)
LBP	=	low back pain
NRS 101	=	numerical pain rating scale 101
OSW	=	oswestry low back pain disability index questionnaire
P.N.F.	=	proprioceptive neuromuscular facilitation
SMT	=	spinal manipulative therapy
s.d.	=	standard deviation
s.e.	=	standard error

DEFINITION OF TERMS

ADJUSTMENT (Chiropractic) : A specific form of direct articular manipulation utilising a short lever and characterised by a dynamic, forceful, high velocity thrust of low amplitude, after appropriate stabilisation of other joints has occurred and the joint is tractioned (Bryner 1984).

CHIROPRACTIC : A discipline of the scientific healing arts concerned with the pathogenesis, diagnostics, therapeutics, and prophylaxis of functional disturbances, pathomechanical states, pain syndromes and neurophysiological effects related to the statics and dynamics of the locomotor system, especially of the spine and pelvis (Bryner 1984).

CONTRA-INDICATION : Symptoms, signs or diagnosis that mitigate against the use of a particular procedure (Bryner 1984).

FIXATION : A state whereby a vertebrae or pelvic bone has become temporarily immobilised in a position it may normally occupy during any phase of physiological spinal movement (Bryner 1984).

JOINT DYSFUNCTION : Joint mechanics showing area disturbances of function without structural change (Bryner 1984).

MOTION PALPATION : Diagnosis of passive and active segmental joint ranges of motion (Bryner 1984).

NUTATION : Motion of the sacrum about a coronal axis in which the sacral base moves anteriorly and inferiorly and the tip of the coccyx moves posteriorly and superiorly (Bryner 1984).

RANGE OF MOTION : The range of translation and rotation of a joint for each of its six degrees of freedom (Bryner 1984).

REFERRED PAIN : Pain felt in a part other than that in which the cause is situated (Bryner 1984).

RELEASE (Cavitation) : The audible "crack" or "pop" heard after the application of an adjustment to a particular articulation (Bryner 1984).

SACROILIAC FIXATION : The absence of normal motion at the sacroiliac joint, demonstrable by motion palpation in which the axis of rotation has shifted to either the superior or inferior portion of the sacroiliac joint, or rarely, a situation in which there is total fixation with no axis of rotation (Bryner 1984).

X-AXIS : A line passing horizontally from side to side. Also called the coronal or frontal axis. Movement around the X-axis is said to be in a horizontal plane (Bryner 1984).

Y-AXIS : A line perpendicular to the ground. Also referred to as the vertical axis. Movement around the Y-axis is said to be in the horizontal or transverse plane (Bryner 1984).

Z-AXIS : A line passing horizontally from front to back. Also referred to as the sagittal axis. Movement around the Z-axis is said to be in the coronal plane (Bryner 1984).

CHAPTER ONE

INTRODUCTION

According to Carey et al. (1996) low back pain is a major cause of suffering, disability, and social costs. It is the second most frequent symptomatic reason for patients to visit primary care physicians, disables 5,4 million Americans per year, and is the second leading cause of work days lost, after the common cold (Carey et al. 1996).

The annual costs of low back pain are approximately 50 billion dollars in the United States (Tufo et al. 1991:67). Eighty percent of the associated costs relate to those who have had it for greater than three months duration (i.e. are chronic). Therefore, the need to ameliorate this financial burden, not least of all in South Africa (Hupkes 1990), becomes all too apparent.

In a review of chiropractic claims by Nyiendo and Lamm (1991), chiropractic claimants were found to more likely have a history of chronic, recurrent low back pain and more likely to have suffered exacerbation, when compared to medical practitioners' claimants. This testifies to the fact that the chiropractors are treating patients with one of the most common, chronic, costly epidemics in health care today. Cats-Baril and Frymoyer (1991:95) state that consistently utilising the least costly and most effective treatment/s would create substantial savings.

Haldeman (1992:116) suggests that greater emphasis needs to be placed on the clinical effectiveness of chiropractic treatments. There are few studies that have determined the combined effects of spinal manipulative therapy with other modalities known to have beneficial physiological effects, especially in terms of mechanical low back pain (Ottenbacher and Difabio 1985). Therefore, this study undertook to compare two forms of chiropractic treatment for sacroiliac syndrome, combining the most effective form of stretching of the hamstring muscles with the proven effectiveness of sacroiliac manipulation versus manipulation alone, in order to determine which protocol was more effective.

1.1 OBJECTIVES OF THE STUDY

The purpose of this study is to investigate the comparative effectiveness of manipulation versus manipulation in conjunction with the contract-relax-antagonist-contract (CRAC) technique of proprioceptive neuromuscular facilitation (P.N.F.) stretching of the hamstring muscle group in terms of subjective and objective clinical findings in the treatment of sacroiliac syndrome.

The first objective is to determine the effectiveness of manipulation and manipulation used in conjunction with the CRAC technique of P.N.F. stretching of the hamstring muscles in terms of subjective clinical findings, in order to determine the relative effectiveness of each approach in the treatment of sacroiliac syndrome.

The second objective is to determine the effectiveness of manipulation and manipulation used in conjunction with the CRAC technique of P.N.F. stretching of the hamstring muscles in terms of objective clinical findings, in order to determine the relative effectiveness of each approach in the treatment of sacroiliac syndrome.

The third objective is to interpret the data from the subjective and objective findings in order to determine which of the treatment protocols is more effective treatment for sacroiliac syndrome.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2.1. INTRODUCTION

According to Cassidy and Burton (1992:3) 60 to 80 percent of the general population will suffer from back pain sometime in their life, and that between 20 to 30 percent are suffering from back pain at any given time. Surveys carried out in Sweden have shown that between 9 and 19.5 percent of all sickness absent days are due to low back pain (LBP) and that 50 to 80 percent of adults at some time suffer from LBP, making this the disease group responsible for the largest number of lost work days (Anderson 1981).

Sacroiliac syndrome is a common but frequently overlooked source of LBP according to Frymoyer et al. (1991 : 2114). The same authors state that dysfunction of the sacroiliac joint can cause pain in the region of the sacroiliac joint and referred pain to the lower extremity, thus mimicking other well known causes of back pain.

2.2.1 INCIDENCE AND PREVALENCE OF SACROILIAC SYNDROME

According to Cats-Baril and Frymoyer (1991:95), after the common cold, low back pain is the most common health problem in the United States. A community based study, involving the use of chiropractic services, found that low back pain is the most common complaint when patients seek chiropractic care (Shekelle and Brook 1991). The incidence in the general population is unknown, but it was reported to be the primary source of back pain in 22.5% of 1293 patients with back pain in a study performed by Bernard and Kirkaldy-Willis (1987).

In 30% of patients with L5-S1 isthmic spondylolisthesis, Bernard and Cassidy (1981) concluded that the radiographic finding was incidental and the sacroiliac joint was the anatomical source of pain. A retrospective study done by Schmid (1984) showed a prevalence of 467 cases of sacroiliac syndrome out of 1344 patients that presented with "back disorders".

In a study of 855 pregnant women, the nine month prevalence of back pain was 49 percent, with a point prevalence of 25 percent throughout pregnancy. The back pain could be divided into three groups, one of

which was localised to the sacroiliac area which increased as the pregnancy progressed (Ostgaard, Anderson and Karlsson 1991).

A study by Mierau et al. (1984) of elementary and high school students revealed an overall incidence of 33.5% for sacroiliac dysfunction. However, the same authors state that the incidence and prevalence of sacroiliac dysfunction in the general population is not known.

2.2.2 INCIDENCE AND PREVALENCE OF HAMSTRING HYPERTONICITY ASSOCIATED WITH LOW BACK PAIN

According to Alston et al. (1966) in 36% of 350 patients with LBP, tightness of the hamstring muscles in one or both of the lower limbs is common. In children, the hamstrings were reported to be the fourth most common muscle group to harbour myofascial trigger points but the pain had been diagnosed as "growing pains" according to Travell and Simons (1992:352). The same authors state that articular dysfunction, particularly of the lower lumbar vertebral joints and the sacroiliac joint, is associated with hamstring spasm and restriction of the straight leg raising test.

According to Frymoyer et al. (1991:2115) neurological findings in sacroiliac syndrome such as motor, reflex or sensory deficits or nerve root tension

signs are absent, but hamstring tightness may be present. Cox (1990:234) noted in patients with sacroiliac syndrome, concomitant decreased flexibility of the hamstring muscles on testing. Travell and Simons (1992:325) demonstrated that a posteriorly rotated ilium shortens the hamstrings and an anteriorly rotated ilium increases the tension on them.

According to Reid (1992:569) the association of low back pathology and its implication in the treatment of hamstring strains needs to be stressed.

Cibulka et al. (1984) demonstrated an increase in peak torque of the hamstrings in a pretest/post-test experimental design following sacroiliac joint mobilization therapy. Reid (1992:569) states that clinicians skilled in manipulative therapy may find it beneficial to include manipulation if they detect the above association.

2.3 RECURRENCE RATE

Although most attacks of back pain remit either spontaneously or after treatment, there is a high incidence of recurrence according to Sims-Williams et al. (1979). It is generally accepted (Gemmell and Jacobson 1990) that acute episodes of LBP usually start around the age of 25, accompanied by a 60% recurrence rate over 2 years, with the highest frequency of symptoms occurring between the ages of 35 and 55.

According to Bernard and Kirkaldy-Willis (1987) the most common causes of low back pain (i.e. facet syndrome and sacroiliac syndrome) are frequently overlooked, since abnormalities of these conditions are not often demonstrable on X-rays.

2.4 ANATOMY AND BIOMECHANICS

2.4.1.1 ANATOMY OF THE SACROILIAC JOINT

The sacroiliac joint is a true synovial joint. It has a joint capsule, synovial fluid, a synovial membrane and a cartilaginous surface (Alderlink 1991).

The sacroiliac joint is commonly auricular or "c-shaped". It has a well defined joint space with two opposing joint surfaces, the iliac surface being covered with fibrocartilage and the sacral surface with hyaline cartilage.

The sacroiliac joint is surrounded by many powerful muscles, none of which are known to directly influence its movement (Cassidy 1992). This is substantiated by Walker (1992) who states that the sacroiliac joint is not crossed by any muscle. According to Walker (1992) all the adjacent muscles (i.e. quadratus lumborum, erector spinae, gluteus maximus, gluteus minimus, piriformis and iliacus) have fibrous expansions that blend

with anterior and posterior sacroiliac joint ligaments and contribute to the strength of the joint capsule and ligaments, and thus to the joints stability.

Bernard and Cassidy (1991) propose that the anterior sacroiliac ligament is a thickening of the anterior joint capsule. The same authors suggest that the joint capsule may be rudimentary or absent and the interosseus ligament forms the posterior border of the joint. The interosseus ligament binds the sacrum and the ilium and is the strongest of the sacroiliac ligaments. Accessory ligaments are the iliolumbar, sacrotuberous, and sacrospinous.

Schafer and Faye (1990:161) state that the posterior aspect of the sacroiliac joint is innervated by the posterior rami of L5 - S2 spinal nerves, and that inflammation at the posterior aspect of the joint refers pain to the buttocks, back and thigh, following the dermatomal distribution. The anterior aspect of the joint is innervated by both posterior branches from the L3 - S2 roots and the superior gluteal nerve (L5 - S2). Schafer and Faye postulate that irritation of the joint anteriorly refers pain to the groin and anterior thigh.

According to Cassidy and Mierau (1992) a wide range of segmental innervation could account for the large spectrum of somatic referred pain patterns attributed to sacroiliac disorders. Bernard and Cassidy (1991)

suggest that articular nerves are thought to have a unique feedback mechanism on the overlying muscles which receive the same innervation. This arthrokinematic reflex exists because articular mechanoreceptors regulate muscle tone.

The synovial capsule of the sacroiliac joint and overlying ligaments have unmyelinated free nerve endings that transmit pain and thermal sensations (Bernard and Cassidy 1991). The same authors state that the sacroiliac capsule is innervated by encapsulated and complex unencapsulated nerve endings, providing pressure and position sense information.

In addition, pain from the sacroiliac joint may be localized or referred distally to an extremity which produces deep, dull and often ill-defined sensation radiating in a sclerotomal distribution. There is, however, no associated motor, sensory or reflex deficit with pain from the sacroiliac joint (Bernard and Cassidy 1991).

According to Schafer and Faye (1990:162) the sacroiliac joint is antero-lateral to the posterior superior iliac spine and the posterior inferior iliac spine of the ilia. The iliac facets articulate with the sacrum which has rough, concave, boot shaped bony articulations, the toes of the boot facing posteriorly. The "foot" of the articulation allows a slight sliding motion anteriorly-inferiorly or posterior-superiorly and there is also a

rotating action. The upper part offers relief to the relatively weak supero-anterior sacroiliac ligaments. The structure also serves to prevent sacral displacement during loading.

Gatterman (1990:112) states that the contours of the sacroiliac joint surfaces continue to change with age, and by the end of the third decade there is an increase in the size and number of elevations which interlock and limit movement. According to the same author, after the third decade, the cartilage becomes rough and degeneration leads to fibrosis or fibrocartilaginous adhesions and occasionally ankylosis of the sacroiliac joint. White and Punjabi (1990:245) state that the joint may become completely ankylosed by fifty years of age.

Bernard and Cassidy (1991), in describing age related changes, state that in the second decade of life, a crescent shape ridge develops on the entire length of the iliac surface, with a corresponding deficit on the sacral side. By the third decade this interdigitation is well developed and further limits joint motion to x-axis rotation or sacral nutation. They state further that in the joints of males, degenerative changes occur on the iliac side as early as the third decade of life and are manifested by increased joint irregularity, fibrillation, crevice formation and clumping of the chondrocytes. However, similar changes do not occur on the sacral side until the fourth or fifth decade.

According to Bernard and Cassidy (1991), degenerative arthrosis occurring in the sacroiliac joint is histologically similar to that occurring in other joints, however it occurs at an earlier stage in life. Whether these changes predispose patients to developing sacroiliac syndrome is unknown as this occurrence may be a normal part of aging.

2.4.1.2. BIOMECHANICS OF THE SACROILIAC JOINT

The movement of the pelvis is a rhythmic torsion in a horizontal plane, which, due to sacroiliac movement, causes no distress to the spine as a whole, but if the sacroiliac movements were compromised, by fixation for example, the altered biomechanics may cause stress elsewhere in the spine (Gemmell and Jacobsen 1990). The predominant finding is a small variable range of X-axis rotation with some degree of Z-axis translation (Bernard and Cassidy 1991, Cassidy 1992).

According to Kapandji (1990:248) movements of nutation and counternutation occur at the sacroiliac joints. During nutation, the sacrum rotates so that the promontary moves anteriorly and inferiorly, while the coccyx and apex move posteriorly. Thus the antero-posterior diameter is reduced and the pelvic outlet increased. Also, the iliac bones approximate

and the ischial tuberosities separate. This movement is checked by the strong sacral ligaments, the sacrotuberous and sacrospinous.

Counternutation involves movement in the opposite direction. The promontory moves posteriorly and superiorly, and the apex moves anteriorly. The antero-posterior diameter of the pelvic brim is increased and the pelvic outlet is decreased. The iliac bones move apart and the ischial tuberosities approximate. The anterior sacroiliac ligament checks this movement.

Jacob and Kissling (1995) studied the mobility of the sacroiliac joints using plain light stereophotogrammetry, employing percutaneously applied markers that were rigidly fixed to the bones. The study consisted of fifteen men and nine women, all healthy between the ages of 20 and 50, and found the total average rotational motion to be about 2 degrees (0.4 to 4.3 degrees).

2.4.1.3 THE SUBLUXATION COMPLEX

Gatterman (1990 : 39) describes the subluxation complex in the following manner :

1. The partial or incomplete dislocation of a joint,

2. the restriction of motion of a joint in a position exceeding normal physiologic motion, although the anatomical limits have not been exceeded,
3. the unnatural relationship between two adjacent articulations which may have functional or pathological consequences, thus altering the biomechanical and/or neurophysiological reflexes of the joint, the structures around the joint and/or the body systems affected by them.

Subluxation is further categorised into two parts by Gatterman (1990 :39) :

1. Neuropathophysiology - subluxation causing irritation and/or compression of the neural components of motion segments.
2. Kinesiopathology - subluxation causing restriction in movement of motion segments due to muscle hypertonicity, joint stabilization, muscle spindle muscle spasm, joint sprain muscle spasm and articular locking.

According to Schafer and Faye (1990 :4) when an articulation is deprived of carrying out its normal function (i.e. movement), one or more articulations are burdened with the compensatory excessive motion, which may include eccentric and/or out of plane movement. This additional

burden within the counterpart joint leads to irritation and ultimately inflammation of that joint.

2.4.2.1. ANATOMY OF THE HAMSTRING MUSCLE GROUP

According to Reid (1992:555) the hamstrings are composed of the semimembranosus, semitendinosus and biceps femoris muscles. The semimembranosus lies postero-medially on the thigh, originating from a tendon on the superolateral impression on the ischial tuberosity. It receives slips from the ramus of the ischium. This conjoint tendon interweaves with that of the semitendinosus and the long head of the biceps, eventually passing deep to them as an aponeurosis from which the muscle belly arises. The distal attachment is to the medial tibial condyle.

The semitendinosus originates from the infero-medial facet of the ischial tuberosity, intimately associated at its origin with the biceps femoris and by its aponeurosis to the semimembranosus. It inserts by passing superior to the medial collateral ligament to attach to the tibia, posterior to the sartorius and distal to the gracilis.

The long head of the biceps femoris, arising from the inferomedial facet of the ischial tuberosity, joins the short head as it originates from the lateral

lip of the linea aspera on the posterior femur. This conjoint muscle has a single tendon that inserts into the head of the fibula.

The semimembranosus, semitendinosus and the long head of biceps femoris are supplied by the tibial portion of the sciatic nerve, mainly from roots L5 - S1. The short head of the biceps femoris gains its innervation from the peroneal portion of the sciatic nerve also mainly from the L5 - S1 nerve roots (Reid 1991). These muscles receive their blood supply from the perforating branches of the profunda femoris artery (Nicholas and Hershman 1995:1002).

The hamstring muscles have a high proportion of type 2 fibers, which are involved with exercise involving high intensity and force production. The hamstrings help extend the hip and flex the knee by synchronising with other prime movers of these joints. Biceps femoris laterally rotates the flexed knee while semimembranosus and semitendinosus medially rotate the flexed knee. The hamstring muscles also co-contract with the quadriceps to stabilize the knee. The hamstring muscles also function to decelerate the swinging leg in gait and running.

2.5 AETIOLOGY OF MECHANICAL LOW BACK PAIN

According to Schafer and Faye (1990 :195), when describing three common types of low back pain (lumbar facet syndrome, sacroiliac syndrome and lumbar radicular syndrome), the causes of these syndromes may be due to :

1. Sprain/strain,
2. overuse,
3. poor posture,
4. disuse,
5. joint dysfunction (fixation or hypermobility),
6. developmental abnormalities,
7. degenerative changes and
8. combination of any of the above.

Carey et al. (1996) state that a variety of pathologic processes such as inflammatory spondyloarthropathies, infection, malignancy and crystal deposition diseases can affect the sacroiliac joint and cause pain. The same authors state that, most commonly, sacroiliac joint pain is due to intrinsic "dysfunction" of the joint.

Mechanical dysfunction of the sacroiliac joint has been described in other terms including : osteopathic lesion, hypomobility, malalignment, fixation, malrotation, joint binding or subluxation (Carey et al. 1996).

2.6. DIAGNOSTIC CONSIDERATIONS OF SACROILIAC SYNDROME

The diagnosis of sacroiliac syndrome is based mainly on clinical examination and patient history (Cassidy and Mierau 1992). According to the same authors the history is that of mechanical back pain with or without referred pain into the lower extremity. There is usually tenderness over the posterior superior iliac spine and posterior sacroiliac ligaments. This syndrome is also often accompanied by a unilateral lumbar paraspinal muscle spasm and gluteal trigger points. Straight leg raising may be reduced due to tightness of the hamstrings and or the associated back pain.

The pain can be sharp, aching or dull in nature, it can be referred to the buttocks, thigh and posterior groin and occasionally below the thigh. According to Bernard and Cassidy (1991), the pain is aggravated by bending, sitting, and riding in an automobile and alleviated by standing and walking. There are rarely associated neurological symptoms of weakness, paraesthesias or dysaesthesias (Bernard and Cassidy 1991).

Bernard and Cassidy (1991) derived the following data from a retrospective review of 250 patients whose symptoms were consistent with sacroiliac syndrome. There were 90 men and 160 women whose average ages were 39.5 and 48.9, respectively. Onset of symptoms was unknown or attributable to minor trauma in 58% of patients or to a compensable injury in 42% of patients. The symptom duration averaged eleven months, although ten patients were symptomatic for over five years. The pain was right-sided in 45%, left-sided in 35% and bilateral in 20% of these cases. The pain radiated below the knee in 10% of cases.

Researchers have found that pain in the sacroiliac joint was either associated with a marked increase or decrease in mobility of the joint (Mierau et al. 1984). Most chiropractic sacroiliac joint function tests use the Gillet-Liekens method of motion palpation (Gemmell and Jacobson 1990). To perform this test, the examiner places one thumb over the second sacral tubercle and the other thumb on the posterior superior iliac spine (PSIS) on the side of the joint to be tested. The subject, who is standing, is then asked to flex the hip and knee, bringing the knee and thigh to the abdomen. In a normal joint the ilium will rotate posteriorly on the sacrum, and the PSIS will be felt level with the second sacral tubercle. Failure of the thumb on the PSIS to move inferiorly during this maneuver indicates reduced or absent sacroiliac mobility. A positive test implies sacroiliac joint hypomobility, rather than pain (Gemmell and Jacobson

1990). The same authors state that as the joints may vary in degree of motion from person to person and from side to side, comparison of one side with the other is necessary. Carmichael (1987) found the standing sacroiliac mobility test of Gillet to have a high mean percentage of agreement, 85.3% for inter and 89.2% for intraexaminer reliability. This study suggests that the Gillet test is clinically useful for a single examiner in determining sacroiliac joint mobility.

There are three clinical orthopaedic tests, namely Gaenslen's, Patrick-Faber's and Erikson's (Yeoman's) that are commonly used to diagnose sacroiliac syndrome and were used in this study for diagnostic purposes (Kirkaldy-Willis and Burton 1992:124 ; Cassidy and Mierau 1992). These are provocative tests which place stress on the sacroiliac joint and elicit pain in sacroiliac syndrome. In most cases, two of these three tests are positive in sacroiliac syndrome (Cassidy and Mierau 1992 ; Kenna and Murtagh 1989 ; Bernard and Cassidy 1991 ; Kirkaldy-Willis 1992:124).

2.7 DIFFERENTIAL DIAGNOSIS

According to Cassidy and Mierau (1992) the differential diagnosis of sacroiliac syndrome can be problematic. At times the joint can be the sight of serious disease, and the examiner must be aware of the

possibility of infection, inflammatory arthropathy and neoplasm. If any of these conditions are suspected an adequate radiographic examination of the lumbar spine, sacroiliac and hip joints is indicated. Radionuclide bone scanning should be considered in cases of suspected sacroilitis or neoplasm of the spine. In the majority of cases of sacroiliac syndrome, the radiographic examination is unremarkable.

According to Yochum and Barry (1995) the sacroiliac joints may be affected by many different arthritides, the most common being osteoarthritis. The inflammatory arthritides may present with either unilateral or bilateral sacroilitis. The same authors state that many disease processes may affect the sacrum or posterior ilium and become superimposed on the sacroiliac joint producing a pseudosacroiliitis appearance. Supplementary laboratory blood examination (including sedimentation rate, HLA B27 antigen, antinuclear antibodies and rheumatoid factor) and urinalysis may be necessary.

2.8 CONTRA-INDICATIONS

a) Contra-indications to spinal manipulation include osteomyelitis, tuberculosis of the spine, infectious arthritis, disc prolapse, haemangioma, vertebral malignancy and advanced spondylolisthesis (Triano 1992:352).

b) Contra-indications to proprioceptive neuromuscular facilitation include recent fractures, open wounds, recent post-operative conditions, pain and acute orthopaedic conditions (Voss et al. 1985:375).

2.9.1 TREATMENT OF SACROILIAC SYNDROME

Low back pain is the most common complaint for which manipulation is recommended (Haldeman 1992:420). The explanation of the physiological biomechanics occurring during chiropractic manipulation according to Sandoz (1976), is of a passive manual maneuver during which the joint complex is suddenly carried beyond the normal physiological range of movement and through the elastic barrier without exceeding the boundaries of anatomical integrity. The usual characteristic is a dynamic specific thrust of controlled velocity and amplitude given at the end of normal passive range of movement to exceed this elastic barrier into the range of the parapsychological space.

When the joint surfaces are forced beyond the elastic barrier gases are suddenly released from the synovial and tissue fluid to form a radiolucent cavity seen in radiographs. Manipulation also affects the mechanoreceptors thereby affecting both the segmental muscles and the pain mechanism (Sandoz 1976).

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. They 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 chiropractic or hospital outpatient care. The results of the study led 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 with hospital outpatient management. These findings prompted the authors to suggest that chiropractic be introduced into the British national health service practice.

A review article by Hendler et al. (1995) revealed that symptoms associated with sacroiliac subluxations are dramatically relieved by manipulation. In a study involving 100 cases of sacroiliac joint subluxation, Guo and Zhao (1994) achieved a 100% symptom relief rate with over

90% of the cases being pain-free after only one treatment. Kirkaldy-Willis (1983) advocates daily manipulation for up to ten days in self-limiting cases. Mierau et al. (1984) state that specific articular manipulations to the dysfunctional sacroiliac joint often relieves the symptoms dramatically.

Herzog et al. (1991) compared the effects of spinal manipulative therapy (SMT) given by a chiropractor, to back school therapy (BST) given by a physiotherapist, on gait symmetry for patients with sacroiliac joint pain. The results of this study showed that the BST was the more effective treatment in terms of subjective measurements. However, objective measurements showed that the SMT group had better results. The mean pain scores for both groups were always lower after treatment than before treatment for all experimental sessions. Herzog et al. (1991) concluded that SMT was more effective than BST in restoring normal gait symmetry in chronic sacroiliac joint patients. This strengthens viability in the use of adjustments in cases of sacroiliac syndrome.

Robinson et al. (1987) showed, in a study using force platform variables, that there was a distinct tendency toward improved gait symmetry after chiropractic adjustment of the sacroiliac joint of subjects with sacroiliac dyskinesia, where the gait was asymmetric prior to the treatment.

Reduction of the painful sacroiliac joint in pregnant and post-partum women is well documented and advocated by numerous therapists of varying disciplines (Mantle 1994 ; Fraser 1976 ; Mahoney and Erhard 1996).

The side posture adjustment seems to be the treatment of choice for sacroiliac syndrome (Schafer and Faye 1990:242 ; Gatterman 1990:117 ; Bergmann 1993:500 ; Cassidy and Mierau 1992: 221). This adjustment is advocated by Schafer and Faye (1990:242) as it does not restrict its force to one articulation, or even one part of an articulation. The functions of an adjustment are to break up adhesions in the articulation by opening it, forcing the joint to glide in the plane lines of its articular surfaces, with a preference for the direction that will "replace" the "subluxated" bone and/or move the two bones that are fixated. This is performed in such a way that it separates the two ends of the muscle to "break down" the hypertonicity, or apply a force at right angles to a shortened muscle or ligament to elongate it (Schafer and Faye 1990:69).

More than two thirds of the 28 randomised clinical trials reviewed by Manga et al. (1993), emphasised that manual manipulation had significant beneficial outcomes in the treatment and management of low back pain. More importantly, the studies gave greater credibility to the effectiveness of chiropractic manipulation for low back pain.

2.9.2. TREATMENT OF HAMSTRING HYPERTONCITY

Proprioceptive neuromuscular facilitation (P.N.F.) was developed by Herman Kabat, M.D., in association with the physical therapists Margaret Knott and Dorothy Voss, for the rehabilitation of various neuromuscular problems (e.g. polio patients with paralysis). The basis of P.N.F. is that muscle function does not occur in a straight line, but is diagonal and spiral. P.N.F. techniques are defined as, "methods of promoting or hastening the response of the neuromuscular mechanism through stimulation of the proprioceptors." (Arnheim and Prentice 1993:360).

P.N.F. uses four major neurophysiological principles: muscle and joint activity, irradiation, Sherrington's law of successive induction, and Sherrington's law of reciprocal innervation (or inhibition). The major muscle and joint reflexes used are the muscle spindle, which is activated by stretch; Golgi's organ, which is activated by pressure and concerned with muscle tonus; deep pressure in receptors in joints; and the righting reflex. Irradiation or reinforcement refers to a strong voluntary muscle action against a resistance that will bring out a response in other muscle areas. Sherrington's law of successive induction states that flexion augments extension and extension augments flexion. Sherrington's law of reciprocal innervation refers to a voluntary or reflex contraction of a muscle that is associated with a simultaneous relaxation of its antagonistic muscle.

because of an inhibitory response of the muscle spindle (Arnheim and Prentice 1993:360).

Eight of fourteen studies reviewed by McAtee (1993:17) on the effectiveness of various stretching techniques found that P.N.F. stretching is significantly more effective for increasing range of motion and flexibility than either static, ballistic or passive stretching. Tanigawa (1972) compared passive stretching with P.N.F. for the hamstrings by measuring the distance of the lateral malleolus to the floor when the straight leg is flexed to its maximum before and after the two stretch techniques were performed. He determined that P.N.F. increased passive hip flexion faster and to a greater extent than did passive stretching.

Moore and Hutton (1980) used electromyography to investigate the differences between static stretching and two P.N.F. techniques, Contract-Relax (C.R.) and Contract-Relax-Antagonist-Contract (CRAC). Their results indicated that CRAC stretches (the technique to be used in this study) were more effective than static stretches for improving flexibility.

According to Moore and Hutton (1980) the physiology of the CRAC technique of P.N.F. is based on reciprocal inhibition. The CRAC technique begins with an isometric contraction (hamstrings) followed by subsequent voluntary agonist contraction (quadriceps) through alpha-gamma coactivation

which contributes additional inhibitory input to hamstring motoneurons through type Ia reciprocal inhibition. Given this circuitry, voluntary activation of the quadriceps would promote reciprocal inhibition of the hamstrings during the stretch phase.

However, recurrent collateral pathways from, for example, quadriceps motoneurons have been shown to inhibit the associated reciprocal interneuron through Renshaw cell activation. This results in inhibition of the type Ia interneuronal drive to the hamstring alpha motoneurons as the quadriceps becomes increasingly active.

Descending control of the excitatory bias of the reciprocal Ia interneuron, the gamma loop, the mutual inhibition of antagonistic pairs of reciprocal Ia interneurons and their recurrent depression by Renshaw cells may all interact to facilitate reciprocal inhibition.

2.10. SUMMARY OF THE LITERATURE REVIEW

The old hypothesis of the sacroiliac joint being a primary source of low back pain is resurgent but still controversial (Bernard and Cassidy 1991). Mierau et al. (1984) found a significant association between sacroiliac hypomobility and low back pain. According to Hendler et al. (1995) purported symptoms caused by sacroiliac subluxations are dramatically relieved with manipulation. Kirkaldy-Willis (1983) advocates daily manipulation (for up to ten days) in self limited cases, with a success rate of up 90 percent.

Herzog et al. (1991) concluded that SMT was more effective than BST in restoring normal gait symmetry in chronic sacroiliac joint pain patients. Robinson et al. (1987) showed that there was a distinct tendency toward improved gait symmetry after chiropractic adjustment of the affected sacroiliac joint/s. Haldeman (1992:221) states that manipulation of the painful sacroiliac joint is successful in the majority of cases of sacroiliac syndrome. The side posture adjustment seems to be the treatment of choice in sacroiliac syndrome (Schafer and Faye 1990:242 ; Gatterman 1990:117 ; Cassidy and Mierau 1992:221 ; Bergmann 1993:500).

McAtee (1993:17) found P.N.F. stretching to be significantly more effective for increasing range of motion and flexibility when compared with static, ballistic or passive stretching. Tanigawa (1972) determined that P.N.F. stretching increased passive hip flexion faster and to a greater extent than did passive stretching. Moore and Hutton (1980), using electromyography, showed that CRAC stretches were more effective than static stretches for improving flexibility.

The orthopaedist, Reid (1992:569), the medical doctors', Travell and Simons (1992:325) and Hammer (1991:119) have all stated the association between lack of hamstring flexibility and hypomobility of the sacroiliac joint/s. Both Reid and Hammer recommend manipulation of the sacroiliac joint in this case. No research, let alone chiropractic research, could be found by this researcher evaluating the effectiveness of stretching the hamstring muscles in conjunction with manipulation of the sacroiliac joint in the treatment of sacroiliac syndrome.

Due to the lack of research on the effectiveness of the CRAC technique of P.N.F. stretching, the dearth of clinical trials proving the effectiveness of the side posture adjustment and the apparent absence in the literature

concerning the treatment of hamstring muscles in patients presenting with sacroiliac syndrome, there seemed to be a need for these techniques to be researched further. Thus, insight would be established as to more effective management of this prevalent neuromusculoskeletal disorder that is common to mankind.

CHAPTER THREE

MATERIALS AND METHODS OF THE STUDY

3.1 INTRODUCTION

This chapter deals with the location and collection of data and the research methodology utilized. The treatment interventions and process of statistical analysis are discussed here.

3.2. MEASUREMENT AND OBSERVATION

3.2.1. METHOD OF MEASUREMENT

SUBJECTIVE MEASUREMENTS

1. Numerical Pain Rating Scale 101 (Appendix A) - The patient was required to indicate by means of a percentage, the intensity of the pain experienced prior to treatment when, (a) it was at its worst, and (b) when it was at its least. The average of these two figures gives an indication of the average pain intensity experienced by the patient.

Jenson et al. (1986) conducted a study where six methods of assessing pain intensity were compared according to five criteria :

a) ease of administration of the scoring ;

- b) relative rates of incorrect responding ;
- c) sensitivity as defined by the number of available response categories ;
- d) sensitivity as defined by statistical power and
- e) the magnitude of the relationship between each scale and a linear combination of pain intensity indices.

The results of this study indicated that the Numerical Pain Rating Scale 101 had practical advantages over the other measures because :

- 1) it was simple and practical to administer and score ;
- 2) it can be administered in either written or verbal form and
- 3) the scale does not appear to be associated with age.

"...The superior measure seems to be the Numerical Pain Rating Scale 101." (Jenson et al. 1986).

2. Oswestry Low Back Pain Disability Index Questionnaire (Appendix B) -

This questionnaire is designed to give the researcher an indication of how the back pain affects the subjects ability to perform daily functional activities. The questionnaire consists of ten questions, each scoring a maximum of five points and a minimum of zero. The questionnaire is scored out of a total of fifty and represented as a percentage disability (Haas and Nyiendo 1992).

OBJECTIVE MEASUREMENT

1. The hamstrings were assessed using the Active-Knee-Extension test (Gajdosik and Lusin 1983). The procedure used was as follows :

The subject relaxes supine on an examination for five minutes before the test. The subject is positioned supine on an examination table with a velcro strap placed across the uninvolved thigh. Another strap is placed over the anterior iliac spines of the pelvis for pelvic stabilisation.

A line is drawn with a skin pencil between the fibular head and the lateral malleolus of the leg to be assessed. This line represents the longitudinal axis of the leg and provides a reference for accurate placement of a digital inclinometer. The hip of the involved leg is then passively flexed to 90 degrees (angle confirmed with a universal goniometer) . A crossbar on a metal bar is placed in contact with the distal anterior surface of the thigh. The subject is then instructed to maintain contact with the crossbar with the knee relaxed in flexion and the ankle in plantar flexion.

From the above position the patient is instructed to actively extend the knee while maintaining contact of the thigh with the crossbar. The patient is instructed to extend the knee to the point of initial, mild resistance of

the hamstring muscles and not to force the leg beyond this point. The angle of knee flexion beyond this point, which represents the degree of hamstring tightness, is then recorded using an inclinometer with a line between the fibular and the lateral malleolus being used as a reference. The use of an inclinometer eliminates the need to establish an axis of motion because it responds to gravity. A decrease in the angle of knee flexion, that is, an increase in maximal knee extension, is representative of an increase in hamstring flexibility.

According to Gajdosik and Lusin (1983) the Active-Knee-Extension test is an objective and reliable tool for measuring hamstring tightness when conducted by one examiner under controlled conditions. The reliability coefficients for test and retest measurements were .99 for the left extremity and .99 for the right extremity. The same authors state that, " The Active-Knee-Extension test, if conducted properly, should provide therapists in the clinic or research setting with a reliable method for measuring hamstring tightness. "

3.3. STUDY PROTOCOL AND DESIGN

3.3.1. OBJECT OF THE STUDY

The objective of this study was to identify the relative effectiveness of each treatment method in terms of the objective and subjective measurements. The study attempted to identify the relative effectiveness of each treatment method in the treatment of sacroiliac syndrome.

3.3.2. ALLOCATION OF THE SUBJECTS

The sample size of thirty-two patients were randomly assigned into one of two groups using a fair die. A fair die was tossed and the number appearing on the top of the die was noted. If the number was odd, the patient was assigned to group 1 otherwise he/she was allocated to group 2.

This process was carried out until sixteen patients were selected for group 1. All remaining patients went to group 2. This procedure ensured that groups 1 and 2 would have fifteen randomly selected patients each.

Group 1 was treated by manipulation alone while group 2 received manipulation of the sacroiliac joint in conjunction with the CRAC technique of P.N.F. stretching of the hamstrings.

3.3.3. CRITERIA FOR ACCEPTANCE OF SUBJECTS

This study was limited to patients from the province of Kwazulu/Natal who were referred by advertisements placed at the Technikon or chiropractic clinic as well as local gyms, sports clubs, daily newspapers and radio. All subjects accepted into the study had to meet the following criteria :

- (a) each subject had to complain of low back pain;
- (b) each subject had to be between 18 and 60 years of age;
- (c) each subject underwent a full case history (Appendix C) ;
- (d) each subject underwent a full physical examination (Appendix D) ;
- (e) each subject underwent a regional low back orthopaedic examination (Appendix E) ;
- (f) each subject had to test positive for at least two of the following sacroiliac joint stress tests namely Gaenslen's, Patrick Faber's or Erikson's (Extension) test ;
- (g) the subjects were not to exhibit any contraindications to spinal manipulative therapy or proprioceptive neuromuscular facilitation as reported on page 24;
- (h) subjects were not accepted if they were on medication for their pain, or if they were undergoing any other treatment for their pain ;
- (i) this study was limited to the treatment of sacroiliac syndrome ;

- (j) all subjects signed an informed consent form (Appendix F) before treatment commenced ;
- (k) when suspected on examination or history, subjects were radiographed to exclude pathology.

3.3.4. INTERVENTIONS

At the initial consultation, the patient was required to complete the Numerical Pain Rating Scale 101 (Appendix A) and the Oswestry Low Back Pain Disability Index Questionnaire (Appendix B). The Active-Knee-Extension test reading (Appendix G) was also taken on the initial visit. The two questionnaires and the Active-Knee-Extension test measurement were obtained prior to the first treatment, at the end of the one month treatment period and again at the end of the four week follow-up period. At each treatment consultation as well as the follow-up consultation the three orthopaedic tests (Gaenslen's, Patrick Faber's and Erikson's) used in diagnosis of sacroiliac syndrome were repeated.

Each patient was treated until clinically asymptomatic, with a maximum of six treatments over a four week period. The treatment for both groups 1 and 2 consisted of a chiropractic adjustment to the area of the sacroiliac joint or joints that was identified on examination to be dysfunctional at

each consultation. The side posture adjusted, as advocated by Schafer and Faye (1990: 242), was used in this study. The treatment for group 2 included the CRAC technique of P.N.F. stretching applied to the hamstrings of both legs.

The CRAC technique of P.N.F. stretching of hamstrings (Moreau and Nook 1995) was performed as follows :

1. STRETCH POSITION

The patient lay on their back with the leg to be stretched placed on the researcher's shoulder. The researcher knelt beside the patient on the same side as the leg to be stretched. The hip was then flexed until a pull was felt in the patient's hamstrings.

2. CONTRACT PHASE

The patient then pushed against the researcher's shoulder with their leg. This was held for a count of eight.

3. RELAXATION PHASE

The patient then lowered their leg and relaxed.

4. ANTAGONIST CONTRACTION PHASE

The patient then lifted his/her foot upward locking the knee in extension and raising their leg until they again felt the stretch.

5. STRETCH PHASE

The researcher then held the leg, as in step one, where the stretch was felt by the patient in the hamstrings.

The patient then pushed their leg against the researcher and thus began the next set of P.N.F. stretches. This was repeated for a total of three sets, then the other leg was done.

All the data from the questionnaires was then converted to percentages and entered together with the Active-Knee-Extension measurements in degrees onto a spreadsheet. This was then entered into the statisticians computer for the statistical analysis.

3.4. THE LOCATION OF THE DATA

The primary data was obtained from the Numerical Pain Rating Scale 101, the Oswestry Low Back Pain Disability Index Questionnaire and the Active-Knee-Extension test answered by/and performed on all subjects

before the first treatment, at the end of the treatment period and again on the one month follow up consultation. The orthopaedic tests, Gaenslen's, Patrick Faber's and Erikson's, were repeated at each consultation and follow up. All treatments and consultations took place at the Technikon Natal chiropractic day clinic.

The secondary data was collected from current journals, text books, CD-Rom and the internet. This data was obtained through the Technikon Natal library.

3.5. STATISTICAL ANALYSIS

3.5.1. TREATMENT OF THE DATA

The statistical data obtained from this study was treated by means of the Mann-Whitney U-Test and the Wilcoxon's Signed Rank Test. The data was tabled, analysed and interpreted as proposed by Fisher et al. (1993 : 315-319) and Norusis (1992 : 362).

The Wilcoxon Signed Rank Test (intra-group analysis) was used to determine whether any significant improvement occurred between the initial

and final treatments, and the final treatments and the follow-up consultations, within each respective study group.

The Mann-Whitney U-Test (inter-group analysis) was used to determine whether there was any significant difference between the two groups at the time of initial consultation, final consultation and at the follow-up consultation. Confidence levels were set at 95% i.e. $\alpha = 0.05$.

The respective objective and subjective responses of the patients were integrated in the final statistical evaluation to determine the relative effectiveness of both treatment protocols in the treatment of sacroiliac syndrome. The procedure of data analysis was as follows :

Procedure 1 : Comparison between groups 1 and 2

Mann-Whitney unpaired tests were used to compare groups 1 and 2, the two groups being treated as independent of one another (unpaired). The objective was to find out whether there was any significant difference with respect to the Active-Knee-Extension, NRS 101 and the Oswestry scores.

Hypothesis Testing and Decision Rule

The null hypothesis (H_0) states that there is no significant difference between the two groups with respect to the variable of interest. The alternative hypothesis (H_1) states that there is a significant difference between the two groups.

$H_0 : H_1 = H_2$

$H_1 : H_1$ and H_2 are significantly different from each other.

$\alpha = 0.05$ = level of significance of the test.

Decision Rule :

For a two tailed test,

Reject H_0 if P is $\leq \alpha / 2 = 0.025$

Accept H_0 if P is $> \alpha / 2 = 0.025$

P is the observed significance level of the test.

Procedure 2: Comparison between related samples within group 1

Wilcoxon Sign Rank Tests were used within group 1 to find out if there was any significant improvement between consultations 1 and 2, 1 and 3, and 2 and 3. All tests were performed at the $\alpha = 0.05$.

Hypothesis Testing and the Decision Rule :

The null hypothesis states that there is no significant improvement between consultations 1 and 2, 1 and 3, and 2 and 3 within group 1 with respect to the variable of interest. The alternative hypothesis (H1) states the contrary of what the null hypothesis does.

Ho : There is no significant improvement

H1 : There is a significant improvement

$\alpha = 0.05$ = level of significance of the test.

Decision Rule :

For a two tailed test,

Reject Ho if $P \leq \alpha / 2 = 0.025$

Accept Ho if $P > \alpha / 2 = 0.025$

P is the observed significance level of the test.

Procedure 3: Comparison between related samples within group 2

Wilcoxon Signed Rank Tests were used within group 2 to find out whether there was any significant improvement between consultations 1 and 2, 1 and 3, and 2 and 3. All tests were performed at the $\alpha = 0.05$ level.

Hypothesis Testing and Decision Rule :

The null hypothesis (H_0) states that there is no significant improvement between consultations 1 and 2, 1 and 3, and 2 and 3 within group 2, with respect to the variable of interest. The alternative hypothesis (H_1) states the contrary of what the null hypothesis does.

H_0 : There is no significant improvement

H_1 : There is a significant improvement

$\alpha = 0.05$ = level of significance of the test.

Decision Rule :

For a two tailed test,

Reject H_0 if P is $\leq \alpha / 2 = 0.025$

Accept H_0 if P is $> \alpha / 2 = 0.025$

P is the observed significance level of the test.

Procedure 4 : Averages, medians and standard deviations

The medians were needed for the construction of barcharts. Averages and standard deviations were used for power analysis.

Procedure 5 : Comparison using barcharts

Barcharts were constructed to present major findings of the study as a visual summary. The barcharts are able to give a visual summary of results obtained from the Mann-Whitney and Wilcoxon Signed Rank Tests. Median readings were used for the construction of the barcharts.

Procedure 6 : Power analysis using the variable AKE

Power analysis was performed three times using observations from the continuous variable AKE.

Statistical Package

The statistical package STATGRAPHICS version 6+ (Norusis 1992 : 362) was used for data entry and analysis.

CHAPTER FOUR

RESULTS OF THE STUDY

4.1 INTRODUCTION

This chapter covers the results obtained from the statistical analysis of the subjective and objective data, for both the control and experimental groups.

Control Group - Manipulation alone (Group 1).

Experimental Group - Manipulation and CRAC technique applied to hamstring muscles (Group 2).

4.2 DISCUSSION OF PATIENT RECRUITMENT

Fifty-five patients were screened, of which thirty-four were accepted into the study. The twenty-one patients who were not accepted did not meet with the selection criteria (Table 4.1). Two patients of the thirty-four accepted into the study dropped out during the course of the treatment period (Table 4.2). Of the thirty-four patients eligible for the study, the details of the 2 or more orthopaedic tests that were positive in each case are detailed on Table 4.3.

Table 4.1 - Reasons for research candidates not meeting the selection criteria :

Reason	No.(%)
Only testing positive for one of the three orthopaedic tests	
- Faber's 7 (53%)	
- Erikson's 4 (31%)	
- Gaenslen's 2 (16%)	13 (62%)
Myofasciitis only	2 (10%)
Lumbar facet syndrome	4 (18%)
Sacroiliitis	1 (5%)
Heart Failure	1 (5%)
TOTAL	21 (100%)
out of 55 = 38%.	

Table 4.2 - Reasons for research candidates not completing treatment period :

Reasons	No.(%)
Lack of transport _____	1 (50%)
Moved to another city _____	1 (50%)
Total _____	2 (100%) out of 34 = 6%.

Table 4.3 - Combinations of orthopaedic tests of eligible research candidates :

Orthopaedic Test Combinations	No.(%)
Patrick Faber's + Erikson's _____	22 (69%)
Patrick Faber's + Gaenslen's _____	6 (19%)
Erikson's + Gaenslen's _____	2 (6%)
Patrick Faber's + Erikson's + Gaenslen's _____	2 (6%)
TOTAL _____	32 (100%)

4.3 DEMOGRAPHIC DATA

Table 4.4. - Gender Distribution

GENDER	GROUP 1	GROUP 2
MALES	12 (75%)	8 (50%)
FEMALES	4 (25%)	8 (50%)

The overall, male : female ratio was 5 : 3.

Table 4.5. - Age Distribution

AGE INTERVALS	GROUP 1	GROUP 2
18 - 28	7 (44%)	6 (38%)
29 - 38	4 (25%)	4 (25%)
39 - 48	2 (13%)	2 (12%)
49 - 60	3 (18%)	4 (25%)

The average age (mean) for group 1 was 30.5.

The average age (mean) for group 2 was 35.4.

The mean age for group 1 and 2 was 32.95.

Table 4.6. - Occupation of Patients

Group 1	N	%	Group 2	n	%
Student	4	25	Student	3	19
Secretary	2	13	Secretary	2	13
Lecturer	1	6	Librarian	1	6
Home executive	1	6	Clerk	1	6
Pensioner	1	6	Pensioner	3	19
Nurse	1	6	Psychologist	1	6
Housewife	2	12	Housewife	1	6
Printer	1	6	Rep	1	6
Businessmen	2	12	Businessmen	2	12
Builder	1	6	Accountant	1	6

Table 4.7. - Average height and weight of patients

Height and Weight	GROUP 1	GROUP 2
Height (cm)	173.45	172.30
Weight (kg)	65.67	63.28

The overall mean height and weight was 172.88cm and 64.48kg.

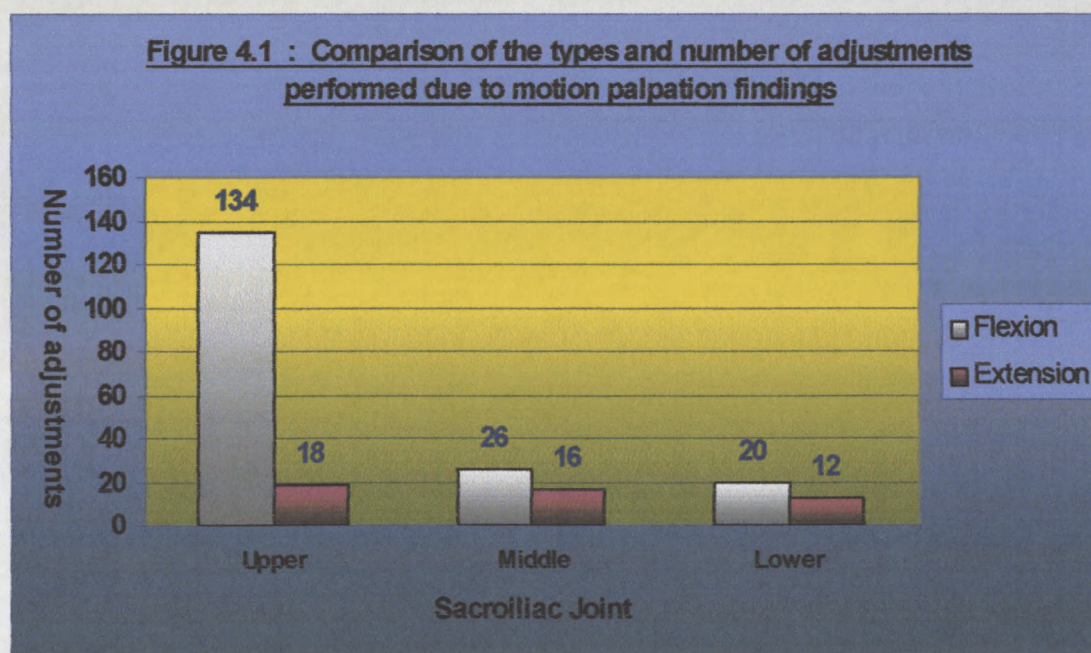
4.4 MANIPULATION DATA

Table 4.8 - Total and average number of adjustments per patient

Total number of adjustments for 32 patients : _____ 226

Average number of adjustments per patient over

the treatment period : _____ 7.06



4.5 THE ANALYSED DATA

4.5.1 P-Value

$$\alpha = 0.05$$

Reject H_0 if P is $\leq \alpha / 2$

Accept H_0 if P is $> \alpha / 2$

P was the observed level of significance of the test

As $\alpha / 2 = 0.025$, the P -Value must be equal or less than 0.025 in order to reject H_0 (there is a significant difference).

4.5.2 Power Test

The sensitivity of a statistical test can be measured using the power test.

The power of a test depends on the size of the sample, accuracy of measurements involved in the study and the level of significance of the study, α . The smaller the power of the test, the larger becomes the likelihood of a Type II error (incorrectly accepting the null hypothesis).

The power of non-parametric tests is usually low, hence indicating that results obtained from non-parametric tests are not necessarily reliable as a decision-making tool. The power of a test should be as close to one as possible. As probability of a Type II error is β , the power of a statistical test is $(1 - \beta)$.

4.6 NONPARAMETRIC TESTS

4.6.1 NON-PARAMETRIC PAIRED HYPOTHESIS TESTS

Table 4.9 - Statistical results of the subjective and objective data
comparing consultations 1 and 6 in group 1 :

GROUP 1

	CONSULTATION 1				CONSULTATION 6		
	median	s.d.	s.e.	p-value	median	s.d.	s.e.
AKE	51.65	11.82	2.96	0.0060	51.85	10.87	2.71
NRS 101	45	10.97	2.74	0.0002	35	11.58	2.89
OSW	22	8.97	2.24	0.0002	8	5.82	1.45

Comparison of the subjective and objective data between consultations 1 and 6 revealed that there was a significant improvement in the AKE (objective) measurements and in both the NRS 101 and OSW (subjective) measurements. The null hypothesis is therefore rejected for all the measurements.

Table 4.10 - Statistical results of the subjective and objective data comparing consultations 1 and 6 in group 2 :

GROUP 2

	CONSULTATION 1			CONSULTATION 6			
	median	s.d.	s.e.	p-value	median	s.d.	s.e.
AKE	51.03	11.90	2.97	0.0060	53.98	11.24	2.81
NRS 101	35.00	11.58	2.89	0.0060	16.00	12.14	3.03
OSW	13.25	11.35	2.84	0.3020	12.50	9.51	2.38

Comparison of the subjective and objective data between consultations 1 and 6 revealed that there was a significant improvement in the AKE and NRS 101 measurements but no statistically significant improvement in the OSW measurements. The null hypothesis is therefore rejected for the AKE and NRS 101 measurements and accepted for the OSW measurements.

Table 4.11 - Statistical results of the subjective and objective data comparing consultation 6 and the 1 month follow-up consultation in group 1 :

GROUP 1

	CONSULTATION 6				1 MONTH FOLLOW-UP		
	median	s.d.	s.e.	p-value	median	s.d.	s.e.
AKE	51.85	10.87	2.72	0.7892	54.63	10.33	2.58
NRS 101	26.25	14.63	3.66	0.0265	25	16.28	4.07
OSW	22	8.97	2.24	0.0026	6	5.21	1.30

From the above results it can be seen that there was no significant improvement in the AKE and NRS 101 measurements, while there was a significant improvement in the OSW measurements between the 6th consultation and the one month follow-up within group 1. The null hypothesis was accepted for the AKE and NRS 101 and rejected for the OSW measurements.

Table 4.12 - Statistical results of the subjective and objective data comparing consultation 6 and the one month follow-up in Group 2 :

GROUP 2

	CONSULTATION 6				1 MONTH FOLLOW-UP		
	median	s.d.	s.e.	p-value	median	s.d.	s.e.
AKE	53.98	11.24	2.81	0.6056	54.83	11.04	2.76
NRS 101	16	12.14	3.03	0.0159	15	10.65	2.66
OSW	12.5	9.51	2.38	0.0960	11.25	9.91	2.48

The above table shows that the improvement between the 6th consultation and the 1 month follow-up consultation was maintained with the exception of the NRS 101 measurements within group 2. The null hypothesis is accepted for the AKE and OSW measurements but rejected for the NRS 101 measurements.

Table 4.13 - Statistical results of the subjective and objective data comparing consultation 1 and the 1 month follow-up in Group 1 :

GROUP 1

	CONSULTATION 1				1 MONTH FOLLOW-UP		
	median	s.d.	s.e.	p-value	median	s.d.	s.e.
AKE	51.65	11.82	2.96	0.0801	54.63	10.33	2.58
NRS 101	45	10.97	2.74	0.0002	25	16.28	4.07
OSW	22	8.97	2.24	0.0002	6	5.21	1.30

The above table shows that while there was a significant improvement in the subjective measurements (NRS 101 and OSW), there was no significant improvement in the objective measurements (AKE) between the first and one month follow-up consultation for group 1. The null hypothesis is therefore accepted for the AKE measurements and rejected for the subjective measurements.

Table 4.14 - Statistical results of the subjective and objective data comparing consultation 1 and the 1 month follow-up in Group 2 :

GROUP 2

	CONSULTATION 1				1 MONTH FOLLOW-UP		
	median	s.d.	s.e.	p-value	median	s.d.	s.e.
AKE	51.03	11.90	2.98	0.0244	54.83	11.04	2.76
NRS 101	35	11.58	2.89	0.0005	15	10.65	2.66
OSW	13.25	11.35	2.84	0.1814	11.25	9.91	2.48

From the above table it can be seen that with the exception of the OSW, there was a significant difference in the AKE and NRS 101 measurements when comparing the subjective and objective readings between the 1st consultation and the one month follow-up within group 2. The null hypothesis is therefore accepted for the OSW and rejected for the AKE and NRS 101 measurements.

4.6.2 NON-PARAMETRIC UNPAIRED HYPOTHESIS TESTS

Table 4.15 - Statistical results comparing Group 1 and Group 2 in terms of objective and subjective data from the initial consultation :

GROUP 1				GROUP 2			
	CONSULTATION 1				CONSULTATION 1		
	median	s.d.	s.e.		p-value	median	s.d.
AKE	51.65	11.82	2.96	0.9249	51.03	11.90	2.98
NRS 101	45	10.97	2.74	0.0170	35	11.58	2.89
OSW	22	8.97	2.24	0.1610	13.25	11.35	2.84

When comparing the objective and subjective measurements obtained from groups 1 and 2 for the initial consultation, it can be seen that there was no statistically significant difference between the AKE and OSW readings. Therefore, the readings for the groups were similar at the initial consultation. There was a significant difference in the NRS 101 readings between the two groups at the initial consultation. Therefore, the null hypothesis was rejected for the NRS 101 readings and accepted for the AKE and OSW readings.

Table 4.16 - Statistical results comparing Group 1 and Group 2
in terms of objective and subjective data from the
sixth consultations :

GROUP 1				GROUP 2			
	CONSULTATION 6			p-value	CONSULTATION 6		
	median	s.d.	s.e.		median	s.d.	s.e.
AKE	51.85	10.87	2.72	0.3656	53.98	11.24	2.81
NRS 101	26.25	14.63	3.66	0.2897	16	12.14	3.03
OSW	8	5.82	1.45	0.1602	12.50	9.51	2.38

When comparing the objective and subjective measurements taken from the sixth consultations for groups 1 and 2, it can be seen that there was no statistically significant difference between the two groups. The null hypothesis was therefore accepted for all the readings.

Table 4.17 - Statistical results comparing Group 1 and Group 2
in terms of subjective and objective data from the 1
month follow-up consultation :

GROUP 1					GROUP 2		
1 MONTH FOLLOW-UP					1 MONTH FOLLOW-UP		
	median	s.d.	s.e.	p-value	median	s.d.	s.e.
AKE	54.63	10.33	2.58	0.4174	54.83	11.04	2.76
NRS 101	25	16.28	4.07	0.3747	15	10.65	2.66
OSW	6	5.21	1.30	0.0348	11.25	9.91	2.48

When comparing the subjective and objective measurements taken from the one month follow-up consultations for groups 1 and 2, it can be seen there was no statistically significant difference between the two groups.

The null hypothesis is therefore accepted for all readings.

Table 4.18 - Power analysis related to the Mann-Whitney Unpaired tests for the Active-Knee-Extension test readings :

CONSULTATION 1 - 0.0501

CONSULTATION 6 - 0.0513

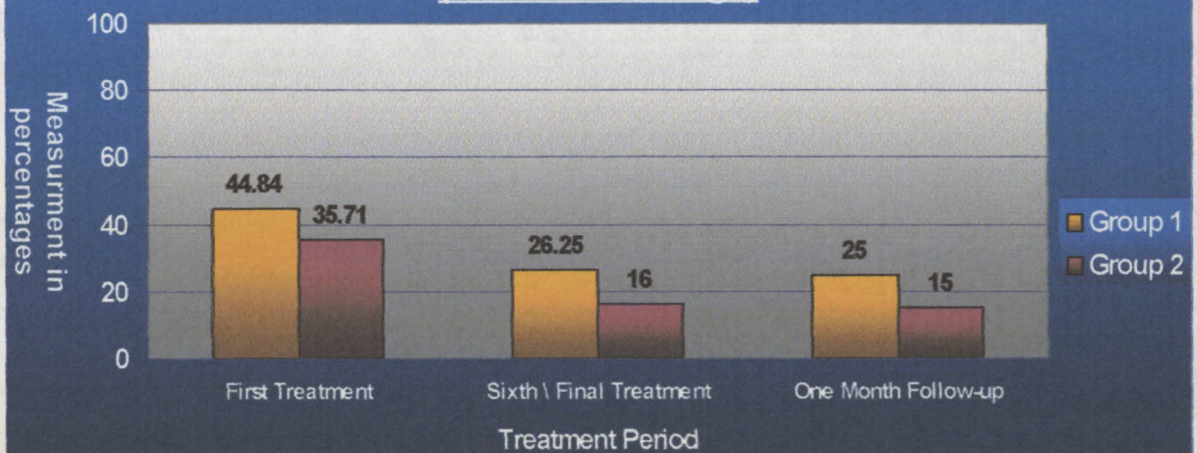
1 MONTH FOLLOW-UP CONSULTATION - 0.0514

The low readings for all the power tests indicate that there was a high possibility of a Type II error being made (incorrectly accepting the null hypothesis).

4.6.3 MEDIAN VALUE CHANGES

These values were obtained from the summary of the statistics. The values used were recorded at the first, sixth/last and one month follow-up consultations for Groups 1 and 2. These values are to indicate subtle differences between the two groups and should not be used to draw comparisons. Figures 4.2 to 4.4 reflect these changes.

**Figure 4.2 : Comparison with respect to NRS 101
(Median Readings)**



**Figure 4.3 : Comparison with respect to OSW
(Median Readings)**

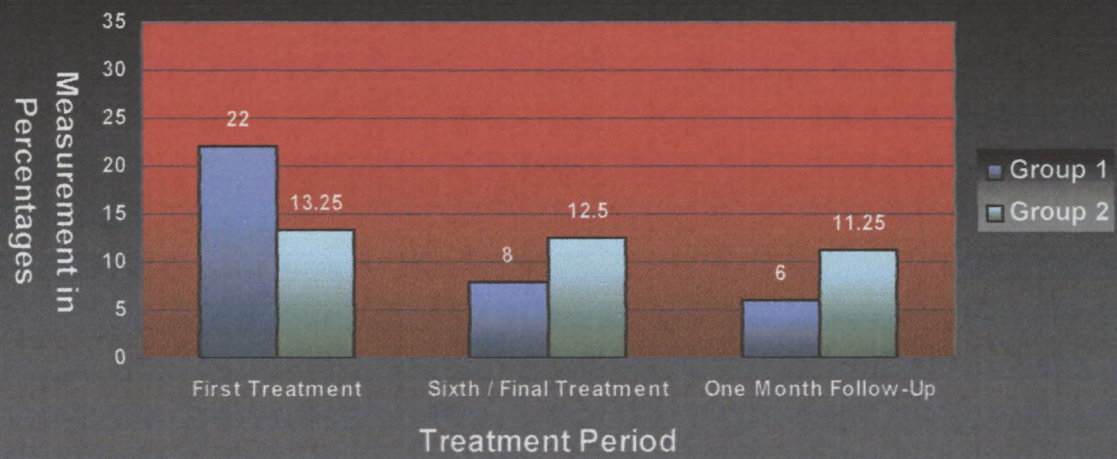
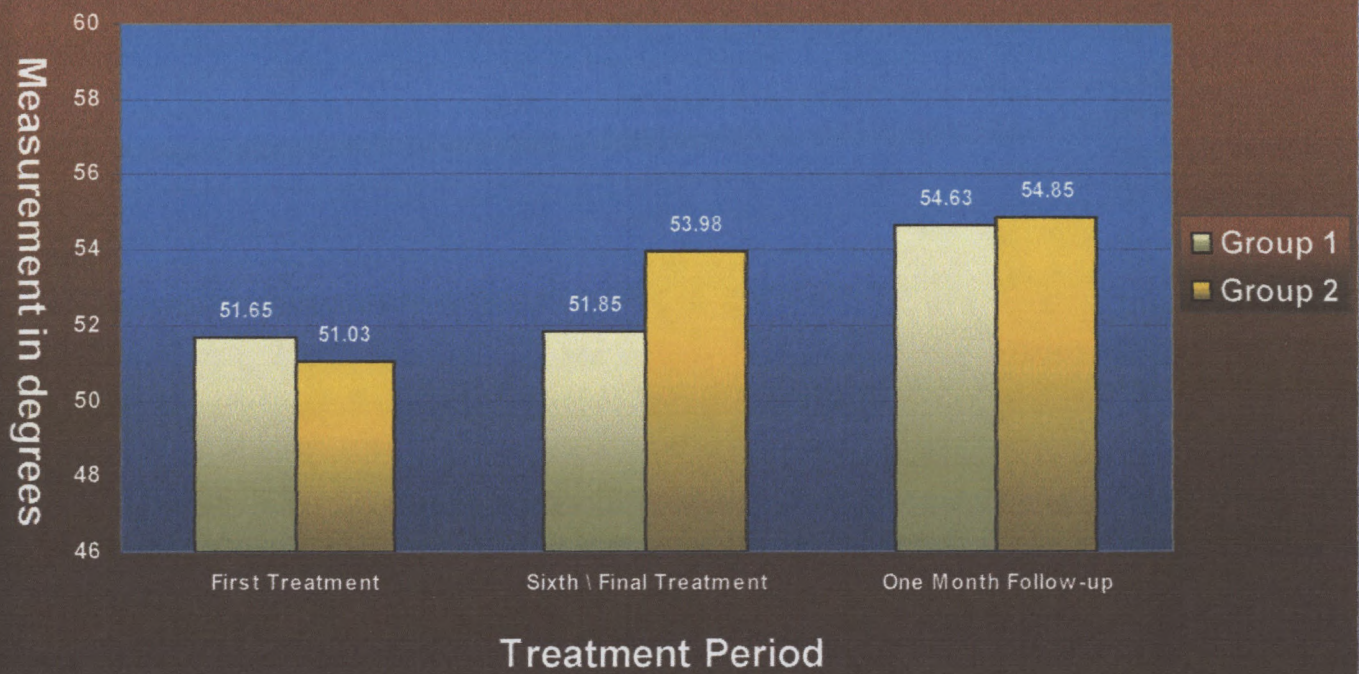


Figure 4.4 : Comparison with respect to AKE (Median Readings)



CHAPTER FIVE

DISCUSSION OF RESULTS

5.1 INTRODUCTION

The results obtained from the Numerical Pain Rating Scale 101, the Oswestry Low Back Pain Disability Index Questionnaire and the readings from the Active-Knee-Extension test are discussed here.

Evaluation of the intra-group results of the first and final treatments give an indication of the effectiveness of each of the treatment protocols.

Evaluation of results from the last treatment and the follow-up consultation show the relative long-term effects of the different treatment protocols over a four week period.

Evaluation of the inter-group data, assessing the first treatment measurements, demonstrates any difference in subjective and objective findings between the two treatment groups, in terms of their initial signs and symptoms. Comparison of the number of treatments demonstrates the rate of improvement. The inter-treatment evaluation of the final treatment measurements indicate which treatment method is more effective.

5.2 REDEFINITION OF THE STUDY OBJECTIVES

This study set out to determine which of the following two treatment approaches was more effective in the management of sacroiliac syndrome.

1. Manipulation only, or
2. manipulation in conjunction with the CRAC technique of P.N.F.
applied to the hamstring muscles.

The results are discussed below in two separate sections :

1. Intra-group comparison, and
2. Inter-group comparison.

Each section is composed of statistical evaluations of both the subjective and objective data. The appropriateness of this format lends to ease of use with which these results can be critically assessed.

5.3 INTRA-GROUP COMPARISON

5.3.1 OBJECTIVE DATA

5.3.1.1 Active-Knee-Extension test readings

The AKE data for intra-group and inter-group comparisons can be found in tables 4.8 to 4.16 and figure 4.4. Comparison between the first and sixth consultations, showed that Group 1 demonstrated significant improvement in AKE readings. In the same treatment period readings from Group 2 also showed significant improvement.

A comparison of the sixth and one month follow-up consultations for Group 1 revealed there was no significant difference in the readings. Over the same period Group 2 demonstrated a significant difference in the readings.

When assessing the period between the first and one month follow-up consultations for Group 1, no significant difference in the AKE readings was found. However, (for the same treatment period, Group 2 demonstrated significant improvement in AKE readings.

The intra-group results suggest that manipulation (Group 1) and manipulation in conjunction with CRAC therapy (Group 2) both produce good short term results in improving hamstring flexibility. However, results seem to indicate that the treatment administered in Group 2 seems to be more effective in terms of relative long-term benefits. This statement is not supported by the inter-group comparison, which will be discussed later.

5.3.2 SUBJECTIVE DATA

5.3.2.1 Numerical Pain Rating Scale 101

Comparison of the first and sixth consultations showed a statistically significant difference in both groups, showing that both treatment protocols reduced the amount of pain experienced by the patients. Analysis of the data from the sixth and one month follow-up consultations showed that that there was no significant change in pain intensity after the last treatment, indicating that the improvement was maintained. Comparison of the first and one month follow-up consultations for group 1 and 2 showed that there was a significant reduction in the level of pain experienced, indicating that the subjects in both groups received relative long-term benefits from each treatment. (Tables 4.8 to 4.1 and figure 4.2).

5.3.2.2 Oswestry Low Back Pain Disability Index Questionnaire

When the first and sixth consultations were compared it was revealed that Group 1 showed significant improvement in OSW measurements over this period. Analysis of Group 2 revealed that there was no statistically significant improvement in disability over the same period. There was a significant decrease in disability between the sixth and one month follow-up consultation for both groups, indicating possible long-term benefits of each treatment. When comparing the data between the first and one month follow-up consultations, Group 1 showed significant improvement, whereas Group 2 did not demonstrate statistically significant improvement. (Tables 4.8 to 4.16 and figure 4.3). Therefore, the patients in group 1 showed a more consistent statistically significant improvement over the treatment period.

5.4 INTER-GROUP COMPARISON

5.4.1 OBJECTIVE DATA

5.4.1.1 Active-Knee-Extension test readings

Statistical analysis revealed that after six treatments and at the one month follow-up consultation there was no significant difference between the two groups in terms of hamstring flexibility. This shows that, at a 95% confidence level, the two treatment regimes were equally effective in improving hamstring extensibility in patients suffering from sacroiliac syndrome. Power analysis for all three assessment periods was low, indicating the high probability of a Type II error being made.

When the median value changes were compared, Group 2 demonstrated greater increase in hamstring flexibility at the sixth consultation. However, median value changes are merely clinical trends and do not represent statistical differences between the two groups.

5.4.2 SUBJECTIVE DATA

5.4.2.1 Numerical Pain Rating Scale 101

Statistical comparison of the first consultation revealed a statistically significant difference in the initial level of pain for both treatment groups.

Data analysis taken from the sixth and one month follow-up consultations showed no statistically significant difference, indicating that both treatment protocols were effective in decreasing the severity of pain associated with sacroiliac syndrome and maintaining improvement over a one month period.

5.4.2.2 Oswestry Low Back Pain Disability Index Questionnaire

At the sixth and one month follow-up consultations, there was no significant statistical difference between the two groups in terms of disability. Therefore, at a 95% confidence level, the two treatment protocols are equally effective in decreasing disability in patients suffering from sacroiliac syndrome.

5.5 PROBLEMS ENCOUNTERED WITH THE SUBJECTIVE DATA

Due to the lack of blinding procedures, there is a possibility that subjects tried to please the researcher by subjectively reporting improvements in their conditions at successive consultations. This finding was not isolated to one group and therefore did not prejudice one group more than another.

The lack of statistically significant differences between the two groups queries whether the questionnaires were sensitive enough to detect subtle changes in patient disability and pain intensity. Some patients struggled to fit their pain and disability into the specific parameters set out in the questionnaires. The OSW questionnaire was not specifically designed to determine disability in sacroiliac syndrome. This may have affected patient responses in terms of improvement.

Factors such as emotional stress, occupation and posture, all of which could have played a role in the return or worsening of the pain and disability between consultations, were not included in the exclusion criteria.

5.6 PROBLEMS ENCOUNTERED WITH OBJECTIVE DATA

Sporting, occupational and recreational activities at times lead to hamstring "stiffness" in certain cases which resulted in altered results than those to be expected when measurements were performed.

One of the major limitations of this study was the small sample size of 16 patients per group, as reflected in the minor sensitivity of the power readings. In terms of time and financing, it was not possible to have a large sample size.

It must also be noted that all manipulations and stretching procedures used in this study were carried out by a sixth year chiropractic student and not a qualified doctor of chiropractic.

5.7 COMPARISON OF THE RESULTS

No study of any description involving hamstring stretching in conjunction with manipulation of the sacroiliac joint of any description in the treatment of sacroiliac syndrome could be found in journals, CD-ROMs, text books or the internet, thus it is impossible to make direct comparisons to other research studies.

Guo and Zhao (1994) reported a 100% success rate in 100 patients using two techniques unfamiliar to this researcher. The study comprised of 34 males and 66 females, with the youngest case being 21 and the oldest, 72 years of age (the age group 30 - 50 years having the majority of cases). The treatments were carried out by orthopaedic surgeons. Their study can be compared with the treatment that group 1 received in this study. In Group 1 there was a 78% (12.5 of 16) subjective improvement, there were 12 males and 4 females and the average age was 30,5. The relevance of this comparison is that it lends credence to Haldeman's (1992 : 221) statement that manipulation of the painful sacroiliac joint is successful in the majority of cases.

A comparison of Group 1's results with those of Bernard and Kirkaldy-Willis' (1987) showed remarkably similar results. Bernard and Kirkaldy-Willis (1987) reported that of the 258 patients with uncomplicated sacroiliac syndrome that were manipulated, the results were as follows : 206 were excellent (80%), 39 were good (15%) and 13 were poor (5%). (Excellent = pain free + complete restoration of normal activity. Good = enough relief of their pre-treatment pain or experienced restoration of their normal activity, which justified the time or discomfort during the treatment. Poor = no relief or deterioration.)

Based on the average of the results of the subjective questionnaires, the results of this study indicate similar results to the above study although the sample size was much smaller (16 patients per group) : Group 1 - 12.5 (78.5%) were excellent, 2 (12.5%) were good and 1.5 (9%) were poor. Group 2 - 8.5 (53%) were excellent, 2.5 (16%) were good and 5 (31%) were poor. Questionnaires and measuring criteria used for the two studies were different, hence making a direct comparison is of questionable merit.

Osterbauer et al. (1993) performed a study on ten patients diagnosed with chronic sacroiliac syndrome. The Visual Analogue Score was reported to have decreased by 13% after a six week treatment period.

The treatment protocol involved 3 manipulations per week with a short-lever, manually assisted instrument to dysfunctional spinal and pelvic segments. This compared to an overall average decrease of 20% in the NRS 101 of Group 1 and Group 2.

The OSW readings of Osterbauer et al. (1993) revealed an average drop of 15%. In comparison, this study demonstrated an average drop of 16% for Group 1 and 2% for Group 2. Once again, as a different treatment modality was used, the results are not readily comparable.

In a study by Reid (1997) side posture sacroiliac joint adjustments (Group 1) were compared with prone drop mechanism adjustments (Group 2) of the sacroiliac joint in the treatment of sacroiliac syndrome. Each group consisted of fifteen patients who were treated a maximum of ten times or until clinically asymptomatic over a period of four weeks, with a follow-up consultation three weeks after the month treatment period. Due to the similarities in study design and treatment in terms of the Group 1's the following comparisons are of interest : in terms of the NRS 101, Reid (1997) reported an average decrease in pain intensity of 27% compared with 20% for this study and in terms of the OSW, Reid (1997) reported an average improvement in disability of 17% compared with 16% for this study.

5.8 CONCLUSION

Both groups showed significant improvement in terms of pain reduction and decrease in disability. The subjects in group 2 showed a greater increase in hamstring flexibility, although this was only short term. From the statistical evidence gathered, it was concluded that there was no discernable benefits to be achieved by including hamstring stretching with manipulation of the sacroiliac joint in the treatment of sacroiliac syndrome. Both treatments were similar in their level of effectiveness.

This research paper therefore thoroughly upholds authors who advocate manipulation of the sacroiliac joint in the treatment of sacroiliac syndrome (Schafer and Faye 1990 : 242, Bergman 1993 : 500, Gatterman 1990 : 117 and Haldeman 1992 : 221).

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

A larger sample size is recommended in order to allow for the use of both paired and unpaired t-tests so that subtle changes in the objective and subjective data can be ascertained. A larger sample size would also minimise the chance of incorrectly accepting the null hypothesis (Type II error).

It is recommended that patient characteristics be taken into account in terms of age, gender, chronicity of problem, extent of pain, disability and occupation, in an attempt to ensure homogeneity.

In research of this nature involving assessment of the patients' hamstring extensibility, patient compliance in terms of ceasing sporting or other activities (which may result in stiffness of the hamstrings) is questionable. Muscular stiffness would most certainly compromise the readings and it is therefore proposed that some manner of live-in environment be sought in order to prevent any activities which could strain the hamstring muscles, during the treatment period, in further research undertakings of this nature.

The financial viability of this type of undertaking, however, would for most researchers, be impossible.

Certain patients had difficulty in producing a value for their pain or disability that would fit the specific parameters of the questionnaires. It is recommended that different questionnaires, or at the very least, additional questionnaires be used in further studies. Failing that, it is recommended that the present ones be worded differently or even redirected.

In order to increase the validity of such a study, it is recommended that the objective measurement recording be blinded, with an outside observer taking the readings rather than the researcher.

6.2 CONCLUSIONS

The results of this study indicate that both treatment protocols were effective in treating sacroiliac syndrome. This study illustrates the relationship between manipulation of the spine and reduction of symptoms in low back pain. This is in line with Haldeman (1992 : 420) who states that low back pain is the most common complaint for which manipulation is recommended.

At a 95% confidence level, neither group showed any advantage over the other in terms of treatment effectiveness. The median and mean data taken from the subjective questionnaires did however favour manipulation alone as a treatment protocol in relieving pain and disability. However, conclusions may not be drawn from this data since it does not comply with the statistical confidence parameters employed by this trial.

Manipulation has become an established protocol in the treatment of sacroiliac syndrome from an orthopaedic (Guo and Zhao 1994), physiotherapeutic (Cibulka 1988 and Cibulka et al. 1992) and chiropractic (Schaefer and Faye 1990 : 242, Bergman 1993 : 500, Gatterman 1990 : 117 and Haldeman 1992 : 221) perspective. In conclusion, to rest on ones laurels is foolhardy when dealing with one of the most common causes of mechanical low back pain. An effective co-intervention with manipulation needs to be established. The need to combat treatment costs, work absenteeism and patient morbidity should be the doctors priority and a modality to complement manipulation in the management of this prevalent neuromuskuloskeletal condition must be found.

"The key to treating any condition is proper evaluation of the problem and then becoming problem orientated, adapting the methods to the problem rather than the problem to the methods." DonTigney (1979).

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APPENDICES

NUMERICAL PAIN RATING SCALE 101

PATIENT NAME: _____ FILE NO.: _____

DATE: _____ TREATMENT NO.: _____

Please indicate on the line below the number between 0 and 100 that best describes the pain of your major problem at this point, when it is at its WORST. A zero (0) would mean "no pain at all" and one hundred (100) would mean "pain as bad as it could be".

Please write only one number.

0 _____ 100

Please indicate on the line below the number between 0 and 100 that best describes the pain of your major problem at this point, when it is at its LEAST. A zero (0) would mean "no pain at all" and one hundred (100) would mean "pain as bad as it could be".

Please write only one number.

0 _____ 100

OSWESTRY BACK DISABILITY INDEX

B

PATIENT NAME: _____ FILE #: _____ DATE: _____

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

Section 1 - Pain Intensity

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

Section 2 - Personal Care (Washing, Dressing, etc.)

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

Section 3 - Lifting

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

Section 4 - Walking

- ☐ Pain does not prevent me walking any distance.
- ☐ Pain prevents me walking more than 1 mile (2.2 km).
- ☐ Pain prevents me walking more than 1/2 mile (1.1 km).
- ☐ Pain prevents me walking more than 1/4 mile (0.5 km).
- ☐ I can only walk using a stick or crutches.
- ☐ I am in bed most of the time and have to crawl to the toilet.

Section 5 - Sitting

- ☐ I can sit in any chair as long as I like.
- ☐ I can only sit in my favorite chair as long as I like.
- ☐ Pain prevents me from sitting more than 1 hour.
- ☐ Pain prevents me from sitting more than 1/2 hour.
- ☐ Pain prevents me from sitting more than 10 minutes.
- ☐ Pain prevents me from sitting at all.

Section 6 - Standing

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

Section 7 - Sex Life

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

Section 8 - Social Life

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

Section 9 - Sleeping

- ☐ I have no trouble sleeping.
- ☐ I can sleep well only by using pills.
- ☐ Even when I take pills I have less than six hours sleep.
- ☐ Even when I take pills I have less than four hours sleep.
- ☐ Even when I take pills I have less than two hours sleep.
- ☐ Pain prevents me from sleeping at all.

Section 10 - Travelling

- ☐ I can travel anywhere without extra pain.
- ☐ I can travel anywhere but it gives me extra pain.
- ☐ Pain is bad but I manage trips over two hours.
- ☐ Pain restricts me to trips of less than one hour.
- ☐ Pain restricts me to trips under 30 minutes.
- ☐ Pain prevents me from travelling, except to the doctor or hospital.

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

C

Patient: _____ Date: _____
file #: _____ X-Ray#: _____
Age: _____ Sex: _____ Occupation: _____
Intern: _____ Signature: _____

FOR CLINICIAN'S USE ONLY

Initial visit clinician: _____ Signature: _____

Case History:

Examination:

Previous:

Current:

X-Ray Studies:

Previous:

Current:

Clinical Path. lab:

Previous:

Current:

Case Status:

PTT: Conditional: Signed Off: Final Sign out:

Recommendations:

Intern's Case History

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

3. Present Illness:

- Location
- Onset
- Duration
- Frequency
- Pain (Character)
- Progression
- Aggravating Factors
- Relieving Factors
- Associated S & S
- Previous Occurrences
- Past Treatment and Outcome

4. Other Complaints:

5. Past Medical History:

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

6. Current health status and life-style:

C

- ▶ Allergies
- ▶ Immunizations
- ▶ Screening Tests
- ▶ Environmental Hazards (Home, School, Work)
- ▶ Safety Measures (seat belts, condoms)
- ▶ Exercise and Leisure
- ▶ Sleep Patterns
- ▶ Diet
- ▶ Current Medication
- ▶ Tobacco
- ▶ Alcohol
- ▶ Social Drugs

7. Immediate Family Medical History:

- ▶ Age
- ▶ Health
- ▶ Cause of Death
- ▶ DM
- ▶ Heart Disease
- ▶ TB
- ▶ Stroke
- ▶ Kidney Disease
- ▶ CA
- ▶ Arthritis
- ▶ Anaemia
- ▶ Headaches
- ▶ Thyroid Disease
- ▶ Epilepsy
- ▶ Mental Illness
- ▶ Alcoholism
- ▶ Drug Addiction
- ▶ Other

8. Psychosocial history:

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

9. Review of Systems:

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



D

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Patient: _____ File#: _____ Date: _____
 Clinician: _____ Signature: _____
 Intern: _____ Signature: _____

1. VITALS

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

2. GENERAL EXAMINATION

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

Urinalysis:

3. CARDIOVASCULAR EXAMINATION

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

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

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

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

Percussion: - borders of heart

Auscultation:

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

4. RESPIRATORY EXAMINATION

1) Is this patient in Respiratory Distress ?

Inspection

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

Palpation

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

Percussion

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

Auscultation

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

5. ABDOMINAL EXAMINATION

1) Is this patient in Liver Failure ?

Inspection

- Shape:
- Scars:
- Hernias:

Palpation

- Superficial:
- Deep = Organomegally:

- Masses (intra- or extramural)
- Aorta:

Percussion - Rebound tenderness:
- Ascites:
- Masses:

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

Rectal Examination

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

6. G.U.T EXAMINATION

External genitalia:
Hernias:
Masses:
Discharges:

7. NEUROLOGICAL EXAMINATION

Gait and Posture

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

Higher Mental Function

- Information and Vocabulary:
- Calculating ability:
- Abstract Thinking:

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

Evidence of head trauma:

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

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

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

- Pupillary light reflexes = Direct:
 = Consensual:
- Fundoscopy findings:
- III Ocular Muscles:
 Eye opening strength:
- IV Inferior and Medial movement of eye:
- V a. Sensory - Ophthalmic:
 - Maxillary:
 - Mandibular:
 b. Motor - Masseter:
 - Jaw lateral movement:
 c. Reflexes - Corneal reflex
 - Jaw jerk
- VI Lateral movement of eyes
- VII a. Motor - Raise eyebrows:
 - Frown:
 - Close eyes against resistance:
 - Show teeth:
 - Blow out cheeks:
 b. Taste - Anterior two-thirds of tongue:
- VIII General Hearing:
 Rinnes = L: R:
 Webers lateralisation:
 Vestibular function - Nystagmus:
 - Rombergs:
 - Wallenbergs:
 Otoscope examination:
- IX & Gag reflex:
- X Uvula deviation:
 Speech quality:
- XI Shoulder lift:
 S.C.M. strength:
- XII Inspection of tongue (deviation):

Motor System:

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

- Forearm = Supination & Pronation:
 - Fingers = Extension (Interphalangeals & M.C.P's):
 - Thumb = Opposition:
 - Hip = Flexion & Extension:
 - = Adduction & Abduction:
 - Knee = Flexion & Extension:
 - Foot = Dorsiflexion & Plantar flexion:
 - = Inversion & Eversion:
 - = Toe (Plantarflexion & Dorsiflexion):
- b. Tone
- Shoulder:
 - Elbow:
 - Wrist:
 - Lower limb - Int. & Ext. rotation:
 - Knee clonus:
 - ankle clonus:
- c. Reflexes
- Biceps:
 - Triceps:
 - Supinator:
 - Knee:
 - Ankle:
 - Abdominal:
 - Plantar:

Sensory System:

- a. Dermatomes
- Light touch:
 - Crude touch:
 - Pain:
 - Temperature:
 - Two point discrimination:
- b. Joint position sense
- Finger:
 - Toe:
- c. Vibration:
- Big toe:
 - Tibial tuberosity:
 - ASIS:
 - Interphalangeal Joint:
 - Sternum:

Cerebellar function:

Obvious signs of cerebellar dysfunction:

- = Intention Tremor:
- = Nystagmus:
- = Truncal Ataxia:

Finger-nose test (Dysmetria):
Rapid alternating movements (Dysdiadochokinesia):
Heel-shin test:
Heel-toe gait:
Reflexes:
Signs of Parkinsons:

8. SPINAL EXAMINATION:(See Regional examination)

Obvious Abnormalities:
Spinous Percussion:
R.O.M:
Other:

9. BREAST EXAMINATION:

Summon female chaperon.

Inspection - Hands rested in lap:
- Hands pressed on hips:
- Arms above head:
- Leaning forward:

Palpation - masses:
- tenderness:
- axillary tail:
- nipple:
- regional lymph nodes:

E

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

PATIENT: _____

FILE #: _____ DATE: _____

INTERN/RESIDENT: _____

SUPERVISING CLINICIAN: _____

STANDING:

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

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

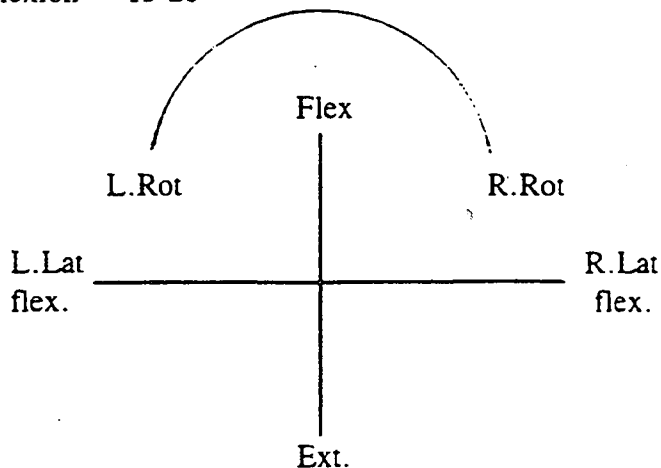
RANGE OF MOTION

Forward Flexion = 40-60°(15cm from floor)

Extension = 20-35°

L/R Rotation = 3-18°

L/R Lateral Flexion = 15-20°



SUPINE:

Skin
Hair
Nails
Palpate Abdomen/groin
Pulses (abdomen)

Observe abdomen
Fasciculations
Abdominal Reflexes

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

actual
apparent

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

LATERAL RECUMBENT

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

NON ORGANIC SIGNS

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

GAIT

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

PRONE

Gluteal skyline
Skin rolling
Iliac crest compression
Facet joint challenge
S-I tenderness
Erichson's Test
Pheasant's Test
Myotome:
Glut. Max
Active MF Trigger Pts:
QL
Glut. Med
Glut. Min
Glut. Max
Piriformis
Hamstrings
TFL

NEUROLOGICAL EXAMINATION

E

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

Tripod

Kemp's Test

MOTION PALPATION and JOINT PLAY:

LEFT: Upper Thoracics:
 Lumbar Spine:
 Sacroiliac Joint:

RIGHT: Upper Thoracics:
 Lumbar Spine:
 Sacroiliac Joint:

Basic Exam: Hip

Case History:

ROM: Active:

Passive:

RIM:

Orthopaedic/Neuro/

Vascular:

Observ/Palpation:

Basic Exam: Thoracic Spine

Case History:

ROM: Motion Palp:

Active:

Passive:

Orthopaedic/Neuro/

Vascular:

Observ/Palpation:

INFORMED CONSENT FORM

F

(To be completed in duplicate by patient/subject*) *Delete whichever is not applicable.

TITLE OF RESEARCH PROJECT

NAME OF SUPERVISOR

NAME OF RESEARCH STUDENT

PLEASE CIRCLE THE APPROPRIATE ANSWER

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

PATIENT/SUBJECT* Name _____
(in block letters)

Signature _____

PARENT/GUARDIAN* Name _____
(in block letters)

Signature _____

WITNESS Name _____
(in block letters)

Signature _____

RESEARCH STUDENT Name _____
(in block letters)

Signature _____

Active-Knee-Extension Test findings:

Patient:

Research no.:

Date:

First treatment: L- R-

Sixth / treatment: L- R-

One month follow up: L- R-