A COMPARISON OF SACROILIAC JOINT MANIPULATION VERSUS PIRIFORMIS MUSCLE ICE- AND- STRETCH COMBINED WITH SACROILIAC JOINT MANIPULATION ON POST- PARTUM FEMALES SUFFERING FROM SACROILIAC SYNDROME

A research study submitted to the
Faculty of Health Sciences, Technikon Witwatersrand, Johannesburg
in fulfilment of the requirements for the degree of Master of Technology: Chiropractic
by

Michael Pritchard
(Student Number: 9308439)

Supervisor:
Dr. N.S. McLean M. Tech. Chiropractic, I.C.S.S.D.

Co-supervisor:
Dr. E.K. Urli M. Dip.C. S.A.

Johannesburg, 2001
DECLARATION

I declare that this research study is my own unaided work. It is being submitted for the degree of Master of Technology at the Technikon Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other Technikon or University.

[Signature of Candidate]

5th day of January 2000
ABSTRACT

Sacroiliac (S.I.) Syndrome / Dysfunction is a collection of symptoms and signs that result from mechanical irritation of the S.I. joint. This results in lower back and buttock pain that can be referred into the groin and posterior thigh. Traditionally chiropractors have successfully treated this condition by manipulation of the S.I. joint (Kirkaldy- Willis and Hill 1979: 102; Kirkaldy-Willis 1988: 136).

The piriformis muscle is closely related to the S.I. joint because it is in close proximity to it and can therefore restrict mobility in the joint. The restriction of mobility in the S.I. joint can result from spasm of the piriformis muscle (Wyke, 1985: 215; Cailliet, 1995: 354). Spasm can be caused by myofascial trigger points which are foci of inflammation and hyperirritability in a muscle that cause increased tone and shortening of the muscle fibres (Travell and Simons 1983:192). Alternatively, spasms may come about as a result of a neurological reflex due to intra-articular irritation of a joint (Freiberg and Vinle 1934:126; Potter and Cassidy 1979: 99; Turek, 1989: 1469; Wyke, 1985: 230). A trigger point can be active or latent. Active trigger points have a spontaneous pain referral pattern at rest or on motion that is specific for that muscle, whereas latent trigger points don't. Both are tender to palpation and both restrict motion of the muscle and the underlying joint (Travell and Simons 1983:1). It is well recognised by numerous authors (Haldeman 1992: 221; Gatterman 1990: 124; Travell & Simons 1992: 193) that piriformis muscle pain syndromes (trigger points/reflex piriformis muscle spasms) and Sacroiliac Syndrome are often
interrelated. A strained piriformis muscle that has undergone trauma, such as resisting rapid medial rotation of the hip joint or from prolonged contraction of the muscle due to external rotation of the hip during the birth process, may develop trigger points. These trigger points may subsequently cause restriction of the S.I. joint due to muscular hypertrophy of the piriformis (Calliet, 1995: 350). A mechanically fixated S.I. joint can also cause shortening of the piriformis muscle due to intra-articular S.I. joint irritation resulting in reflex muscle spasm (Travell and Simons, 1992: 188; Freiberg and Vinle 1934: 126; Potter and Cassidy 1979: 99; Haldeman, 1992: 220; Turek, 1989: 1469; Wyke, 1985: 217). Traditionally, muscular trigger points and muscle spasms have been treated with intermittent cold spray (or ice) and stretching of the muscle (Travell and Simons, 1983: 65; Calliet, 1995: 264).

It is agreed that S.I. Syndrome most commonly occurs in pregnant females or females with a recent history of pregnancy (Potter and Cassidy, 1979: 102; Berg et al., 1990: 71). The main reasons for this are due to the increased anterior weight carriage that starts during the final stages of pregnancy, as well as the fact that the post-partum female continues with the anterior weight carriage when she lifts and carries her newly born baby (Dontigny, 1985: 124). Coupled with this, the hormone relaxin is released during the final stages of pregnancy. This causes hypermobility in the S.I. joints. If the S.I. joint is challenged in its range of motion (due to uneven weight distribution such as lifting up a child), the joint may twist around the X-axis causing non-congruent joint surfaces to come in contact with each other. The S.I. joint then becomes hypomobile (fixated) with subsequent intra-articular joint irritation and inflammation. Until normal joint congruency is restored, this aberration may continue indefinitely (Dontigny, 1985: 124).
This study proposed to evaluate the effectiveness of manipulation of a fixated S.I. joint on its own, as opposed to manipulation of a fixated S.I. joint combined with piriformis muscle ice-and-stretch on post-partum females suffering from S.I. Syndrome.

Thirty post-partum females suffering from S.I. Syndrome were used for this study and all were within six months post delivery. The patients were randomly divided into two groups, each consisting of fifteen patients. Due to the fact that the study was started without a full sample of subjects, it was decided that every odd numbered patient to qualify for the study would be placed into the Experimental Group (piriformis ice-and-stretch combined with S.I. joint manipulation). Thus every even numbered patient that qualified for the study was placed into the Control Group. This is known as systematic randomised sampling (Lind, Mason and Marchal, 2000: 220). The patients were drawn from the Kempton Park (East Rand) area. One group received chiropractic manipulation of the motion-restricted sacroiliac joint/s. The other group received a combination of both sacroiliac joint manipulation and intermittent ice-and-stretch of the piriformis muscle on the ipsilateral side of the S.I. fixation. If both S.I. joints were fixated then both piriformis muscles would receive the intermittent ice-and-stretching. The post-partum females, in both groups, received six treatments over two weeks (three treatments per week) followed by a two week break at which point a final assessment took place.

Subjective measurements included the McGill Pain Questionnaire (Appendix C), the Oswestry Low Back Pain Disability Questionnaire (Appendix D) and the Numerical Pain Rating Scale (Appendix E) which the patients completed prior to the first, third and the sixth
treatments, as well as at the final assessment consultation two weeks later.

Excluding the use of a bone scan, Gaenslen’s Test, Patrick-Faber Test and Yeoman’s Test (Figures 5, 6 & 7) are considered to be the most provocative tests for the S.I. joint (Hestoeck and Leboeuf, 2000: 258). Motion palpation and finger palpation are considered to be important tests that are used in the diagnosis S.I. Syndrome (Haldeman, 1992: 218; Gatterman, 1990: 120; Hestoeck and Leboeuf, 2000: 258). The provocative orthopaedic tests were used in the diagnostic process, as well as to objectively monitor the patient’s progress.

Sacroiliac motion palpation was used to diagnose decreased movement in either of the S.I. joints. Finger palpation was used to pin point the sensitive posterior capsule of the S.I. joint (the capsule is found inferior and medial to the PSIS). However, it must be mentioned that motion palpation and finger palpation (over the S.I. joint) were not statistically analysed, as they were merely used to direct the examiner to the appropriate location for the required treatment. According to Hoestoeck and Leboeuf (2000: 258), motion palpation of the S.I. joints is a valid diagnostic technique but it should not be used as an objective form of measurement. The provocative orthopaedic tests as well as sacroiliac motion palpation and finger palpation were performed before each treatment. It was hypothesised that the number of painful provocative tests would probably decrease with time and thus highlight the patient’s progress with regard to the symptomatic joint. The most objective form of measurement consisted of measuring pain sensitivity over the symptomatic S.I. joint (didn't have to be the fixated joint) with the aid of an algometer. This was also repeated before each treatment. The algometer would numerically quantify the patient’s pain threshold over the symptomatic S.I. joint and thus objectively monitor the patient’s progress with regard to pressure sensitivity.
With regard to the statistical analysis of the algometer readings, the following analyses were performed:

- **Paired T-tests.** These were done to determine the effect of each treatment in comparison to all previous treatments within the same group. For example, Treatment 2 (T2) minus Treatment 1 (T1), T3-T1 and T3-T2 etc. (Lind, Mason and Marchal, 2000: 317).

- **The Two Sample T-Test.** This test was done to determine the difference between the two groups. The Two-Sample T-test was performed separately for possible treatment effects, i.e. treatment 2 minus treatment 1, T3-T1, T3-T2 etc. (Lind, Mason and Marchal, 2000: 273).

Similar analyses were performed for the McGill Pain Questionnaire (Appendix C), the Oswestry Low Back Pain Disability Questionnaire (Appendix D) and the Numerical Pain Rating Scale (Appendix E), except that the tests in these cases were based on non-parametric techniques. For the paired tests, the Sign Rank test (Lind, Mason and Marchal, 2000: 188) was used and for the testing of group differences, the Mann-Whitney Test was performed (Lind, Mason and Marchal, 2000: 189). Since the provocative orthopaedic tests (Gaenslen's, Patrick-Faber and Yeoman's tests, Figures 5, 6 & 7 respectively) consisted of binary responses to pain, the pain assessment was represented graphically.

The results (which were tabulated and plotted on graphs) showed, in terms of reduced pain and disability, that an overall statistically and clinically significant difference between the two groups existed in favour of the combination treatment group. These results therefore
indicate that manipulation of the motion-restricted sacroiliac joint combined with piriformis muscle ice-and-stretch on the ipsilateral side of the fixation, is more effective than sacroiliac manipulation alone on a sample of post-partum females suffering from Sacroiliac Syndrome. Thus we can agree with the findings of Dontigny (1985: 124), that the ipsilateral piriformis muscle and the fixated S.I. joint, do in fact interact with each other in the pathogenesis of post-partum Sacroiliac Syndrome.
Acknowledgements

Firstly I would like to thank my supervisor, Dr. N. S. McLean and my co-supervisor, Dr. E.K. Urli, for their dedication and guidance throughout my research.

I would also like to thank the gynaecologists at both the ARWYP and the Sunninghill Hospitals for referring patients to me for this research study, for which I am extremely grateful.

To my mom, my dad and my three brothers, thank-you for your relentless encouragement throughout my student years. Without you this task would have been more difficult.

Last, but not least, I would like to thank my wife Natalie, for always pushing me forward even when the end looked so far away. Thank you!
TABLE OF CONTENTS

Declaration I
Abstract II
Acknowledgements VIII
Table of Contents IX
Defining The Terms X

CHAPTER ONE

THE PROBLEM AND ITS SETTING

1.1 THE PROBLEM STATEMENT 1
1.2 SUBPROBLEMS 2
1.2.1 Subproblem 1 2
1.2.2 Subproblem 2 4
1.2.3 Subproblem 3 4
1.2.4 Subproblem 4 4
1.3 HYPOTHESES 5
1.3.1 Hypothesis 1 5
1.3.2 Hypothesis 2 5
1.3.3 Hypothesis 3 5
1.3.4 Hypothesis 4 6
1.4 IMPORTANCE OF THE STUDY 6
1.4.1 Immediate background of the problem 6
1.4.2 The need for a solution to the problem 7
1.4.3 The benefits that will arise from solving the problem 9
1.4.4 The feasibility of the solution 10
CHAPTER 2

LITERATURE REVIEW

2.1 RELATED ANATOMY 11
2.1.1 Anatomy of the sacroiliac joint 11
2.1.2 Anatomy of the piriformis muscle 13
2.1.3 Function of the piriformis muscle 15
2.2 MOTION AT THE SACROILIAC JOINT 16
2.3 SACROILIAC SYNDROME DURING AND AFTER PREGNANCY 17
2.4 WHAT IS SACROILIAC SYNDROME? 19
2.5 CLINICAL PRESENTATION OF SACROILIAC SYNDROME 20
2.6 SPECIAL TESTS FOR S.I. JOINT DYSFUNCTION 23
2.7 HOW THE PIRIFORMIS INTERACTS WITH THE S.I. JOINT 28
2.8 MANIPULATION OF THE S.I. JOINT 30
2.9 INTERMITTANT COLD AND STRETCH OF MUSCLES 32

CHAPTER 3

MATERIALS AND METHODS

3.1 INTRODUCTION 34
3.2 METHODS, TECHNIQUES AND MEASUREMENTS 34
3.3 TYPE AND NATURE OF THE DATA 39
3.3.1 The primary data 40
3.3.2 The secondary data 40
3.4 CRITERIA GOVERNING THE ADMISSIBILITY OF THE DATA 40
3.5 CAPTURING AND SECURING THE DATA 41
3.6 STATISTICS 44
6.14 Answer to Hypothesis 1 81
6.2 PROBLEMS ENCOUNTERED IN THE STUDY 82
6.3 RECOMMENDATIONS 82

REFERENCES 84

APPENDICES

APPENDIX A: Eligibility Questionnaire 87
APPENDIX B: Subject Information Sheet & Patient Consent Form 89
APPENDIX C: The McGill Pain Questionnaire 91
APPENDIX D: The Oswestry Questionnaire 95
APPENDIX E: The Numerical Pain Rating Scale 96
APPENDIX F: The Case History Form 97
APPENDIX G: The Physical Examination Form 102
APPENDIX H: The Lumbar and Pelvic Examination Form 114
APPENDIX I: The Statistical Test Procedure 121
LIST OF DIAGRAMS AND GRAPHS

Figure 1: The C-shaped sacroiliac joint
Figure 2: Ligaments of the sacroiliac joint
Figure 3a & 3b: Proximal and distal attachments of the piriformis muscle
Figure 3c: The structures adjacent to the piriformis muscle
Figure 4: The congruent surfaces of the sacroiliac joint
Figure 5: Gaenslen’s Test
Figure 6: Patrick-Faber Test
Figure 7: Yeoman’s Test
Figure 8: The Algometer / Force Dial
Figure 9a: Adjusting an upper S.I. joint fixation
Figure 9b: Adjusting a lower S.I. joint fixation
Figure 10: The ice-and-stretch technique for the piriformis muscle
Figure 11: The algometer readings
Figure 12: The McGill Pain Questionnaire
Figure 13: The Oswestry Questionnaire
Figure 14: The Numerical Pain Rating Scale
Figure 15: Gaenslen’s Test
Figure 16: Patrick-Faber Test
Figure 17: Yeoman’s Test
DEFINING THE TERMS

An algometer is a spring-operated device specifically designed to measure pressure threshold in relation to sensitive joints, bones and trigger points (Travell and Simons, 1983:12).

Control Group is the sample of females only receiving sacroiliac manipulation of the fixated sacroiliac joint/s.

Experimental Group is the sample of females receiving sacroiliac manipulation of the fixated sacroiliac joint/s in conjunction with intermittent piriformis muscle ice-and-stretch on the ipsilateral side of the S.I. fixture.

Intermittent ice-and-stretch - For the purpose of this study, the patient was positioned into the stretch position for the piriformis muscle. An ice pack was then placed directly over the piriformis muscle for thirty seconds. During the application of the ice pack, the researcher passively applied a progressive increase in the stretch of the muscle. In total this was repeated three times per treatment session.

Joint fixation refers to any physical, functional, or psychic mechanism that produces a loss of joint mobility within its normal physiological range of motion. Thus, ankylosis would be considered a fixation in its purest sense i.e. 100% fixation. However, most fixations found clinically will be far less (e.g. in the 20%-80% range of normal mobility). Common causes
of a joint fixation are muscle spasms, trigger points, (muscular fixation), ligament shortening (ligamentous fixation), synovial intra-articular adhesions (articular fixation) and exostoses (bony fixation) (Schafer and Faye, 1990: 2).

- **Motion palpation** is a palpatory diagnostic procedure performed on joints in order to determine if a lack of normal range of motion (joint fixation) does exist (Schafer and Faye, 1990). For the purpose of this study, this test was merely used as a diagnostic procedure for the examiner and was not used as a quantitative form of measurement.

  **Pressure threshold** is the pressure that is first perceived as painful by the subject as increasing pressure is applied (Travell and Simons, 1983: 12).

- **Sacroiliac manipulation (adjustment)** is the principal therapeutic procedure employed by chiropractors for the management of S.I. Syndrome. The manipulative thrust is delivered to the posterior superior iliac spine or to the ischial tuberosity, and is a high velocity, low impact thrust. This results in a cracking sound, which is the result of intra-articular cavitation of synovial carbon dioxide. The goal of this therapy is to mobilise a stiff or fixated joint and restore normal range of motion (Mierau et al, 1988: 135).

**Sacroiliac (S.I.) Syndrome/Dysfunction** is a collection of symptoms and signs that result from mechanical irritation of the S.I. joint. This results in lower back and buttock pain that
can be referred into the groin and posterior thigh (Haldeman, 1992: 211).

Trigger point is a focus of inflammation and hyperirritability in a muscle that causes increased tone and shortening of the muscle fibres. A trigger point can be active or latent. An active trigger point has a spontaneous pain referral pattern at rest or on motion that is specific for that muscle, whereas a latent trigger point does not. Both are tender to palpation and both restrict motion of the muscle and the underlying joint (Travell and Simons, 1983:1).
CHAPTER 1

THE PROBLEM AND ITS SETTING

1.1. PROBLEM STATEMENT

This study proposed to evaluate the effectiveness of chiropractic manipulation of the sacroiliac (S.I.) joint/s on its own, as opposed to chiropractic manipulation of the S.I. joint/s combined with piriformis muscle ice-and-stretch on the ipsilateral side of the fixation. This was carried out on post-partum females, within the sixth month post-partum-period, that were suffering from S.I. Syndrome. The diagnosis was defined in terms of pain and disability questionnaires (Appendices C, D & E), a case history, a relevant physical examination and a regional lumbar and pelvic neurological/orthopaedic examination. This was done in order to eliminate other conditions that may present with the same symptoms (such as lumbar facet syndrome).

The first reason for the comparative study was to ascertain which one of the above-mentioned treatments was more beneficial in the management of S.I. Syndrome on post-partum females.

The second reason for the comparative study was to find out whether the piriformis muscle played a role in the fixation of the S.I. joint/s. This study proposed to challenge traditional
chiropractic philosophy, which stipulated that the adjustment was sufficient in treating a fixated joint, and that soft tissue therapy was of little or no value (Haldeman, 1992: 211).

1.2. SUBPROBLEMS

1.2.1. Subproblem 1

The first subproblem was to make a correct clinical diagnosis of S.I. Syndrome due to the fact that there were other conditions that presented with similar signs and symptoms to that of S.I. Syndrome.

The conditions that had a similar presentation to that of S.I. Syndrome were: Lumbar Posterior Facet Syndromes, Lumbar Intervertebral Disc Herniations, a Lumbar Lateral Canal Stenosis, a Quadratus Lumborum Myofascial Pain and Dysfunction Syndrome, as well as a Piriformis Myofascial Syndrome with bilateral S.I. joint instability. This rarely occurs, as you will normally find a fixated S.I. joint is opposite to a hypermobile S.I. joint (Gatterman, 1990: 114).

As mentioned in the Abstract, intra-articular irritation of the S.I. joint can cause reflex muscle spasm of the ipsilateral piriformis muscle (Freiberg and Vinle, 1934: 126; Potter and Cassidy, 1979: 102; Wyke, 1985: 217). It was also mentioned that a shortened piriformis muscle (due to trigger points resulting from the birth process, trauma etc.) would restrict mobility in the ipsilateral S.I. joint (Cited by Travell and Simons 1983: 192; Retzlaff and
associates, 1974: 799; Cailliet, 1995: 350). It was therefore decided that provided the standard orthopaedic tests (that were done in the lumbar and pelvic regional) confirmed a S.I. Syndrome (with pain in and around the S.I. joint/s, combined with S.I. joint fixation/s and no neurological deficit) the patient would be chosen for the study. Travell and Simons (1992: 196) also state that a hypermobile S.I. joint can be stabilised by a shortened ipsilateral piriformis muscle (containing active or latent trigger points). Patients who presented solely with this type of piriformis myofascial syndrome were not considered for the study, as there were no S.I. joint fixations. If this condition did appear in conjunction with a S.I. joint fixation on the contra-lateral side, then the patient would be treated on the side of the fixation. Gatterman (1990:125) states that by restoring normal mobility to the fixated side, the hypermobile joint would then have time to start stabilising (due to decreased motion demands). However, the hypermobile S.I. joint may be the symptomatic joint and thus the algometer would be placed over this joint.

As mentioned in the Abstract, a hypermobile S.I. joint may twist or subluxate around its x-axis, thereby causing non-congruency with subsequent joint fixation and irritation (Dontigny, 1985: 124). In this case the symptomatic joint would be treated to restore normal mobility by stretching the already shortened joint capsule (Kikaldy-Willis, 1992: 248). It is well documented by numerous authors that sacroiliac dysfunction can be coupled with a piriformis neurovascular entrapment. This would cause a wide variety of neurological and/or vascular disturbances (Cited by Travell and Simons, 1992: 201). Patients who presented with these clinical signs and symptoms were not allowed to participate in the study.
1.2.2. **Subproblem 2**

The second subproblem was to evaluate the effectiveness of **chiropractic manipulation** of the motion restricted S.I. joint/s on its own. This was achieved in terms of the patients' subjective and objective responses to treatment, which tried to determine the extent to which this form of treatment was beneficial in the management of S.I. Syndrome in a sample of post-partum females.

1.2.3. **Subproblem 3**

The third subproblem was to evaluate the effectiveness of **chiropractic manipulation** of the fixated S.I. joint/s combined with **piriformis muscle ice-and-stretch** on the ipsilateral side of the S.I. fixation. This was achieved in terms of subjective and objective clinical findings, in order to determine the extent to which this form of treatment was beneficial in the management of S.I. Syndrome in a sample of post-partum females.

1.2.4. **Subproblem 4**

The fourth subproblem concerned itself with the integration of the data arising from the previous subproblems. This was done in order to determine which of the above-mentioned treatment protocols was more beneficial (in terms of patient response to treatment) in the management of S.I. Syndrome in a sample of post-partum females.
1.3. HYPOTHESES

1.3.1. Hypothesis 1

It has been proven that S.I. Syndrome commonly affects pregnant and post-partum females (Diakow et al., 1991: 116). Therefore if a correct diagnosis of S.I. Syndrome is made, then it should be possible to identify those elements necessary for the formulation of a suitable chiropractic management programme for S.I. Syndrome in post-partum females.

1.3.2. Hypothesis 2

The second hypothesis was that chiropractic manipulation of the restricted S.I. joint on its own, would be beneficial for the patient in the management of S.I. Syndrome in post-partum females.

1.3.3. Hypothesis 3

The third hypothesis was that chiropractic S.I. joint manipulation combined with piriformis muscle intermittent-ice-and-stretch, on the ipsilateral side of the fixation, would be beneficial for the patient in the management of S.I. Syndrome in post-partum females.
1.3.4. **Hypothesis 4**

It was hypothesised that the two forms of chiropractic treatment would be beneficial to varying degrees in the management of S.I. Syndrome in post-partum females. It was thus hypothesised that S.I. joint manipulation combined with piriformis intermittent-ice-and-stretch on the ipsilateral side of the fixation would be more effective than chiropractic S.I. joint manipulation alone.

1.4. **IMPORTANCE OF THE STUDY**

1.4.1. **Immediate background of the problem**

It is generally accepted that pregnant and post-partum females tend to suffer the most from Sacroiliac Syndrome (Haldeman, 1992: 217; Berg et al., 1990: 71; Daly et al., 1991: 149). This is due to increased mechanical strains on the lower back and pelvis during pregnancy, as well as the influence of the hormone Relaxin during the final stages of pregnancy (Dontigny: 124, 1985). The post-partum female continues to experience anterior mechanical strain. The anterior mechanical strain is due to the fact that she is continually lifting and carrying the child (Berg et al., 1990: 75). This may cause **excessive movement** of the S.I. joint/s resulting in non-congruent joint surfaces contacting each other. Non-congruency may lead to aberrant locking (fixation) of the joint/s, with subsequent intra-articular joint irritation. This may cause a neurological reflex resulting in ipsilateral muscle spasm (Wyke: 230, 1985). If not mechanically corrected by manipulation, this dysfunction progresses into
the post-partum period (Dontigny, 1985: 124). Dysfunction of the S.I. joint has been considered to be a common and important component of piriformis muscle trigger points. Displacement and/or restriction of the S.I. joint may lead to the development of myofascial trigger points of the piriformis muscle on the ipsilateral side to establish a self-sustaining relationship (Travell and Simons, 1992: 192; Schneider, 1998: 1). The sustained tension of the muscle caused by trigger points could maintain displacement and/or restriction of the ipsilateral S.I. joint. In this situation, both conditions must be corrected (Travell and Simons, 1992: 193).

The sacroiliac fixations associated with pregnancy or the post-partum period tend to be of an acute or sub-acute nature (Bowen and Cassidy, 1981: 620). Schafer and Faye (1990: 4) state that an acute fixation produces far more clinical expressions than a chronic fixation, and its effects tend to reflect signs of hyperactivity (e.g. muscle spasm, warmth, hyperaesthesia and visceral hyperfunction) due to intra-articular irritation.

1.4.2. The need for a solution to the problem

Post-partum females, as well as gynaecologists and post-natal clinics might not be fully aware of what chiropractic treatment has to offer in terms of management of Post-Partum Sacroiliac Syndrome. Therefore the results of this study may offer an alternative to the conventional medical treatment, which traditionally included the prescription of anti-inflammatoryes, bed rest and analgesics (Cailliet,1995: 264). Chiropractic manipulation of the S.I. joint combined with piriformis intermittent-ice-and-stretch, on the ipsilateral side of
the fixation in a sample of post-partum females, needs to be compared with chiropractic manipulation of the S.I. joint on its own. This will determine which of the two chiropractic treatments is more effective in the management of Sacroiliac Syndrome in post-partum females, and the extent to which it is more beneficial. This will enable chiropractors in the future to treat Post-Partum Sacroiliac Syndrome more efficiently.

According to Kirkaldy-Willis and Burton (1992: 249), it is recommended to give a patient 3 to 4 treatments per week for 2 weeks. If thereafter, the Sacroiliac Syndrome hasn't resolved, then the condition should be reassessed for other possible causes. In this study, it was decided to give each patient 3 treatments a week for two weeks and then a two-week break with a final assessment thereafter. In this manner we would be able to see if a significant difference existed between the 1st and the 6th treatments as well as between the 6th and the final assessment consultation. Thus we would be able to see whether a predictable outcome could be formulated for each group in terms of the two-week treatment period and the two-week rest period. It would also allow us to see which group responded significantly better over this time period.
1.4.3. Benefits that will arise from solving the problem

The traditional chiropractic paradigm has always been directed at the correction of the joint fixation (restriction in range of motion) without any correction of the adjacent musculature. Traditionally it was theorised that once the joint dysfunction has been corrected, the muscles that service that joint will correct themselves (Cited by: Schafer and Faye 1990:12-13). This research study may or may not validate this theory.

Should it be proven that the combination treatment (psoas intermittent-ice-and-stretch combined with S.I. manipulation) is more effective than S.I. joint manipulation alone, it would thus ensure a more effective chiropractic treatment protocol for Post-Partum Sacroiliac Syndrome? It is important to disseminate such information to the chiropractic profession in order to ensure a shift away from the traditional chiropractic paradigm (which has traditionally concentrated on joint manipulation and not incorporating myofascial work on the underlying musculature).

Paradigm and theory guide education, research and practice. As expertise accumulates within a profession, recognition follows that pries open the doors of competition with other disciplines for access to resources for continued theory development. Chiropractic’s ability as a profession to remain autonomous and competitive for resource allocation is directly related to the power derived from its theoretical development. In the absence of a well-developed and well-documented theoretical basis, the future of chiropractic as a profession will be in the hands of anecdotal evidence alone (Coulter, 1990: 279).
If chiropractic is shown to be beneficial (regardless of the type of treatment) in the management of Post-Partum Sacroiliac Syndrome, it would too cause a paradigm shift within the **medical profession**. This is because the traditional medical treatment for S.I. Syndrome has been analgesics, anti-inflammatory drugs and bed-rest (Cailliet, 1995: 264).

### 1.4.4. Feasibility of the solution

The solution was feasible in that chiropractic sacroiliac manipulation as a whole had already been shown to be beneficial in the management of Sacroiliac Syndrome (Haldeman, 1992: 221). Contact with post-partum females was made possible due to referrals from gynaecologists and post-natal clinics in the area. The treatment was for free which thereby increased patient-compliance. Ethical considerations included a patient consent form that informed the patient regarding the purpose of the study and that confidentiality would be ensured, as well as informing the patient that participation was purely voluntary.
CHAPTER 2

LITERATURE REVIEW

2.1. RELATED ANATOMY

2.1.1. Anatomy of the sacroiliac joint

The S.I. joint is usually auricular or C-shaped, with the convex contour facing anterior and slightly inferior. There can be marked variations in the size, shape, contour, and relative lengths of the cephalad and caudal limbs of the joint. The vertically orientated auricular surface lies obliquely at an angle to the sagittal plane. Along with the symphysis pubis, the S.I. joints impart a limited degree of flexibility to the pelvic ring (Haldeman, 1992: 215).

Figure 1  The C-shaped (auricular) S.I. joint

(Haldeman, S. Principles & Practice of Chiropractic, 2nd Edition, 212)
The S.I. joint is a weight-bearing joint that is stabilised by a series of very strong ligaments. These include the sacrospinous and sacrotuberous ligaments, attaching from the anterior and posterior surface of the sacrum and running to the ischial spine and tuberosity, respectively. The massive interosseous ligament binds the sacrum to the ilium and forms the posterior joint margin. The thin posterior sacroiliac ligament overlies the interosseous ligament and is separated from it by the dorsal rami of sacral nerves and vessels. The anterior sacroiliac ligament is little more than a thickening of the joint capsule. These ligaments serve to bind the sacrum tightly between the two ilia. As with the synovial facet joints of the lumbar spine, the sacroiliac joints are contained by a fibrous joint capsule. This capsule is well developed anteriorly, but poorly developed posteriorly, where fasciculi of the interosseous ligament can extend into the joint and appear to be intra-articular (Haldeman, 1992: 211).

Figure 2

Ligaments of the S.I. joint

(Haldeman S. Principles & Practice of Chiropractic, 2nd Edition: 212, 1992)

It is reported that the S.I. joint capsule contains a dense plexus of unmyelinated nerve fibres
indicative of a nociceptive receptor system analogous to other synovial joints (Wyke, 1985: 222; Schneider, 1998: 2). The segmental derivation of this nerve supply can range from as high as L-2 to as low as S-4. This wide range of segmental innervation could account for the large spectrum of somatic referred pain patterns attributed to sacroiliac disorders (Duckworth, 1970: 46; Kirkaldy-Willis and Burton, 1991: 20).

There is general agreement that the joint is an atypical synovial articulation with a well-defined joint space and two opposing cartilage surfaces (Kikaldy-Willis and Burton, 1992: 72). It is atypical because one surface, the iliac surface, has the appearance of fibrocartilage rather than hyaline cartilage. Over time the iliac cartilage degenerates more than the sacral cartilage. Moreover, the joint often undergoes degenerative changes at an early age, giving it an appearance of an amphiarthrosis in later years of life (Bowen and Cassidy, 1981: 620; Kirkaldy-Willis and Burton, 1992: 71).

2.1.2. Anatomy of the piriformis muscle

The piriformis is a thick and bulky muscle in most individuals. The piriformis muscle can be small with only one or two sacral attachments. Conversely, it can be so broad that it joins with the capsule of the S.I. joint above and with the sacrospinous and sacrotuberous ligaments below (Travell and Simons, 1992: 189).

This muscle is anchored medially to the anterior surface of the sacrum usually by three fleshy digitations between the first, second, third and fourth anterior sacral foramina. Some
may attach with the inferior aspect of the capsule of the S.I. joint. Laterally, the muscle is secured by a rounded tendon onto the greater trochanter on the medial side of its superior surface. This tendon often blends with the common tendon of the obturator internus and the gemelli muscles (Travell and Simons, 1992: 186-189).

Figure 3a & 3b  Proximal and distal attachments of the piriformis muscle
2.1.3. Function of the piriformis muscle

In weight-bearing activities, the piriformis muscle is often needed to restrain (control) vigorous and/or rapid medial rotation of the thigh, for example, during the early stance phase of walking and running. The piriformis is also thought to stabilise the hip joint and to assist...
in holding the femoral head in the acetabulum (Travell and Simons, 1992: 192).

The piriformis is primarily a lateral rotator with the hip in the neutral or extended position. It also abducts the thigh when the hip is flexed at 90 degrees. The five "short lateral hip rotators" comprise the superior and inferior gemelli, the obturator internus and externus, and the quadratus femoris muscle. These muscles are almost exclusively lateral rotators in either flexion or extension (Travell and Simons, 1992: 192).

Examination of an articulated skeleton makes it apparent that the degree of flexion of the thigh profoundly affects the function of the piriformis muscle. At 90 degrees of flexion it produces horizontal abduction of the thigh. However, with full flexion at the hip, it appears to rotate the thigh medially. The action of the other short lateral rotators is less influenced by flexion of the thigh at the hip (Travell and Simons, 1992: 192).

2.2. **MOTION AT THE SACROILIAC JOINT**

According to Gatterman (1990: 113), S.I. joint motion is considered to be very slight (3-5 degrees of flexion and extension around the x-axis of the S.I. joint). S.I. motion is affected by a number of factors, including the age and sex of the individual and the configuration of the joint surface. Motion at this particular joint does decrease gradually with age, and the decrease is more rapid in the male than the female. The joint in the female tends to be more excavated, with a wider retro-articular space and longer interosseous ligaments, all promoting greater mobility. Hormonal influences of pregnancy and to some extent, the
menstrual cycle, participate in a reversible laxity process (Potter and Cassidy, 1979: 102; Berg et al., 1990: 72). Motion of the S.I. articulations occurs primarily in the oblique sagittal plane, with the axis of rotation centred around the iliac tubercle, located immediately posterior to the S.I. joint (Gatterman, 1990: 112; Haldeman, 1992: 215).

2.3. S.I. SYNDROME DURING AND AFTER PREGNANCY

Anterior dysfunction (anterior weight carriage) is a common and uncomfortable complication of pregnancy (Diakow et al., 1991: 117). As weight increases on the anterior pelvis, pelvic support weakens and thus the conditions are set for an anterior or posterior rotational strain to occur at the sacroiliac joints (Dontigny, 1985: 124).

Another factor is the hormonal influence of Relaxin during the final stages of pregnancy, which softens and relaxes the S.I. joint ligaments and the symphysis pubis for the passage of the mature foetus (Haldeman, 1992: 217; Kikaldy-Willis and Burton, 1992: 125). The softening (hypermobility), however, makes these areas less stable and more prone to rotational slippage around the x-axis in an anterior or posterior direction (Diakow et al., 1991: 117). The slippage may cause non-congruent joint surfaces (two crests as opposed to a crest and a corresponding trough) to become locked together (fixated), causing pain and inflammation with subsequent **intra-articular irritation** (Dontigny, 1985: 124).

Wyke (1985: 220) reported that if there is severe intra-articular sacroiliac joint irritation ("grinding of prominent cartilage surfaces"), the piriformis muscle might experience reflex
muscle spasm on the side of the irritation. Severe sacroiliac joint irritation can occur in either a hypermobile or a hypomobile joint. This type of piriformis reflex is more commonly found amongst pregnant and post-partum females, due to the fact that their S.I. joints go through phases of both hyper- and hypo-mobility (Wyke, 1985: 230-232).

Daily et al (1991: 151) mentions that sacroiliac fixation is a common finding in post-partum back pain, and it responds with rapid resolution of symptoms following appropriate manipulative therapy. Daily et al (1991: 151) found that 40% percent of a sample of pregnant females, who were suffering from Sacroiliac Syndrome, recovered spontaneously after delivery. This was due to the restoration of normal congruency within the S.I. joint (without intervention). The remaining 60% percent tended to suffer from post-partum sacroiliac joint pain and discomfort. Therefore, in the presence of S.I. joint fixations, this type of patient needs to undergo sacroiliac joint manipulation to restore normal joint congruency (Daily et al, 1991: 153).

According to Dontigny (1985: 125), if this type of sacroiliac dysfunction is not corrected by manipulation, the pelvic rotation will be maintained due to capsular shortening (joint fixation), thus perpetuating the intra-articular joint irritation.
Micro-trauma and repeated pregnancies with resultant sacroiliac instability can lead to the initiation of degenerative changes, some of which may be seen on radiographs as sclerosis in the iliac bones, known as Hyperostosis Triangularis (Gatterman, 1990:124).

2.4. **WHAT IS SACROILIAC SYNDROME?**

S.I. Syndrome may take the form of simple joint locking or joint locking with compensatory hypermobility in adjacent articulations. A locked or fixated S.I. joint may result in increased motion demands on the opposite S.I. joint, in turn causing pain and inflammation of that joint. Acute tenderness and irritation is frequently found in the S.I. joint contra-
lateral to the one that is locked, but does also occur in the fixated joint. As with the other causes of mechanical low back pain, the pathogenesis of this syndrome is not well understood. The diagnosis of S.I. Syndrome is based almost entirely on the history and clinical examination. The history is that of mechanical backache with or without referred pain into the lower extremity (Gatterman, 1990:114). In many cases of S.I. Syndrome, the patient is a young woman with a recent history of pregnancy or delivery (Potter and Cassidy, 1979: 99-102; Diakow et al, 1991: 117).

Although the basic anatomic structure of the S.I. joint has been thoroughly investigated, its biomechanical function is not certain. The joint does possess a small range of motion that serves to give the pelvic ring a degree of elasticity. In addition, the role that this joint plays in the pathogenesis of low back pain is not entirely clear. Nevertheless, chiropractic manipulation of the motion restricted S.I joint has been traditionally successful in the majority of cases. There is a need for more research regarding the role of the S.I. joint in low back pain (Haldeman, 1992: 222).

2.5. CLINICAL PRESENTATION OF SACROILIAC SYNDROME

The pain of S.I. Syndrome is most often localised over the posterosuperior iliac spine and buttock. The pain may be referred into the groin and the lower extremity in a non-dermatomal pattern (Haldeman, 1992: 211). Rarely does this syndrome present with lower quadrant pain that may be confused with urological disease and appendicitis (Norman, 1968:116).
Groin, trochanteric and knee pain can occur in both S.I. Syndrome and hip disorders. Pain accompanying the S.I. syndrome is typically unilateral, dull in character and located over the buttocks. It may radiate posteriorly down the thigh (high sciatica) or to the groin and anterior thigh. Because the S.I. joint receives its nervous innervation from such a wide range of spinal levels, referred pain from this joint can cause some diagnostic confusion (Haldeman, 1992: 213). On examination, the patient may present with a slight limp due to difficulty in weight bearing on the affected side (Robinson et al. 1987: 172).

There is usually tenderness over the posterosuperior iliac spine (PSIS) and the posterior sacroiliac ligament (capsule). Unilateral lumbar paraspinal muscle spasm and gluteal trigger points (most commonly in the piriformis muscle) usually accompany this syndrome (Kirkaldy-Willis and Burton, 1992: 137). Midline lumbar tenderness and decreased lumbar range of motion occur when there is associated lumbar dysfunction. Signs of nerve root tension and neurological deficit do not occur in S.I. Syndrome. The patient may complain of paraesthesiae or subjective decrease in light touch sensation in the lower limb, but there is preservation of temperature, pain and position sense. Any loss in muscle power in the lower extremity is due to pain rather than neurological deficit (Kirkaldy-Willis and Burton, 1988: 137). A portion of the examination should be directed toward excluding other causes for low back pain, both mechanical and pathological (Mierau and Cassidy, 1984: 81).

There are several provocation tests that place stress on the S.I. joints and can elicit pain in
the S.I. joint in people suffering from S.I. Syndrome. According to Hestoek and Leboeuf (2000: 258), the bone scan is the most accurate way to detect inflammation in the S.I. joint. However, in terms of orthopaedic tests that the practitioner can conduct in his/her office, Hestoek and Leboeuf (2000: 258) state that Gaenslen's Test, Patrick-Faber Test and Yeoman's Test (Figures 5, 6 & 7, respectively), have been proven to be the most objective provocative orthopaedic tests for the sacroiliac joint. Although, it must be stressed that the practitioner must be careful not to hyperextend the patient's lumbar spine, as this may cause a false positive if there is lumbar involvement. It is also very important to rule out hip joint pathology before these tests can be interpreted (Hestoek and Leboeuf, 2000: 258). In most cases, two of these three tests are positive in the presence of a S.I. Syndrome (Haldeman, 1992: 219).

According to Schafer and Faye (1990: 259-261), motion palpation of the S.I. joint (Gillet's Test for S.I. joint fixations), with the patient standing and flexing one hip at a time, while the examiner palpates posteriorly for S.I. mobility, is a very effective test for determining sacroiliac joint dysfunction/restrictions. Due to the fact that it is very difficult to objectively demonstrate a S.I. joint fixation, it was decided that for the purposes of this study, motion palpation would be used purely as a diagnostic procedure and not for objective forms of measurement.
2.6. **SPECIAL TESTS FOR S.I. JOINT DYSFUNCTION**

*Gaenslen's test.* The patient lies supine on the examining table. The patient is positioned so that the test hip is extended beyond the edge of the table. The patient draws both legs up onto the chest and then slowly lowers the test leg down into extension. The other leg is tested in a similar fashion for comparison. Pain in the S.I. joints is indicative of a positive test (Magee, 1992: 319).

![Gaenslen's Test](image)

*Figure 5*  
Gaenslen's Test

(Haldeman, S. Principles and Practice of Chiropractic, 2nd Edition: 218, 1992)

*Patrick-Faber Test.* The patient lies supine, and the examiner places the patient's test leg so that the foot of the test leg is on top of the knee of the opposite leg. The examiner then slowly lowers the test leg in abduction toward the examining table. A negative test is indicated by the test leg falling to the table or at least being parallel with the opposite leg. A positive test is indicated with the test leg remaining above the opposite leg. If positive, the test indicates that the hip joint may be affected, there may be an iliopsoas spasm, or the
sacroiliac joint may be affected. Faber (which stands for flexion, abduction, and external rotation) is the position of the hip when the patient begins the test. When the S.I. joint is involved it is indicated by pain localised usually to the ipsilateral S.I. joint. Pain or loss of joint play at the hip indicates a hip lesion. Joint play at the hip can be tested by moving the knee through an arc, beginning with the knee and thigh flexed and internally rotated and ending with the thigh flexed, abducted, and externally rotated. In the absence of hip pathology, restriction of motion in the FABER position indicates hip-joint fixation (decreased range of motion), and therapy should be directed to the hip joint rather than the S.I. joint. Sacroiliac pain can be produced on the FABER test by articular fixation at the site of pain or by compensatory hypermobility of that joint, produced by fixation of the ipsilateral hip or contra-lateral S.I. joint. This test does not differentiate between these possibilities (Magee, 1992: 320).

**Figure 6**  
Patrick-Faber Test  
(Haldeman, S. Principles and Practice of Chiropractic, 2nd Edition: 218, 1992)
**Yeoman's Test.** The patient lies prone. The examiner flexes the patient's knee to ninety degrees and extends the hip. Pain localised to the sacroiliac joint indicates pathology in the anterior sacroiliac ligaments. Lumbar pain indicates lumbar involvement (Magee, 1992: 321).

![Yeoman's Test](image)

**Figure 7  Yeoman's Test**

(Haldeman, S. Principles and Practice of Chiropractic, 2nd Edition: 219, 1992)

**Gillet's Motion Palpation for S.I. joint fixations.** This test attempts to measure x-axis rotation (flexion and extension) of the S.I. joint when the subject flexes the hip joint. This small amount of rotation is amplified at the posterosuperior iliac spine (PSIS) because of its location dorsal to the axial centre of rotation. In an abnormal test, the motion is lacking, and this is one indication for manipulation (Haldeman, 1992: 220).
When the S.I. joint is fixed in flexion (flexion fixation), motion in the upper joint is restricted around the x-axis in the sagittal plane. With the patient standing, one thumb is placed over the second sacral tubercle and the other over one PSIS. The patient then flexes the ipsilateral thigh and knee and lifts the leg as high as possible. With normal motion, the thumb over the ipsilateral PSIS moves downward 1 to 2 centimetres. In a fixated joint the PSIS does not move downward. The patient will consequently rotate the entire buttock downward and forward, and with the superior portion of the joint fixed in flexion, the PSIS does not move posteriorly and inferiorly as it should (Gatterman, 1990: 118).

When the S.I. joint is fixed in extension (extension fixation), motion in the lower joint is restricted around the x-axis in the sagittal plane. To detect inferior joint locking (extension fixation) one thumb is placed on the sacral apex and the other over the ipsilateral ischial tuberosity. As the patient flexes the ipsilateral thigh and knee, lifting the leg as high as possible, the ischial tuberosity normally moves laterally 1-2 centimetres. With joint fixation, there is no lateral movement of the tuberosity, and the joint is locked in extension.

In order to take the joint to its end range (when testing for both types of fixations) the patient can be instructed to pull the flexed knee (with his/her hands on the knee) up onto the abdomen as far as possible (Gatterman, 1990: 319).

**Spring-operated Algometers.** An algometer/force dial may be defined as an apparatus for determining sensitivity to pain caused by pressure. According to Fischer (1987: 207), the reliability of the assessment of pain by the algometer has been documented and the
reproducibility of the results collected by those trained in pressure threshold measurement is sufficient for practical use. The algometer is used to assess the sensitivity to pressure (which can indicate the degree of inflammation) over the symptomatic joint, bone or muscular trigger point. The pressure threshold of the patient is defined as the minimum pressure that causes pain or discomfort to the patient.

The reading, obtained in Newton's per kilogram, will indicate the sensitivity of the S.I. joints and can be used to calibrate the patient's improvement, i.e. the better the patient feels the less sensitive the joint will be to pressure. This will also indicate that the amount of inflammation has decreased over the symptomatic area (Fischer, 1987: 207).
2.7. **HOW THE PIRIFORMIS MUSCLE INTERACTS WITH THE S.I. JOINT**

Mitchell (1965: 178-199) noted that the piriformis exerts an oblique force on the sacrum. The plane of the muscle closely approximates the frontal plane and lies at an angle of approximately thirty degrees to the plane of the adjacent S.I. joint. As illustrated by Retzlaff et al (1974:99), the lower fibres of the piriformis muscle are able to produce a strong rotatory shearing force on the S.I. joint. This force would tend to displace the ipsilateral base of the sacrum anteriorly and the apex of the sacrum posteriorly.

Travell and Simons (1992:195) mention that the piriformis muscle can develop trigger points due to a functional leg length inequality. This is due to the constant external rotation of the shorter leg. Magee (1992: 321) and Gatterman (1990: 278) state that when a sacroiliac joint is locked in a flexion fixation the relative position of the acetabulum changes and the leg appears to be shorter. However, if the sacroiliac joint is fixated in an extension fixation the leg will appear longer in relation to the opposite leg, thus the relatively shorter leg will develop piriformis muscle trigger points. This is another example of how a S.I. joint fixation can bring about piriformis muscle trigger points on the ipsilateral side.

Dysfunction of the S.I. joint has been considered to be a common and important component of the piriformis trigger points (Travell and Simons, 1992: 194). Displacement/resiriction of the S.I. joint may initiate the development of myofascial trigger points of the piriformis muscle to establish a self-sustaining relationship. The sustained tension of the muscle caused by trigger points could maintain displacement of the joint, and the dysfunction of the joint
(displacement/restriction) may perpetuate piriformis trigger points (Gatterman, 1990: 297-298). Travell and Simons, (1992: 121), state that muscle spasm and tenderness secondary to articular dysfunction (upward/downward or rotational shear slippage of the innominate) at the sacroiliac joint are likely to be associated with general buttock and low back pain. They also found that ventral coccygeal tenderness is often associated with a blocked sacroiliac joint.

Retzlaff et al. (1974:799), found that spasm of the piriformis muscle subjects the sacrum to abnormal rotatory stress that exacerbates pelvic dysfunction. Specifically, shortening of the right piriformis muscle produces left oblique axis rotation of the sacrum. The sacral base on the right is more anterior (depressed) in relation to the adjacent posterior superior iliac spine. This causes the sacral sulcus to be deepened on the right. It was also found by Retzlaff et al. (1974: 800), that the apex (distal tip) of the sacrum is displaced to the left of the midline and that the sulcus on the left appears more shallow. This torsion of the pelvis is likely to be associated with misalignment and decreased mobility at the symphysis pubis and the ipsilateral sacroiliac joint.

Potter and Cassidy (1979:102) stated that the sacroiliac joint/s becomes hypermobile during and after pregnancy. The hypomobility can cause intra-articular irritation causing the piriformis muscle on the ipsilateral side to go into reflex spasm. This in turn may stabilise the sacroiliac joint (Cassidy and Kirkaldy-Willis, 1988: 136). In most cases this is a normal occurrence, provided that the congruent joint surfaces come into contact with each other again and allow normal sacroiliac mobility. The aberration occurs when the hypomobile
joint is challenged beyond its normal range of motion (such as bending forward with her weight concentrated on a straightened leg) and thus non-congruent joint surfaces become wedged upon each other. Concomitantly, the ligaments become taught (joint fixation) with subsequent ipsilateral reflex muscle spasm of the piriformis and the gluteus maximus muscles (Turek, 1989: 1469; Wyke, 1985: 230).

2.8. MANIPULATION OF THE SACROILIAC JOINT

According to Haldeman (1992:221), there are many different techniques available to manipulate the S.I. joint, but he emphasises that the side-posture method is the most effective. The manipulative thrust is delivered to the posterosuperior iliac spine or the ischial tuberosity. This results in a cracking sound, which is the result of intra-articular cavitation of synovial carbon dioxide (Unsworth et al., 1971: 348; Mierau et al., 1988: 135). The goal of this form of treatment is to mobilise a stiff or fixated joint and restore normal range of motion. Sandoz (1976:141) stated that the usual, but not obligatory characteristic of an adjustment (chiropractic manipulation) is the thrust that is a brief, sudden and carefully applied impulse at the end of the normal passive range of motion. The method of manipulation should vary according to pain tolerance of the patient.

To manipulate the S.I. joint, the patient's pelvis is brought to the edge of the table. The doctor grasps the iliac crests and draws the patient's pelvis toward the edge of the table. The patient's lower leg is then straightened and the upper leg is flexed at the knee and hip with the patient's foot in the popliteal fossa of the lower knee. The clinician's cephalad hand is
placed on the patient's upper shoulder with moderate pressure executed toward the head, locking the patient's spine against rotation. The clinician's caudal hand then contacts the upper PSIS (for a flexion fixation), and traction is exerted to the point of tension. The patient's superior leg is tractioned with the clinician's inferior thigh in a cephalad direction to create tension in the S.I. joint (States Manual, 1985: 15-17).

![Adjusting an upper S.I. fixation](image)

**Figure 9a**  
Adjusting an upper S.I. fixation

(Headman, S. Principles and Practice of Chiropractic, 2nd Edition: 232, 1992)

As the patient relaxes, usually following exhalation, a high velocity, low-amplitude thrust, is delivered through the clinician's inferior arm and through the thigh down the long axis of the patient's flexed leg. The clinician's superior arm must maintain tension to stabilise the trunk and spine through the delivery of the thrust. The direction of the thrust of the inferior hand is anterior and slightly toward the patient's inferior shoulder (Gaterman, 1990: 121).

Manipulation of the patient with an extension fixation is performed with the patient
positioned in the side-posture (as for a flexion fixation) with the side of the fixation up and the upper thigh flexed past 90 degrees. The clinician's inferior hand contacts the ischial tuberosity and following a deep breath and exhalation by the patient, a high-velocity, low-amplitude thrust is delivered anteriorly and inferiorly with a scooping cephalad motion toward the patient's lower shoulder (Gatteman, 1990: 122).

Figure 9b  Adjusting a lower S.I. fixation

(Haldeman, S. Principles and Practice of Chiropractic, 2nd Edition: 222, 1992)

2.9. INTERMITTENT COLD AND STRETCH OF MUSCLES

According to Travell and Simons (1983: 63-72), stretch and vapocoolant spray or intermittent cold with stretch is the "workhorse" of myofascial therapy. It inactivates myofascial trigger points more quickly, and with less patient discomfort, than local injection or ischaemic compression.

A single-muscle syndrome of recent onset frequently responds with full return of pain-free
function when two or three sweeps of vapocoolant spray or ice are applied while the muscle is being passively stretched (Travell and Simons, 1983: 62). It is considered that the stretch is the essential component of the therapy, while the vapocoolant spray or intermittent ice facilitates the stretch. Gentle persistent stretch without spray or ice is more likely to inactivate trigger points than is spraying without stretch. However, the best results are obtained by spraying or icing first, followed by stretching and then further cooling (Travell and Simons, 1983: 62).

Travell and Simons (1983: 63), maintain that the stretch is the action and the ice or spray is the distraction for muscles. The sensory and reflex effects of a jet stream of vapocoolant spray can be obtained to a considerable degree by stroking with ice. The skin must remain dry, because dampness reduces the rate of change in skin temperature. It is the rate of change of skin temperature that activates the closure of the Pain Gate System, which is a spinal inhibition reflex (Travell and Simons, 1983:64). This reflex blocks the nociceptive impulses arriving at the Substantia Gelatinosa and the Nucleus Proprius of the posterior horn of the spinal cord (Melzack and Wall, 1965: 971-979; Cailliet, 1995: 264). Thus, with the closure of the Pain Gate at the spinal cord level, the patient can then have an increased pain-free stretch of the involved muscle, which is required for the lengthening of the muscle and thus the removal of the trigger point/s (Travell and Simons, 1983: 62-64).
CHAPTER 3

MATERIALS AND METHODS

3.1. INTRODUCTION

This chapter concerns itself with the following:

- The methods, techniques and measurements.
- The type and nature of the data.
- The location of the data and the sample.
- The statistics used.

3.2. METHODS, TECHNIQUES AND MEASUREMENTS

This study was performed at Kempton Chiropractic Clinic and the T.W.R. Clinic, with the permission of Dr. E.K. Urli and the W.I.T.S. TechaiRon Research Department. The sample consisted of post-partum females over the age of eighteen from the greater Johannesburg area. These people were obtained via referrals from gynaecologists and post-natal clinics in the area, as well as from Kempton Chiropractic Clinic. The sample size was limited to 30 patients. The candidates were screened via an eligibility questionnaire (Appendix A) to determine whether they were in fact suffering from a mechanical problem involving the sacroiliac joint/s. Patients were excluded from the study if it was found that their low back
pain was attributable to causes other than sacroiliac joint dysfunction. The contra-indicated conditions for this study were the following:

- Lumbar disc herniations
- Lumbar posterior facet syndromes
- Lumbar lateral canal stenosis
- Quadratus lumborum myofascial syndromes
- Spinal tumors (and or any neoplastic diseases)
- Osteoporosis
- Piriformis Syndrome (with neurological and/or vascular deficit even in the presence of S.I. joint fixations)
- Spinal trauma
- Lumbar Spondylosis or Ankylosing Spondylitis
- Gout or Pyogenic Sacroilitis
- Visceral pathologies (such as kidney diseases, bladder infections, Crohn’s Disease or other inflammatory bowel diseases etc.)
- Bilateral sacroiliac instability [this can occur in conjunction with piriformis trigger points and therefore manipulation is contra-indicated (Gatterman 1990, 125)].

Travell and Simons (1992: 196) also state that a hypermobile S.I. joint may have ipsilateral piriformis muscle trigger points in an attempt to stabilise the joint. Patients who presented solely with this type of piriformis myofascial syndrome were not considered for the study, as there were no S.I. joint fixations.

Patients who presented with any concurrent systemic diseases that could have had a direct effect on their low back pain (such as a viral infection) were automatically excluded from the study. In the patient eligibility questionnaire (Appendix A), the patients were asked
whether they were taking any medication such as analgesics and/or anti-inflammatories. If the answer to this question was “yes”, the patient had to agree not to take any medication for five days before beginning the treatment. This would allow the patient’s symptoms to follow a natural progression without any unnatural intervention. It was also made quite clear that under no circumstances would the patient be allowed to undergo any additional treatment (by another practitioner) for their low back pain.

Only those with true mechanical sacroiliac dysfunction (fixated S.I. joint/s, pain and tenderness over S.I. joint and all the other clinical signs and symptoms) were considered for the purpose of this study. Due to the common occurrences of S.I. Syndrome presenting with concomitant ipsilateral piriformis muscle shortening (Travell and Simons, 1992: 189), it didn’t matter if the patient had active or latent trigger points, or if the piriformis was merely in reflex spasm on the ipsilateral side of the fixation. Provided that the sacroiliac joint dysfunction was confirmed by the already-mentioned diagnostic procedures (Figures 5, 6 & 7), the patient was admitted into the study. The patients had to fall into the category of a maximum post-partum period of six months or less, at the time of the initial consultation. The purpose of the trial was explained to the eligible subjects after which their informed consent was required (Appendix B).

On the initial consultation, each patient was required to fill in a McGill Pain Questionnaire (Appendix C) an Oswestry Low Back Pain Disability Questionnaire (Appendix D), and the Numerical Pain Rating Scale (Appendix E), after which a full case history was taken.
(Appendix F). Each patient underwent a full physical examination (Appendix G) followed by a regional examination of the lumbar spine and pelvis (Appendix H).

The Control Group was managed using sacroiliac manipulation (Diversified Technique) on its own. The patients received six treatments each, even if they had fully recovered before the sixth treatment. This was done in order to ensure consistency of intervention. The other reason for maintaining the treatment until the end was to ensure mobility was maintained in the previously fixated S.1 joint/s in order to prevent recurrence of the previous symptoms.

The Experimental Group was managed by using sacroiliac manipulation (Diversified Technique) immediately after the piriformis intermittent ice-and-stretch. As previously discussed, intermittent ice-and-stretch involved the application of an ice pack (a dry pack) over the piriformis for thirty seconds during which the muscle was being progressively stretched. This was done three times with a twenty-second break in between.
Each patient completed the respective pain questionnaires before the 1st, 3rd and 6th consultations, as well as at the final assessment consultation. These questionnaires comprised the subjective measurements of the outcome. Objective measurements of the outcome included provocative orthopaedic tests (Figures 5, 6 & 7, respectively) that were specific for Sacroiliac Syndrome (Gaenslen's, Patrick-Faber and Yeoman's), as well as an algometer/force dial which was used to measure pain sensitivity over the most symptomatic S.I. joint. The algometer pressure was directed onto the posterior joint capsule, which is located inferior and medial to the posterior superior iliac spine (PSIS). These tests were done before each treatment in order to monitor the patient’s progress over the 2-week treatment period and after the 2-week rest period.

The algometer/force dial (Figure 8) is a calibrated dial with a load shaft that comes into
contact with the painful joint. As the examiner places a downward pressure through the dial, the corresponding pressure is loaded onto the painful joint via the load shaft. Due to the fact that the algometer load shaft (which comes in contact with skin) is very narrow, a plastic block was placed between the pin and the skin in order to make a bigger surface contact area, thus preventing bruising of the skin. Before the plastic block was placed over posterior joint capsule (which is inferior and medial to the PSIS) the examiner would finger palpate the most painful part of the joint under the guidance of the patient (in order to be consistent in placement of the algometer). Once this point was located, the plastic block was carefully positioned to accept the load shaft of the algometer. Thereby measuring the true joint sensitivity to pressure, which was measured in Newtons per Kilogram.

Before the applying the downward pressure of the force dial, the patients were instructed to signal the moment at which minimal pressure (from the algometer) caused pain in the S.I. joint. Once the algometer was carefully positioned the examiner would then slowly begin applying pressure to the S.I. joint with a gradual increase in intensity until the patient signaled to the examiner to stop. The reading was then recorded for that day.

3.3. **Type and Nature of the Data**

The data of this research was of two kinds, namely primary and secondary data.
3.3.1. **The Primary Data**

- The responses of the patients (in both groups) to:
  
  a) The McGill Pain Questionnaire;
  
  b) The Oswestry Low Back Pain Disability Questionnaire; and
  
  c) The Numerical Pain Rating Scale

- The patients' responses to the respective chiropractic treatment in terms of objective clinical specifications such as the provocative orthopaedic tests and the algometer readings.

3.3.2. **The Secondary Data**

The secondary data was obtained from a search of the related literature. Previous research regarding Sacroiliac Syndrome and piriformis muscle dysfunction amongst post-partum females, as well as studies documenting the efficacy of chiropractic management for Sacroiliac Syndrome were required.

3.4. **CRITERIA GOVERNING THE ADMISSIBILITY OF THE DATA**

Only the responses of the patients suffering from Post-Partum Sacroiliac Syndrome, within a six-month post-partum period, were considered. The other criterion for patient eligibility was that they should not have any contra-indications to manipulation. The purpose of the study was explained to eligible subjects with their informed consent.
Only the data from the questionnaires completed under the supervision of the researcher was admissible (it should be noted that the subjects were guaranteed that the information they provided would not be released to anyone on an individual basis, thus ensuring patient confidentiality). All the objective clinical findings were assessed by the researcher, and had to comply with the specifications of the study. If the subjects became non-compliant, they were excluded from the study.

3.5. **CAPTURING AND SECURING THE DATA**

The data needed for subproblem one was collected at the initial consultation by means of a case history and examination (i.e. the general physical and the lumbar spine & pelvic regional examinations), the results of which were recorded.

The data that was needed for testing the hypothesis of subproblems two, three and four were obtained from the following:

- The patients' response to the McGill Pain Questionnaire (Appendix C), the Oswestry Low Back Pain Disability Questionnaire (Appendix D) and the Numerical Pain Rating Scale (Appendix E), which comprised their subjective responses to the treatment.

- Although motion palpation of the sacroiliac joints was conducted prior to each treatment (like the objective tests), it was used purely as diagnostic procedure for the examiner to locate the appropriate sacroiliac fixation/s. Motion palpation was not used as an objective form of measurement due to the fact that it has been proven to be a valid diagnostic procedure but not a reliable objective test (Hestoeck and Leboeuf, 2000: 250).
consisted of words with associated numerical values in ascending order. Part 3 was out of 3 points and part 4 was out of thirty. Scores for each part were given, from which a corresponding percentage was calculated. The percentages of all four parts were added together and then divided by 4 to get an average percentage for the questionnaire.

The Oswestry Low Back Pain Disability Questionnaire (Appendix D) gave scores for 10 sections (Pain intensity, difficulty with personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and difficulty travelling). The result was expressed on a scale ranging from 0% (no disability) to 100% (highest score for disability on all items).

In the Numerical Pain Rating Scale (Appendix E), the intensity of pain ranged from 0 (no pain) to 10 (indicating unbearable pain). The patient would then place a tick next to the corresponding pain level.

Pain sensitivity was measured by using an algometer/force dial (Figure 8) over the most symptomatic joint. The reading was taken before each treatment to measure whether or not the joint became less sensitive to pressure as the treatments progressed.

The provocative orthopaedic tests (Figures 5, 6 & 7) were repeated before each treatment to highlight a decrease in the number of tests that provoked sacroiliac pain and dysfunction. The patient’s response to each test was recorded (positive indicated that the test provoked the pain and a negative test indicated no provocation of pain). The type of joint restriction (whether it was an upper or lower sacroiliac fixation) was recorded in order to assess
whether a reduction in pain indicated a change in the type of joint fixation.

3.6. **STATISTICS**

The sample size consisted of 30 Post-Partum female patients suffering from Sacroiliac Syndrome. There were 15 patients in the Experimental Group (receiving S.I. joint manipulation combined with piriformis muscle ice-and-stretch) and 15 patients in the Control Group (receiving S.I. joint manipulation alone). All the data gathered was represented graphically and in tabular form.

The assessment of SI joint pain was done through the analysis of:

I. **Algometer Readings**

II. **McGill Pain Questionnaire** (Appendix C)

III. **Oswestry Pain Low Back Pain Disability Questionnaire** (Appendix D)

IV. **Numerical Pain Rating Scale (NPRS)** (Appendix E)

V. **Gaenslen’s Test** (Figure 5)

VI. **Patrick Faber Test** (Figure 6)

VII. **Yeoman’s Test** (Figure 7)

For Algometer readings the following analyses were performed:
a) **Paired T-Tests** (Lind, Mason & Marchal, 2000: 314). These were done to determine the effect of the treatments compared to treatment 1 as well as the follow-up consultation (treatment 7) compared to treatment 1. In order for a significant difference to occur, the probability value (T-value) had to be less than 0.05. The reason for the T-value having to be less than 0.05 is that it was measured at the 5% level on each group's individual probability curve (i.e. there are 2 curves and each group's T-value is taken from its own curve at the 5% level). In the tables, the significant differences were indicated by three stars, which are next to the T-values.

b) **Two-Sample T-Test** (Lind, Mason & Marchal, 2000: 315). This test was done to determine the difference between the two groups. The Two-Sample T-Test was performed separately for possible treatment effects. That is, **treatment 2 minus treatment 1** etc. Here the T-value had to be less than 0.025 in order for a significant difference's to be noted. The reason for the T-value having to be less than 0.025 (i.e. which is half the T-value for the Paired T-Test) is that it was measured at the 5% level on both ends of the same probability curve (because two groups are being compared). The significant differences were also indicated by three stars, which are next to the T-values.

Similar analyses were performed for the McGill Pain Questionnaire, the Oswestry Low Back Pain Disability Questionnaire and the Numerical Pain Rating Scale (NPRS). However, the tests in these cases were based on non-parametric techniques (i.e. for the
paired-tests, the Sign rank tests were applied and for tests of group differences, -unpaired-, the Mann Whitney tests were performed).

The Sign Rank Test (Lind, Mason and Marchal, 2000: 300) is the simplest non-parametric technique applied to data with a non-normal distribution. The test is generally used for testing hypotheses about the median of any continuous population. In this case it was used to determine whether a significant difference existed (over time) between treatments 1, 3, 6 and 7, within the same group with respect to their subjective responses to treatment.

In the context of this study, the null-hypothesis is:

**H0: The difference between any pair of treatments (over time) is zero.**

Against the alternative hypothesis:

**H1: There is a significant treatment effect over time.**

The Mann-Whitney Test (Lind, Mason and Marchal, 2000: 301) is a non-parametric test used to determine a difference between two groups when the assumption of normal distribution does not hold. In this case it was used to determine whether a significant difference existed between the two groups (S.I. manipulation alone versus S.I. manipulation with piriformis ice-and-stretch) with respect to their subjective responses to treatment. In the context of the this study, the null-hypothesis is:

**H0: There is no significant treatment effect between the two groups.**

Against the alternative hypothesis:

**H1: There is a significant treatment effect between the two groups.**
Since Gaenslen's, Patrick-Faber and Yeoman's tests (Figures 5, 6 & 7, respectively) consisted of binary responses (either pain was felt on provocati0n, or no pain was felt on provocation), the pain assessment in this case was only done graphically (Figures 15, 16 & 17).
CHAPTER 4

THE STATISTICAL RESULTS

4.1. **TABLE ONE**  Paired T-Test results - Algometer Readings

| GROUP | EFFECT           | Mean  | Std Dev | T      | Prob>|T| |
|-------|------------------|-------|---------|--------|------|-----|
| Combination Treatment experimental group | Treatment2-Treatment1 | 0.08  | 0.1781  | 1.73   | 0.1038     |
|       | Treatment3-Treatment1 | 0.27  | 0.2154  | 4.91   | 0.0002 ***|
|       | Treatment3-Treatment2 | 0.19  | 0.1486  | 5.03   | 0.0002 ***|
|       | Treatment4-Treatment1 | 0.49  | 0.2576  | 7.41   | 0.0001 ***|
|       | Treatment4-Treatment2 | 0.41  | 0.2326  | 6.88   | 0.0001 ***|
|       | Treatment4-Treatment3 | 0.22  | 0.2274  | 3.74   | 0.0022 ***|
|       | Treatment5-Treatment1 | 0.76  | 0.3924  | 7.50   | 0.0001 ***|
|       | Treatment5-Treatment2 | 0.68  | 0.3321  | 7.93   | 0.0001 ***|
|       | Treatment5-Treatment3 | 0.48  | 0.2696  | 6.99   | 0.0001 ***|
|       | Treatment5-Treatment4 | 0.26  | 0.2160  | 4.78   | 0.0003 ***|
|       | Treatment6-Treatment1 | 0.94  | 0.4997  | 7.28   | 0.0001 ***|
|       | Treatment6-Treatment2 | 0.86  | 0.4925  | 6.76   | 0.0001 ***|
|       | Treatment6-Treatment3 | 0.66  | 0.3958  | 6.52   | 0.0001 ***|
|       | Treatment6-Treatment4 | 0.44  | 0.3944  | 4.38   | 0.0006 ***|
|       | Treatment6-Treatment5 | 0.18  | 0.2933  | 2.37   | 0.0322 ***|
|       | Treatment7-Treatment1 | 1.40  | 0.9497  | 5.71   | 0.0001 ***|
|       | Treatment7-Treatment2 | 1.20  | 0.6803  | 5.30   | 0.0001 ***|
|       | Treatment7-Treatment3 | 0.98  | 0.8288  | 4.61   | 0.0004 ***|
|       | Treatment7-Treatment4 | 0.72  | 0.7380  | 3.77   | 0.0020 ***|
|       | Treatment7-Treatment5 | 0.54  | 0.5742  | 3.64   | 0.0027 ***|
| Manipulation treatment control group | Treatment2-Treatment1 | 0.00  | 0.1668  | 0.15   | 0.8792     |
|       | Treatment3-Treatment1 | -0.01 | 0.1407  | -0.36  | 0.7192     |
|       | Treatment3-Treatment2 | -0.02 | 0.1699  | -0.45  | 0.6554     |
|       | Treatment4-Treatment1 | 0.10  | 0.1604  | 2.41   | 0.0300 ***|
|       | Treatment4-Treatment2 | 0.09  | 0.1438  | 2.51   | 0.0248 ***|
|       | Treatment4-Treatment3 | 0.11  | 0.1457  | 2.01   | 0.0593 ***|
|       | Treatment5-Treatment1 | 0.19  | 0.1981  | 3.78   | 0.0020 ***|
|       | Treatment5-Treatment2 | 0.18  | 0.1767  | 4.09   | 0.0011 ***|
|       | Treatment5-Treatment3 | 0.20  | 0.1580  | 5.06   | 0.0002 ***|
|       | Treatment5-Treatment4 | 0.09  | 0.1223  | 2.95   | 0.0104 ***|
|       | Treatment6-Treatment1 | 0.21  | 0.2232  | 3.70   | 0.0024 ***|
|       | Treatment6-Treatment2 | 0.20  | 0.1831  | 4.37   | 0.0006 ***|
|       | Treatment6-Treatment3 | 0.22  | 0.1710  | 5.13   | 0.0002 ***|
|       | Treatment6-Treatment4 | 0.11  | 0.1302  | 3.37   | 0.0046 ***|
|       | Treatment6-Treatment5 | 0.02  | 0.1373  | 0.56   | 0.5816     |
|       | Treatment7-Treatment1 | 0.35  | 0.3021  | 4.53   | 0.0005 ***|
|       | Treatment7-Treatment2 | 0.34  | 0.2167  | 6.19   | 0.0001 ***|
|       | Treatment7-Treatment3 | 0.36  | 0.2127  | 6.67   | 0.0001 ***|
|       | Treatment7-Treatment4 | 0.25  | 0.2222  | 4.39   | 0.0006 ***|
|       | Treatment7-Treatment5 | 0.16  | 0.2165  | 2.86   | 0.0125 ***|
|       | Treatment7-Treatment6 | 0.14  | 0.1805  | 3.00   | 0.0095 ***|
This test was used in order to determine whether a significant difference existed over time between treatments 1 up to the final consultation (T7), within the same group (the Control and the Experimental Group). For a significant difference to occur, the probability (T) value had to be less than 0.05. This was calibrated in terms of increases in the patients' pain thresholds to pressure over the symptomatic S.I. joints.

With regard to the Control Group, it was evident that significant differences existed over time. The first significant difference was at T4 in relation to T1, where the T-value was 0.03. Significant differences were noted between T4 and the following treatments, except between T5 and T6 (T-value was 0.58).

With regard to the Experimental Group, it was evident from the results that statistically significant differences existed over time. The first difference was noted at T3 (where the T-value was 0.002) in relation to T1. From T3 it continued to show significant differences between the following successive treatments right up to T7 (where the T-value was 0.0027).

In conclusion, it was evident from the Paired T-Tests that both groups demonstrated increases in the algometer readings (over time) with regard to pressure over the symptomatic joints i.e. the pain over the symptomatic S.I. joint diminished over time as a result of the treatment that was administered. It was also evident from the Paired T-Test that the Control Group took longer to show a significant difference in relation to T1. With regards to the Control Group, it was also evident that there was no significant difference in the average algometer reading between T5 and T6. This indicated a slowing-down in the rate of change.
in the algometer reading at this point, and therefore no improvements in the patients’ pain thresholds were present. This could be attributed to the fact that the treatment for the control group wasn’t as extensive to that of the experimental group. Nevertheless, H1 was accepted and H0 was rejected for both groups at the 5% level of the probability curve.

4.2. **TABLE TWO**

**Two Sample T-Test – Algometer Readings**

**Test for difference/s between Manipulation and Combination treatment**

| Effect                  | T    | Prob>|T| |
|-------------------------|------|-----|
| Treatment2-Treatment1   | 1.1641| 0.2542|
| Treatment3-Treatment1   | 4.3154| 0.0002***|
| Treatment3-Treatment2   | 3.6603| 0.0011***|
| Treatment4-Treatment1   | 5.0198| 0.0000***|
| Treatment4-Treatment2   | 4.5327| 0.0001***|
| Treatment4-Treatment3   | 1.5295| 0.1374|
| Treatment5-Treatment1   | 4.9926| 0.0000***|
| Treatment5-Treatment2   | 5.0789| 0.0000***|
| Treatment5-Treatment3   | 3.4709| 0.0017***|
| Treatment5-Treatment4   | 2.7044| 0.0115***|
| Treatment6-Treatment1   | 5.1424| 0.0000***|
| Treatment6-Treatment2   | 4.8156| 0.0000***|
| Treatment6-Treatment3   | 3.9523| 0.0005***|
| Treatment6-Treatment4   | 3.1086| 0.0043***|
| Treatment6-Treatment5   | 1.9137| 0.0659|
| Treatment7-Treatment1   | 4.3325| 0.0002***|
| Treatment7-Treatment2   | 4.1923| 0.0003***|
| Treatment7-Treatment3   | 3.5923| 0.0012***|
| Treatment7-Treatment4   | 3.3089| 0.0026***|
| Treatment7-Treatment5   | 2.8202| 0.0087***|
| Treatment7-Treatment6   | 2.5738| 0.0956***|

This test was used to determine whether a significant difference/s existed between the Experimental Group and the Control group over the time. For a significant difference to occur, the probability (T) value had to be less than 0.025.

According to the results, throughout the study there were significant differences between the
two groups that were in favour of the **Experimental Group** (See figure 11). However between treatments 1&2, 3&4 and 5&6, there were no significant differences because the T-values were greater than 0.025. The significant differences were noted between the rest of the treatments, where the T-values were less than 0.025. Thus H1 was accepted and H0 rejected at the 5% level.

Therefore, within the Experimental Group the average algometer readings (*Newtons / Kilogram*) were greater than the average readings within the Control Group. With regards to improving the average pain threshold to pressure over the symptomatic S.I. joint, the Experimental Group responded most significantly to the treatment. This indicates that the combination treatment (S.I. joint manipulation with piriformis ice-and-stretch) was more effective in reducing the pain and inflammation in and around the joint. Therefore, in order to be more effective, the combination treatment should be used when treating post-partum females suffering from Sacroiliac Syndrome.
This graph represents the average Newtons per Kilogram at each consultation for both groups. It also indicates the significant differences between the two groups in that the Experimental Group responded more significantly in terms of decreased sensitivity to pressure from the algometer over the symptomatic S.I. joint (indicated by the blue line).
4.3. TABLE THREE

**Paired Nonparametric test – Sign Rank test**

**McGill Pain Questionnaire**

<table>
<thead>
<tr>
<th>EFFECT</th>
<th>GROUP</th>
<th>SIGNRANK</th>
<th>PROBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment3-Treatment1</td>
<td>Manipulation</td>
<td>-51.0</td>
<td>0.76540</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>-21.5</td>
<td>0.00033 ***</td>
</tr>
<tr>
<td>Treatment6-Treatment1</td>
<td>Manipulation</td>
<td>-60.0</td>
<td>0.75326</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>-55.0</td>
<td>0.88532</td>
</tr>
<tr>
<td>Treatment6-Treatment3</td>
<td>Manipulation</td>
<td>-60.0</td>
<td>0.39445</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>-20.0</td>
<td>0.00263 ***</td>
</tr>
<tr>
<td>Treatment7-Treatment1</td>
<td>Manipulation</td>
<td>-60.0</td>
<td>0.57863</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>-21.0</td>
<td>0.00146 ***</td>
</tr>
<tr>
<td>Treatment7-Treatment3</td>
<td>Manipulation</td>
<td>-60.0</td>
<td>0.07778</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>-22.0</td>
<td>0.00731 ***</td>
</tr>
<tr>
<td>Treatment7-Treatment6</td>
<td>Manipulation</td>
<td>-60.0</td>
<td>0.51950</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>-51.0</td>
<td>0.73917</td>
</tr>
</tbody>
</table>

This test was used to determine whether a significant difference existed between treatments within the same group. A significant difference was noted if a T-value was less than 0.05 at the 5% level of the probability curve (this was the same for all the sign rank tests). Graph 2 was plotted in terms of the medians for the percentages obtained from the McGill Pain Questionnaire, over the course of the study.

At the 5% level of the probability curve, the Control Group showed no statistically significant differences between the respective treatments. This was due to the T-values all being greater than 0.05. Therefore in terms of the medians (which is a form of measurement usually used in non-parametric tests) for the percentages obtained from the McGill Pain Questionnaire, the Control Group (S.I. joint manipulation alone) did not
display any statistically significant improvements over time. Therefore H1 was rejected and H0 accepted.

The Experimental Group however, displayed statistically significant differences between T1&T3, T3&T6, T1&T7 and T3&T7. This was indicated by the T-values being less than 0.05. In these cases, the T-values were 0.00033, 0.00263, 0.00146 and 0.00731 respectively. Thus the Experimental Group (in terms of the McGill Pain Questionnaire) responded with significant improvements between those respective treatments. There were no statistically significant differences noted between the remaining treatments in relation to each other. Therefore at the 5% level of the probability curve, H1 was accepted and H0 rejected between T1&T3, T3&T6, T1&T7 and T3&T7. However, H1 was rejected and H0 accepted between the other treatments. At the end of the treatment period (T7) there were statistically significant differences in relation to T1. In conclusion, this indicated that the combination treatment brought about a statistically significant improvement within the Experimental Group.
4.4. **TABLE FOUR**

**Two-sample nonparametric test – Mann-Whitney Test**

**McGill Pain Questionnaire**

| Effect                  | T       | Prob>|T| |
|-------------------------|---------|-----|---|
| Treatment3-Treatment1   | -2.23982| 0.0251 |
| Treatment6-Treatment1   | -3.40158| 0.0007 *** |
| Treatment6-Treatment3   | -2.11538| 0.0344 |
| Treatment7-Treatment1   | -3.67122| 0.0002 *** |
| Treatment7-Treatment3   | -3.06338| 0.0021 *** |
| Treatment7-Treatment6   | -1.18265| 0.2369 |

This test was used to **compare** the medians for the percentages obtained from the McGill Pain Questionnaire for the two groups. If a T-value was less than 0.025, it indicated that a significant difference existed between the groups at that time.

From the results of the Mann-Whitney Test there were no statistically significant differences noted between the groups at T1&T3 and T3&T6. However there were statistically significant differences noted between the following: T1&T6, T1&T7 and T3&T7, but between T6 and T7 there was no significant difference noted. These statistically significant differences indicated that the Experimental Group’s medians for the percentages obtained from the McGill Pain Questionnaire, declined at a faster rate over time (See Figure 12).

Although, in Figure 12, it is evident that a significant difference did exist between T6 and T7, this was not the case because of the fact that nonparametric two-sample tests have too much variation within the data to plot accurate graphs between the two groups. These graphs were merely plotted in order to highlight the rate of change in the medians for each
time (the same occurred for figures 13 & 14).

Therefore, in terms of the medians for the percentages obtained from the McGill Pain Questionnaire, the Experimental Group responded statistically better to the treatment. This indicates that in terms of the McGill Pain Questionnaire, post-partum females suffering from Sacroiliac Syndrome should be treated with this type of combination treatment for more effective results. Thus H1 was accepted and H0 rejected.

4.4.1. Figure 12

Over the course of the study, the experimental group demonstrated a faster rate of change in the medians for the percentages obtained (from T1 to T7) from the McGill Pain Questionnaire (indicated by the blue line).
4.5. **TABLE FIVE**

**Paired Nonparametric Test – Sign Rank Test**

*Oswestry Questionnaire*

| EFFECT        | GROUP     | SIGNRANK | Prob>|T| |
|---------------|-----------|----------|----------|
| Treatment3-Treatment1 | Manipulation | -23.0 | 0.10064 |
|                | Combination | -8.5 | 0.00007 *** |
| Treatment6-Treatment1 | Manipulation | -52.5 | 0.94700 |
|                | Combination | -7.5 | 0.00018 *** |
| Treatment6-Treatment3 | Manipulation | -52.5 | 0.42225 |
|                | Combination | -18.0 | 0.03380 *** |
| Treatment7-Treatment1 | Manipulation | -60.0 | 0.82133 |
|                | Combination | -60.0 | 0.19331 |
| Treatment7-Treatment3 | Manipulation | -60.0 | 0.11126 |
|                | Combination | -33.5 | 0.71585 |
| Treatment7-Treatment6 | Manipulation | -60.0 | 0.07982 |
|                | Combination | -33.0 | 0.18354 |

This test was done in order to determine whether a significant difference existed between treatments *within the same group*. This was measured in terms of the medians for the percentages obtained from the Oswestry Low Back Pain and Disability Questionnaire, over the course of the study. If a T-value was less than 0.05, it indicated that a significant difference existed within the group.

At the 5% level of the probability curve, it was evident that the **Control Group** did not display any statistically significant differences in its medians over time (T-values>0.05). In contrast, the **Experimental Group** did show significant differences in its medians. These differences were noted between T3&T1, T6&T1 and T6&T3, where the Experimental Group’s probability values were 0.00007, 0.00018 and 0.0338 respectively. Therefore, this
indicated that up to T6, the Experimental Group responded with statistically significant improvements to the treatment. By the two-week follow-up consultation (T7), there were no statistically significant differences in relation to T1, T3 and T6. This was due to the fact that the T-value at T7 was greater than 0.05.

In conclusion, this indicates that after the two-week break from the treatment, the Experimental Group did not feel any better (in terms of its medians for the percentages obtained from the Oswestry Low back Pain Disability Questionnaire). Therefore H1 was accepted and H0 rejected between T1&T3, T1&T6 and T3&T6, but was rejected at T7 in relation to all previous treatments. This result may indicate that for a longer lasting improvement, the patient should be instructed on how to do home stretches for the piriformis muscle.
4.6. **TABLE SIX**

Two-sample Nonparametric Test - Mann-Whitney Test

**Oswestry Questionnaire**

| Effect                  | T      | Prob>|T| |
|-------------------------|--------|------|
| Treatment3-Treatment1   | -1.18564 | 0.2358 |
| Treatment6-Treatment1   | -3.30598 | 0.0009 *** |
| Treatment6-Treatment3   | -3.09736 | 0.0020 *** |
| Treatment7-Treatment1   | -3.96955 | 0.0001 *** |
| Treatment7-Treatment3   | -3.40347 | 0.0007 *** |
| Treatment7-Treatment6   | -1.91761 | 0.0552 |

This test was done in order to determine whether a significant difference existed between the two groups. This was measured in terms of **comparing** the medians for the percentages obtained from the Oswestry Low Back Pain and Disability Questionnaire. If a T-value was less than 0.025, it indicated that a statistically significant difference existed between the groups.

From the results it was evident that there were statistically significant differences between the two groups. The differences were noted between T1&T6, T3&T6, T1&T7 and T3&T7 (T-values were less than 0.025). Thus H1 was accepted and H0 rejected between those respective treatments. There were no statistically significant differences noted between T1&T3 and between T6&T7. Thus H1 was rejected and H0 accepted between those respective treatments. From Figure 13, it is evident that the Experimental Group's medians for the percentages obtained from the Oswestry Questionnaire had a **faster rate of change**, when **compared** to the Control Group's medians. Therefore, the Experimental Group
obtained from the Oswestry Low Back Pain Disability Questionnaire. Therefore, in terms of the Oswestry Questionnaire, it is evident that the combination treatment (*S.I. joint manipulation and piriformis ice-and-stretch*) is a more effective treatment protocol for a Sacroiliac Syndrome in post-partum females.

4.7.1. **Figure 13**

![Oswestry Pain Questionnaire diagram]

This graph indicates the rate of change in the medians for the percentages obtained from the Oswestry Questionnaire. These were calculated at T1, T3, T6, and at T7. Thus the experimental group demonstrated a faster rate of change in the medians (from T3 to T7) over the course of the study.
4.7. **TABLE SEVEN**

**Paired Nonparametric test – Sign Rank Test**

**Numerical Pain Rating Scale (N.P.R.S.)**

| EFFECT                      | GROUP     | SIGNRANK | Prob>|T| |
|-----------------------------|-----------|----------|------|
| Treatment3-Treatment1       | Manipulation | -33.0    | 0.05176 |
|                             | Combination | -33.0    | 0.00236 *** |
| Treatment6-Treatment1       | Manipulation | -60.0    | 0.28553 |
|                             | Combination | -52.5    | 0.05174 |
| Treatment6-Treatment3       | Manipulation | -60.0    | 0.00561 *** |
|                             | Combination | -22.5    | 0.00318 *** |
| Treatment7-Treatment1       | Manipulation | -60.0    | 0.21016 |
|                             | Combination | -60.0    | 0.08686 |
| Treatment7-Treatment3       | Manipulation | -60.0    | 0.03718 *** |
|                             | Combination | -60.0    | 0.00005 *** |
| Treatment7-Treatment6       | Manipulation | -60.0    | 0.00004 *** |
|                             | Combination | -33.0    | 0.00043 *** |

This test was used to determine whether a significant difference existed between treatments **within the same group**. This was measured in terms of the medians for the percentages obtained for the Numerical Pain Rating Scale over the course of the study. If a T-value was less than 0.05, it indicated that a statistically significant difference existed within the group at that time.

At the 5% level of the probability curve, the results indicated that the **Control Group’s medians** were significantly different between T3&T6, T3&T7 and T6&T7, where the T-values were 0.00561, 0.03718 and 0.00004 respectively. Therefore H1 was accepted and H0 rejected from T3 up to T7, but H1 was rejected and H0 accepted between T1&T3. In conclusion, this indicated that over time, S.l. joint manipulation on its own brought about a statistically significant improvement within the Control Group.
Similarly at the 5% level of the probability curve, the results indicated that the Experimental Group's medians were significantly different between T1&T3, T3&T6, T3&T7 and T6&T7, where the T-values were 0.00236, 0.00318, 0.00005 and 0.00043 respectively. Therefore H1 was accepted and H0 rejected for the Experimental Group. This was due to the fact that by T7 there were statistically significant differences in relation to T1. In conclusion, this indicated that over time, the combination treatment brought about a statistically significant improvement within the Experimental Group.

4.8. TABLE EIGHT

Two-sample nonparametric test – Mann-Whitney Test

Numerical Pain Rating Scale (N.P.R.S.)

| Effect              | Z      | Prob>| |Z| |
|---------------------|--------|---------|
| Treatment3-Treatment1 | -1.00192 | 0.3164  |
| Treatment6-Treatment1 | -3.29311 | 0.0010 *** |
| Treatment6-Treatment3 | -3.57394 | 0.0004 *** |
| Treatment7-Treatment1 | -3.53410 | 0.0004 *** |
| Treatment7-Treatment3 | -3.96352 | 0.0001 *** |
| Treatment7-Treatment6 | -3.08088 | 0.0021 *** |

This test was done in order to determine whether a significant difference existed between the two groups. This was measured in terms of comparing the medians. If the T-value was less than 0.025, it indicated that a statistically significant difference existed between the groups at that time.

Between T1&T3, it was evident that no statistically significant difference existed, as the T-
value was 0.3164 (greater than 0.025). At the 5% level of the probability curve, statistically significant differences existed between the following treatments: T1&T6, T3&T6, T1&T7, T3&T7 and T6&T7. This was because the T-values were 0.0010, 0.0004, 0.0004, 0.0001 and 0.0021, respectively (less than 0.025). Because there were statistically significant differences between the two groups, H1 was accepted and H0 rejected.

Therefore, in terms of the medians for the percentages obtained from the Numerical Pain Rating Scale, it was evident (Figure 14) that the Experimental Group experienced a faster rate of improvement. It must be mentioned though, that the Control Group responded significantly over time. This was due to the findings of the Sign Rank Test and thus the Control Group displayed an improvement in relation to T1. In conclusion, both groups responded with statistically significant improvements over time. However, due to the fact that when the two groups were compared, it was found that the Experimental Group had a faster rate of improvement in its medians for the N.P.R.S. Therefore, the combination treatment proved to be the more effective treatment.
4.8.1. Figure 14

The Experimental Group demonstrated the faster rate of change in the medians for the percentages (from T1 to T7) that were obtained from the Numerical Pain Rating Scale (indicated by the blue line).
4.9. **Figure 15**

Figures 15 - 17 display the test results for Gaenslen's Test, Patrick-Faber Test and Yeoman's Test in terms of pain responses. *(straight manipul. = Control Group and manipulation wit. = Experimental Group)*

![Gaenslen Test - Painful Side](image)

At treatment one (T1), 93% of the Experimental Group and 100% of the Control Group were experiencing pain on provocation. Between T1 and T3, the Experimental Group had decreased by 13%, while in the Control Group all the patients were still experiencing pain on provocation. Between T3 and T6, the Experimental Group had decreased by 73%, whereas the Control Group had only decreased by 13%. Between T6 and T7, both groups had decreased by 7%. However, at T7, Gaenslen's Test did not provoke pain in the Experimental Group, whereas in the Control Group 80% of the patients still experienced pain on provocation.

In terms of Gaenslen's Test provoking pain, we can deduce that by T7 the Experimental
Group had improved by 73% more than the Control Group (at T1 there was a 7% difference between the two groups), therefore the combination treatment was the more effective treatment.

4.10. Figure 16

In terms of pain on provocation at T1, the Experimental Group demonstrated a 100% reaction to the test, and the Control Group demonstrated an 87% reaction. Between T1 and T3 the Experimental Group had only dropped by 7%, whereas the Control Group experienced a 14% drop. Between T3 and T4 the Experimental Group experienced an 80% drop (down to 13%), whereas there was no change in the Control Group and thus 73% of them were still experiencing pain on provocation. Between T4 and T5, the Experimental Group dropped to 0% with the Control Group still on 40%. From T5 to T7 the Experimental Group remained at 0%, while the Control Group declined progressively to 13%
Experimental Group remained at 0%, while the Control Group declined progressively to 13% by T7. Because the Control Group was 13% below the Experimental Group at T1, the Experimental Group actually demonstrated a 26% improvement in relation to the control group at T7. Due to the fact that the Experimental Group dropped to 0% at T5, it therefore demonstrated a much faster rate of improvement when compared to the Control Group. It also demonstrated a 93% improvement in relation to T1. At T7 the Control Group was down to 13% and it therefore demonstrated a 77% improvement in relation to T1. Therefore, in terms of pain on provocation with the Patrick-Faber Test, the Experimental Group appeared to respond better to the treatment when compared to the Control Group and thus it can be deduced that the combination treatment was the more effective treatment.
These results didn’t follow a uniform pattern as the previous graphs. At T1 both groups measured 100%, in terms of pain provocation. At T2 both groups dropped to 93.33%, but at T3 they both returned to 100% and remained there until T4. Between T4 and T6, the Experimental Group demonstrated a 20% drop from 100% to 80%, whereas the Control Group demonstrated a 13.33% drop to 86.67%. Between T6 and T7 the Experimental Group dropped from 80% to 33.33% (46.67% drop). At the same interval the Control Group dropped from 86.67% to 66.67% (20% drop).

Therefore, in terms of Yeoman’s Test provoking pain, the Experimental Group demonstrated the biggest improvement at T7 in relation to T1. Thus once again, the combination treatment proved to be the more effective treatment.
4.12. **Additional Discussion of the graphs**

The additional conclusion that can be drawn from these three graphs is that Yeoman's Test appeared to be the most pain-provoking orthopaedic test of the sacroiliac joint. This was due to the fact that the graph for Yeoman's Test demonstrated the slowest rate of improvement. The graph for Gaenslen's Test was second in terms of the rate of improvement. The least provocative test was the Patrick-Faber Test. This was because the Patrick-Faber Test demonstrated the fastest rate of improvement in terms of provocation of pain in the sacroiliac joint. Therefore, it is fair to say that the Patrick Faber Test does not accurately provoke S.I. joint pain, whereas Gaenslen's and Yeoman's Tests are respectively more accurate (*in that they are more sensitive tests*). Bearing that in mind, this finding may be useful for practitioners when testing for S.I. joint dysfunction.
CHAPTER 5

DISCUSSION OF THE RESULTS

5.1. INTRODUCTION

This chapter covers the discussion of the results that were obtained from the statistical evaluation of the algometer readings, the provocative orthopaedic tests as well as the questionnaires. These results will be discussed in two sections 1) the objective results and 2) the subjective results.

The following three hypotheses will be referred to:

- The treatment group receiving chiropractic sacroiliac joint manipulative therapy (Control Group) will demonstrate positive results in terms of objective and subjective measurements.
- The treatment group receiving chiropractic sacroiliac joint manipulative therapy in conjunction with piriformis muscle ice-and-stretch (Experimental Group) will demonstrate positive results in terms of objective and subjective measurements.
- The Experimental Group will demonstrate the most positive results in terms of objective and subjective measurements.
5.2. **THE OBJECTIVE RESULTS**

5.2.1. **The Algometer Readings and The Provocative Orthopaedic Tests**

In terms of decreases in pain thresholds (*pressure-sensitivity*) over the symptomatic S.I. joint, both groups experienced statistically significant improvements (increases in the average Newton/Kilogram) over time. However, the Control Group did not experience any statistically significant differences (improvements) between T1&T2, T1&T3, T2&T3 and T5&T6 (table one). On the other hand, the Experimental Group experienced statistically significant improvements after each consecutive treatment (refer to Table One). When the two groups were compared, it was discovered that statistically significant differences were present between them, in that the Experimental Group experienced a faster rate of improvement for the increases in the average Newton/Kilogram. This indicated that by T7 the average patient in the Experimental Group was capable of withstanding a lot more pressure from the algometer over the symptomatic S.I. joint, than was the case for the average patient in the Control Group. According to Fischer (1987: 210), *pressure-sensitivity* from a calibrated force dial can indicate the degree of inflammation and swelling within a tissue. This is measured in accordance with the patient’s pain threshold over similar tissue that is not damaged or inflamed. Therefore, by T7 the average patient in the Experimental Group was suffering from less pain and inflammation over the symptomatic S.I. joint, compared to the average patient in the Control Group.

Similarly, for all three provocative orthopaedic tests, both groups responded with significant
decreases in the percentage of patients who felt pain on provocation at each treatment. However, the Experimental Group outperformed the Control Group in terms of the rate at which the percentages dropped (refer to Figures 15, 16 and 17). Because these provocative tests specifically stress the S.I. joint capsule (Hestoeck and Leboeuf, 2000: 253) they too indicated the presence of pain and inflammation in and around the S.I. joint.

Therefore, in terms of irritation of the S.I. joint capsule by pressing on it (Algometer) and stressing it (provocative stress tests), the Experimental Group experienced a statistically faster rate of improvement in the reduction of pain and inflammation in and around the S.I. joint.

Reasons for the Control Group not responding as quickly and as effectively to the treatment as the Experimental Group did, can be explained in terms of the most likely physiological mechanisms that brought about the end result.

It is well documented by numerous authors (Potter and Cassidy, 1979: 102; Berg et al., 1990: 71; Daily et al., 1991: 149) that during and after pregnancy the S.I. joints become hypermobile due to the body's release of the hormone Relaxin (normal physiological mechanism). According to Travell and Simons (1992: 192), the hypermobility can cause the piriformis muscle to shorten (with active or latent trigger points) in order to stabilise the joint. If, according to Berg et al., (1990: 80), the hypermobile S.I. joint is still in a state of congruency, it is not a manipulable lesion but the contra-lateral S.I. joint should be checked for a fixation. According to Diakow et al., (1991: 117) and Daily et al., (1991: 151) the
problem occurs when the female moves and stresses the hypermobile S.I. joint/s, causing it to twist around the X-axis, thus allowing non-congruent joint surfaces to come into contact with each other. This causes the S.I. joint ligaments to become taught, thereby fixating the joint (Daily et al., 1991: 151). This in turn causes intra-articular irritation, which normally results in pain and inflammation in and around the S.I. joint. As a result of this irritation, the piriformis muscle (on the same side) may go into reflex spasm (Turek, 1989: 1469; Wyke, 1985: 230; Gatterman, 1990: 115). However, all of the above-mentioned authors, do mention that once this joint dysfunction has been addressed by manipulation and joint range of motion has been restored, the muscle spasm will cease.

However the results of the study are more in agreement with the findings of Travell and Simons (1992: 193) who mention that both structures need to be corrected for lasting relief from S.I. Syndrome/dysfunction. The reason for this is that once the joint fixation has cleared, it may later return due to the untreated trigger points in the lower fibres of the piriformis muscle. These trigger points are capable of producing a strong rotary shearing force on the S.I. joint (Synek, 1991: 37; Schneider, 1998: 2). Therefore, the shortened piriformis muscle (from trigger points) would tend to displace the ipsilateral base of the sacrum anteriorly and the apex of the sacrum posteriorly, thereby restricting mobility (fixating) in the S.I. joint (Retzlaff et al., 1974: 800). Schneider (1998: 3) states that shortening of the piriformis muscle due to trigger points can cause restriction of the sacroiliac joint. Thus, when treating a restricted sacroiliac joint, it is paramount to make sure that the piriformis is devoid of trigger points in order to restore normal mobility to the joint.
5.3. THE SUBJECTIVE RESULTS

The results of the Sign Rank Tests and the Mann-Whitney Tests for the McGill Pain Questionnaire (Appendix C), the Oswestry Low Back Pain Disability Questionnaire (Appendix D) and the Numerical Pain Rating Scale (E) comprise the subjective results of the study. These questionnaires were completed by the patients in each group before the 1st, 3rd and 6th treatments as well as at the final follow-up consultation.

The results of the Sign Rank tests for the McGill and the Oswestry questionnaires indicated that over time, the Control Group did not experience any improvements in the medians for the percentages obtained from these questionnaires. This was due to the fact that the T-values were all greater than 0.05. Thus, when the two groups were compared (Mann-Whitney Test), the Experimental Group responded significantly better to the treatment (which followed the same pattern as the objective results). The explanation for these results could thus be due to the same physiological mechanisms as discussed for the objective results.

However, the results of the Sign Rank Test for the Numerical Pain Rating Scale indicated that between T3&T6, T3&T7 and T6&T7, the Control Group experienced statistically significant improvements in its medians. This was because the T-values were 0.00561, 0.03718 and 0.00004, respectively (i.e. less than 0.05). When the two groups were compared (Mann-Whitney Test for the N.P.R.S.), the Experimental Group experienced a
statistically faster rate of improvement in the medians for the scores obtained from the Numerical Pain Rating Scale (refer to Tables 3, 4, 5, 6, 7 & 8).

In terms of the Numerical Pain Rating Scale, the possible reason why the Control Group demonstrated statistically significant improvements/differences in its medians for the Sign Rank Test, but not for the other two Questionnaires (McGill & Oswestry) can be explained.

The Oswestry Low Back Pain Disability Questionnaire (refer to Appendix D) asks the patient questions as to how the pain affects her daily activities, which is the best way of measuring any form of subjective improvement (Davies et al., 1990: 82). In the 1st section of the McGill Pain Questionnaire (appendix C), the patient was asked to mark on a diagram where she felt the pain (a good way of seeing if the painful area is diminishing in size). In the 2nd and 3rd sections, the patient had to circle the words that best described what her pain felt like (as the pain diminishes, fewer and less descriptive words will be used). In the final section the patient is asked to numerically compare the pain (as it now feels) to how it was at its worst, and how it compares to the worst headache, toothache and stomach ache she has ever experienced. However, the N.P.R.S. (appendix E) simply asked the patient to cross the number (0 to 10) that best described her pain at that moment (10 = unbearable pain, 0 = no pain). According to Fairbank et al., 1988: 60, when conducting clinical trials, a pain questionnaire should request the patient to mark on a diagram where he/she feels the pain. It must also question how the patient feels when performing daily activities. To simply ask the patient to numerically rate his/her pain on a scale of 1 to 10, is the least accurate way of
understanding the patient's pain. This is due to the fact that the researcher needs to be able to compare what, where and how the pain felt at each consultation. Therefore, according to Fairbank's observation in his book: "Medical Research Methodologies" (1988: 66), the Control Group's improvement with regards to the Numerical Pain Rating Scale may be questionable.
CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1. CONCLUSIONS

In Chapter One there were four hypotheses that this research had to answer. Those hypotheses will be answered in this section. Hypothesis One will be answered last.

6.1.1. Answer to Hypothesis 2

It was hypothesised that chiropractic manipulation of the fixated S.I. joint on its own would be beneficial for the patient in the management of S.I. Syndrome, in a sample of post-partum females. The answer to this came from the Paired T-Test for the algometer readings, the Sign Rank Tests for the questionnaires and the graphs of the provocative orthopaedic tests.

The results of the Paired T-Test for the algometer readings indicated that manipulation on its own was beneficial for the average patient. This proved that within the specified trial period, there was a significant increase in the average patient’s pain threshold to pressure
over the symptomatic S.I. joint.

*The results of the Sign Rank Tests* indicated that by the end of the trial period, the Numerical Pain Rating Scale was the only questionnaire which showed that manipulation on its own caused a significant reduction in pain, for the average patient in the Control Group. It also indicated that according to the Oswestry and the McGill Questionnaires, the average patient in the Control Group did not notice an improvement over time.

*The graphs of the provocative orthopaedic tests for the Control Group* indicated that over time, to a greater or lesser degree (depending on the orthopaedic test), each graph demonstrated a significant reduction in the percentage of patients who felt pain on provocation.

Therefore, in terms of the algometer readings and the provocative orthopaedic tests (objective findings), Hypothesis 2 was accepted. However, in terms of the subjective findings of the Oswestry Low Back Pain Disability Questionnaire and the McGill Pain Questionnaire (*questionnaires that discussed how debilitating, where and what the pain felt like*) the average patient did not notice a significant improvement. Thus, hypothesis 2 was rejected for the subjective tests that asked intricate questions about the patient's pain, but was accepted for the Numerical Pain Rating Scale, as this test merely asked the patient to numerically calibrate the pain.
6.1.2. Answer to Hypothesis 3

It was hypothesised that *chiropractic manipulation combined with piriformis muscle ice-and-stretch on the ipsilateral side of the fixation would be beneficial for the patient, in the management of S.I. Syndrome in a sample of post-partum females.* Again the answers came from the above-mentioned tests.

According to the *results of the Paired T-Test for the algometer readings*, the combination treatment proved to be beneficial for the average patient over the trial period. This was due to an increase in the average patient’s pain threshold to pressure over the symptomatic S.I. joint.

According to the results of the *Sign Rank Tests* for the Numerical Pain Rating Scale and the McGill Pain Questionnaire, it was proven that by treatment 7 the combination treatment had brought about a significant improvement in relation to the initial consultation. It was also proven that in terms of the Oswestry Questionnaire, the combination treatments gave the average patient statistically significant improvements between T1&T3 and between T3&T6. However, by *treatment seven*, there was no significant improvement in relation to the initial consultation. Therefore, this indicated that in terms of the Oswestry Questionnaire, the average patient in the Experimental Group did not experience a lasting improvement.
The results of the provocative orthopaedic tests for the Experimental Group indicated that over time, to a greater or lesser degree (depending the orthopaedic test), each one demonstrated a progressive reduction in the percentage of patients who felt pain on provocation.

Therefore, in terms of both the objective (algometer readings & provocative orthopaedic tests) and subjective (questionnaires) findings, the combination treatment brought about a statistically significant improvement for the average patient in the Experimental Group.

6.1.3. Answer to Hypothesis 4

It was hypothesised that the two forms of chiropractic treatment would be beneficial to varying degrees in the management of S.I. Syndrome in a sample of post-partum females. It was thus hypothesised that S.I. joint manipulation combined with piriformis ice-and-stretch on the ipsilateral side of the fixation would be more effective than chiropractic manipulation of the S.I. joint alone.

The answers to this question came from the Two-Sample T-Test (for the algometer readings), the Mann-Whitney Tests (for the questionnaires) and the general pattern for all three graphs of the provocative orthopaedic tests.
Due to the answer to Hypothesis 4, it can be assumed that Post-Partum Sacroiliac Syndrome (within 6 months of child delivery) should be treated with the combination of S.I. joint manipulation and piriformis muscle ice-and-stretch (on the ipsilateral side to the S.I. joint fixation).

6.2. **PROBLEMS ENCOUNTERED IN THE STUDY**

There was a problem with patients not completing the trial. This was possibly due to the fact that the patient felt better and therefore did not feel the need for any further treatments. It could have also been due to the fact that the patient was disappointed with the type of treatment she was undergoing. The ones that did see the trial period to completion often rescheduled their appointments (due to unforeseen problems). Therefore, for some of the weeks, they only received two treatments instead of three per week. This caused a disruption in the time interval between treatments and could explain some of the variation in the response to treatment. The other problem was that the mother would continue picking up her newborn baby, thus placing additional strain on the lower back and pelvis, which then interfered with the outcome of the treatment.

6.3. **RECOMMENDATIONS**

It is recommended that a larger sample size be used in future studies to increase the validity of the study. The additional use of a Technetium Bone Scan is advised in order to be more
objective, as the bone scan indicates areas of inflammation. Therefore, the change in the inflammation in the S.I. joint will indicate an improvement or deterioration in the patient's condition. Future studies should attempt to group the patients together in terms of similarities such as age, exact number of months since the delivery, height, weight, race etc. in order to eliminate as many variables as possible. A larger sample size would be required in order to achieve this. It would be advisable to re-evaluate the patients after one month, six months, and a year, in order to monitor the patients' progress over time and to determine whether the improvement has been maintained and for how long. Thus the long-term efficacy of chiropractic sacroiliac manipulation on its own, versus chiropractic sacroiliac manipulation combined with piriformis muscle ice-and-stretch could be ascertained. Future studies should attempt to ensure that all patients are treated at similar time intervals over the same time period.

In conclusion, it is evident from this study that post-partum females who are suffering from Sacroiliac Syndrome should undergo both S.I. joint manipulation as well as ipsilateral piriformis muscle trigger point therapy. This study highlighted the fact that the piriformis muscle does play a role in sacroiliac joint fixations in post-partum females. In view of the results of this study, it is important that medical doctors (especially gynaecologists) be made aware of the benefits of chiropractic care for Post-Partum Sacroiliac Syndrome.
REFERENCES


APPENDICES

Appendix A

Eligibility Questionnaire

- Date of birth of your youngest child?

- Do you presently suffer from any pain? Please state where it is.

- Have you recently been in an accident and had any back trauma inflicted, if so please explain?

- Do you have any numbness, weakness or pins-and-needles in your legs and feet? Please state where.

- Have you ever had lower back surgery?

- Please state when your back pain started?

- Have you ever been diagnosed with a spinal abnormality, if so please explain?

- Are you presently getting any form of treatment for your back problem (including medication and/or a stretching programme)? If so please state what kind?
Do you, to the best of your knowledge, suffer from any form of cancer, pathological osteoporosis, Tuberculosis, Multiple Myeloma, Ankylosing Spondylitis, Rheumatoid Arthritis, Sacroilitis or any other chronic disease? (Please state what kind.)
Appendix B

Subject information and Patient Consent Form

Dear patient,

Your participation in this research study concerning the management of Sacroiliac Syndrome on postpartum females will require the disclosure of certain personal details such as age, address and telephone number. This study will be comparing two types of treatment for Sacroiliac Syndrome.

You will be questioned extensively as to your low back condition and your health in general. A thorough physical examination will be undertaken, and the management will consist of three treatments for two consecutive weeks with a follow up consultation three weeks later, in order to assess your progress and to conclude the study. Your treatment will consist of either straight manipulation of the motion-restricted Sacroiliac joint, or manipulation combined with ice and stretch of the piriformis muscle (which is located in the buttock musculature). (Please note, the treatment you receive, may or may not result in complete resolution of your condition.)

We assure you that all information disclosed will be kept strictly confidential and we thank you for your co-operation. Your participation is voluntary and refusal to participate will involve no penalty. You may discontinue participation at anytime should you so wish to. Due to the fact that this study will involve an extensive physical examination, the risk to you the patient is negligible. The only possible discomfort that you may experience could be muscle stiffness the day following the treatment.

Date: ___________________________ Researcher: _______________________________
I, the undersigned, am willing to participate in this research study and give my consent to be questioned, examined and treated for the research purpose of comparing two types of treatments for Sacroiliac Syndrome (Straight manipulation of the Sacroiliac joint versus manipulation and triggerpoint therapy of the piriformis muscle) at the Technikon Witwatersrand Day Clinic.

Date:_________ Patient:_________
APPENDIX C

McGill-Melzack
PAIN QUESTIONNAIRE

Patient's name ____________________________ Age __________
File No. ____________________________ Date __________
Clinical category (e.g. cardiac, neurological, etc.):

____________________________________

Diagnosis: ____________________________

____________________________________

Analgesic (if already administered):
1. Type ____________________________
2. Dosage ____________________________
3. Time given in relation to this test ____________________________

Patient's intelligence: circle number that represents best estimate
1 (low)  2  3  4  5 (high)

******

This questionnaire has been designed to tell us more about your pain. Four major questions we ask are:

1. Where is your pain?
2. What does it feel like?
3. How does it change with time?
4. How strong is it?

It is important that you tell us how your pain feels now. Please follow the instructions at the beginning of each part.

© R. Melzack, Oct 1970
Part 1. Where is your Pain?

Please mark, on the drawings below, the areas where you feel pain. Put E if external, or I if internal, near the areas which you mark. Put EI if both external and internal.
# Part 2. What Does Your Pain Feel Like?

Some of the words below describe your present pain. Circle ONLY those words that best describe it. Leave out any category that is not suitable. Use only a single word in each appropriate category—the one that applies best.

<table>
<thead>
<tr>
<th>1</th>
<th>Flickering</th>
<th>2</th>
<th>Jumping</th>
<th>3</th>
<th>Pricking</th>
<th>4</th>
<th>Sharp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quiivering</td>
<td></td>
<td>Flashing</td>
<td></td>
<td>Boring</td>
<td></td>
<td>Cutting</td>
</tr>
<tr>
<td></td>
<td>Pulsing</td>
<td></td>
<td>Shooting</td>
<td></td>
<td>Drilling</td>
<td></td>
<td>Lacerating</td>
</tr>
<tr>
<td></td>
<td>Throbbing</td>
<td></td>
<td></td>
<td></td>
<td>Stabbing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beating</td>
<td></td>
<td></td>
<td></td>
<td>Lancinating</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pounding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Pinching</td>
<td>6</td>
<td>Tugging</td>
<td>7</td>
<td>Hot</td>
<td>8</td>
<td>Tingling</td>
</tr>
<tr>
<td></td>
<td>Pressing</td>
<td></td>
<td>Pulling</td>
<td></td>
<td>Burning</td>
<td></td>
<td>Itchy</td>
</tr>
<tr>
<td></td>
<td>Gnawing</td>
<td></td>
<td>Wrenching</td>
<td></td>
<td>Scalding</td>
<td></td>
<td>Smarting</td>
</tr>
<tr>
<td></td>
<td>Cramping</td>
<td></td>
<td></td>
<td></td>
<td>Searing</td>
<td></td>
<td>Stingig</td>
</tr>
<tr>
<td></td>
<td>Crushing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Dull</td>
<td>10</td>
<td>Tender</td>
<td>11</td>
<td>Tiring</td>
<td>12</td>
<td>Sickening</td>
</tr>
<tr>
<td></td>
<td>Sore</td>
<td></td>
<td>Taut</td>
<td></td>
<td>Exhausting</td>
<td></td>
<td>Suffocating</td>
</tr>
<tr>
<td></td>
<td>Hurting</td>
<td></td>
<td>Rasping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aching</td>
<td></td>
<td>Splitting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Fearful</td>
<td>14</td>
<td>Punishing</td>
<td>15</td>
<td>Wretched</td>
<td>16</td>
<td>Annoying</td>
</tr>
<tr>
<td></td>
<td>Frightful</td>
<td></td>
<td>Gruelling</td>
<td></td>
<td>Blinding</td>
<td></td>
<td>Troublesome</td>
</tr>
<tr>
<td></td>
<td>Terrifying</td>
<td></td>
<td>Cruel</td>
<td></td>
<td></td>
<td></td>
<td>Miserable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vicious</td>
<td></td>
<td></td>
<td></td>
<td>Intense</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Killing</td>
<td></td>
<td></td>
<td></td>
<td>Unbearable</td>
</tr>
<tr>
<td>17</td>
<td>Spreading</td>
<td>18</td>
<td></td>
<td>19</td>
<td>Cool</td>
<td>20</td>
<td>Nagging</td>
</tr>
<tr>
<td></td>
<td>Radiating</td>
<td></td>
<td></td>
<td></td>
<td>Cold</td>
<td></td>
<td>Nauseating</td>
</tr>
<tr>
<td></td>
<td>Penetrating</td>
<td></td>
<td></td>
<td></td>
<td>Freezing</td>
<td></td>
<td>Agonizing</td>
</tr>
<tr>
<td></td>
<td>Piercing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dreadful</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Torturing</td>
</tr>
</tbody>
</table>
Part 3. **How Does Your Pain Change With Time?**

Which word or words would you use to describe the pattern of your pain?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Continuous</td>
<td>Rhythmic</td>
<td>Brief</td>
</tr>
<tr>
<td></td>
<td>Steady</td>
<td>Periodic</td>
<td>Momentary</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>Intermittent</td>
<td>Transient</td>
</tr>
</tbody>
</table>

Part 4. **How Strong Is Your Pain?**

People agree that the following 5 words represent pain of increasing intensity. They are:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild</td>
<td>Discomforting</td>
<td>Distressing</td>
<td>Horrible</td>
<td>Excruciating</td>
</tr>
</tbody>
</table>

To answer each question below, write the number of the most appropriate word in the space beside the question.

1. Which word describes your pain right now? __________
2. Which word describes it at its worst? __________
3. Which word describes it when it is least? __________
4. Which word describes the worst toothache you ever had? __________
5. Which word describes the worst headache you ever had? __________
6. Which word describes the worst stomach-ache you ever had? __________
APPENDIX D

Exhibit 7.3 The Oswestry Low Back Pain Disability Questionnaire

<table>
<thead>
<tr>
<th>How long have you had back pain?</th>
<th>Years</th>
<th>Month</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>How long have you had leg pain?</td>
<td>Years</td>
<td>Months</td>
<td>Weeks</td>
</tr>
</tbody>
</table>

Please read:
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 realise 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 can tolerate the pain I have without having to use painkillers.
- [ ] The pain is bad but I manage without taking painkillers.
- [ ] Painkillers give complete relief from pain.
- [ ] Painkillers give moderate relief from pain.
- [ ] Painkillers give very little relief from pain.
- [ ] Painkillers have no effect on the pain and I do not use them.

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, 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, e.g. on a table.
- [ ] Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned.
- [ ] I can lift only very light weights.
- [ ] I cannot lift or carry anything at all.

Section 4 — Walking
- [ ] Pain does not prevent me walking any distance.
- [ ] Pain prevents me walking more than 1 mile.
- [ ] Pain prevents me walking more than ½ mile.
- [ ] 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 favourite chair as long as I like.
- [ ] Pain prevents me sitting more than 1 hour.
- [ ] Pain prevents me sitting more than ½ hour.
- [ ] Pain prevents me from sitting more than 10 mins.
- [ ] 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 1 hour.
- [ ] Pain prevents me from standing for more than 30 mins.
- [ ] Pain prevents me from standing for more than 10 mins.
- [ ] Pain prevents me from standing at all.

Section 7 — Sleeping
- [ ] Pain does not prevent me from sleeping well.
- [ ] Pain prevents me from sleeping well only by using tablets.
- [ ] Even when I take tablets I have less than six hours sleep.
- [ ] Even when I take tablets I have less than four hours sleep.
- [ ] Even when I take tablets I have less than two hours sleep.
- [ ] Pain prevents me from sleeping at all.

Section 8 — Sex Life
- [ ] My sex life is normal and causes no extra pain.
- [ ] My sex life is normal but causes some extra pain.
- [ ] My sex life is nearly normal but is very painful.
- [ ] My sex life is severely restricted by pain.
- [ ] My sex life is nearly absent because of pain.
- [ ] Pain prevents any sex life at all.

Section 9 — Social Life
- [ ] My social life is normal and gives me no extra pain.
- [ ] My social life is normal but increases the degree of pain.
- [ ] Pain has no significant effect on my social life apart from my more energetic interest, e.g. dancing, etc.
- [ ] Pain has restricted my social life and I do not go out as a result.
- [ ] Pain has restricted my social life to my home.
- [ ] I have no social life because of pain.

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 journeys over two hours.
- [ ] Pain restricts me to journeys of less than one hour.
- [ ] Pain restricts me to short necessary journeys under 30 m.
- [ ] Pain prevents me from travelling except to the doctor hospital.

Comments

Scoring (not seen by patients)

For each section the total possible score is 3. If the first statement is marked the section score is 0. If the last statement is marked it is 3.

If all ten sections are completed the score is calculated as follows:

Example: 16/30 (total scored) x 100 = 53%

If one section is missed or not applicable:

Example: 16/45 (total scored) (total possible score) 95%

Exhibit 7.2  Formats of the Numerical Rating (NRS) and Visual Analogue Scales (VAS) as Used by Downie et al.

APPENDIX F

TECHNIKON WITWATERSRAND

CHIROPRACTIC DAY CLINIC

CASE HISTORY

Date:______________

Patient:_________________________ File No.:______________

Intern:_________________________ Signature:______________

FOR CLINICIAN'S USE ONLY

Initial visit clinician:______________ Signature:

Case History:

--------------------------------------------------------------------------------

--------------------------------------------------------------------------------

--------------------------------------------------------------------------------

Examination:

  Previous: TWR Other
  Current: TWR Other

X-Ray studies:

  Previous: TWR Other
  Current: TWR Other

Clinical path. lab:

  Previous: TWR Other
  Current: TWR Other

Case status

PIT: 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 Sx’s and Sg’s

   Previous occurrences

   Past treatment and outcome
4. Other complaints:
5. Past history:
   General health status
   Childhood illnesses
   Adult illnesses
   Psychiatric illnesses
   Accidents/injuries
   Surgery
   Hospitalisation
6. Current health status and lifestyle
   Allergies
   Immunizations
   Screening tests
   Environmental hazards
   Safety measures
   Exercise and leisure
   Sleep patterns
Diet
Current medication

Tobacco

Alcohol

Social drugs

7. Family history:
   Immediate family:
   Cause of death
   DM
   Heart disease
   TB
   HBP
   Stroke
   Kidney disease
   CA
   Arthritis
   Anaemia
   Headaches
   Thyroid disease
   Epilepsy
   Mental illness
   Alcoholism
   Drug addiction
   Other

8. Psychosocial history:
   Home situation

   Daily life

   Important experiences
Religious beliefs

9. Review of systems:

General
Skin
Head
Eyes
Ears
Nose/sinuses
Mouth/throat
Neck
Breasts
Respiratory
Cardiac
Gastro-intestinal
Urinary
Genital
Vascular
Musculoskeletal
Neurologic
Haematologic
Endocrine
Psychiatric
TECHNIKON WITWATERSRAND
CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Underline abnormal findings in RED.

Patient: ____________________________ File No: __________

Clinician: __________________________ Signature: __________

Intern: ___________________________ Signature: __________

Date: __________

Height: ________ Weight: ________ Temp: __________

Rates: Heart: ________ Pulse: ________ Respiration: __________

Blood pressure: Arms: L R

Legs: L R

General Appearance:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
STANDING EXAMINATION

1. Minoc's sign
2. Skin changes
3. Posture: Erect
   Adam's
4. Ranges of motion (Thoracolumbar Spine)
   T/L spine:
   - Flexion: 90° (fingers to floor)
   - Extension: 50°
   - R. lat. flex.: 30° (fingers down leg)
   - L. lat. flex.: 30° (fingers down leg)
   - Rot. to R.: 25°
   - Rot. to L.: 35°

\[ \text{Flex.} \quad \text{L. Rot} \quad \text{R. Rot.} \]
\[ \text{L. lat flex} \quad \text{|} \quad \text{R. lat. flex} \]
\[ \text{Ext.} \]

\[ / = \text{pain-free limitation} \quad // = \text{painful limitation} \]

5. Romberg's sign
6. Pronator drift
7. Trendelenburg's sign
8. Gait:
   - rhythm
   - balance
   - pendulousness
   - on toes
   - on heels
   - tandem

9. Half squal
10. Scapular winging
11. Muscle tone
12. Spasticity/Rigidity
13. Shoulder:  
- skin  
- symmetry  
- ROM  
- glenohumeral  
- scapulo-thoracic  
- acromioclavicular  
- elbow  
- wrist

14. Chest measurement:  
<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>- inspiration</td>
<td>cm</td>
<td>cm</td>
</tr>
<tr>
<td>- expiration</td>
<td>cm</td>
<td>cm</td>
</tr>
</tbody>
</table>

15. Visual acuity:

16. Breast examination:  
- Inspection:  
  - skin  
  - size  
  - contour  
  - nipples  
  - arms overhead  
  - hands against hips  
  - leaning forward  
- Palpation:  
  - axillary lymph nodes  
  - breast incl. tail

**SEATED EXAMINATION**

1. Spinal posture
2. Head.  
- hair  
- scalp  
- skull  
- face  
- skin

3. Eyes:  
- Observation  
  - conjunctiva  
  - sclera  
  - eyebrows  
  - eyelids  
  - lacrimal glands  
  - nasolacrimal duct  
  - position and alignment  
  - corneas and lenses

- corneal reflex

- ocular movement
  
<table>
<thead>
<tr>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>IV</td>
</tr>
<tr>
<td>VI</td>
<td>II</td>
</tr>
<tr>
<td>IV</td>
<td>VI</td>
</tr>
</tbody>
</table>
- visual fields
- accommodation
- Ophthalmoscopic Examination
  - iris
  - pupils
  - red reflex
  - optic disc
  - vessels
  - general background
  - macula
  - vitreous
  - lens

4. Ears:
- Inspection
  - auricle
  - ear canal
  - drum

- auditory acuity
- Weber test
- Rinne test

5. Nose:
- external
- internal
  - septum
  - turbinates
  - olfaction

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

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

- pharynx
  - inspection
  - CN X
8. Neck

- posture
- size
- swelling
- scars
- discolouration
- hair line

Ranges of Motion (cervical spine)

The following are normal ranges of motion

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

- lymph nodes
- trachea
- thyroid
- carotid arteries (thrills, bruit)
- Cranial Nerves: - CN V
- CN VII
- CN VIII (nystagmus)
- CN IX
- CN XI
- CN XII
9. NEUROLOGICAL EXAMINATION (CERVICAL SPINE)

<table>
<thead>
<tr>
<th>DERMATOMES</th>
<th>Left</th>
<th>Right</th>
<th>MYOTOMES</th>
<th>Left</th>
<th>Right</th>
<th>REFLEXES</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td></td>
<td></td>
<td>Neck Flexion C1/2</td>
<td></td>
<td></td>
<td>Brachio - radialis C6</td>
<td>Triceps C7</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td></td>
<td></td>
<td>Lat. Neck Flexion C3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td></td>
<td></td>
<td>Shoulder Elevation C4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td></td>
<td></td>
<td>Shoulder Abduction C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td></td>
<td></td>
<td>Elbow Flexion C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td></td>
<td></td>
<td>Elbow Extension C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td></td>
<td></td>
<td>Elbow Flexion at 90° C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td></td>
<td></td>
<td>Forearm Pronation C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Forearm Supination C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wrist Extension C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wrist Flexion C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Finger Flexion C8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Finger Abduction T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Finger Adduction T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. PMI
3. auscultation heart
   (L.lat.recumbent)
4. respiratory excursion
5. percussion chest
   (anterior)
6. breast palpation
7. Abdominal Examination
   - Inspection:
     - skin
     - umbilicus
     - contour
     - peristalsis
     - pulsations
     - hernias (umbilical/incisional)
   - Auscultation:
     - bowel sounds
     - bruit
   - Percussion:
     - general
     - liver
     - spleen
   - Palpation:
     - superficial reflexes
     - cough
     - light
     - rebound tenderness
     - deep
     - liver
     - spleen
     - kidneys
     - aorta
     - intra-/retro-abdominal wall mass
     - shifting dullness
     - fluid wave
   - Acute abdomen:
     - where pain began and now
     - cough
     - tenderness
     - guarding/rigidity
     - rebound tenderness
     - Rovsing's sign
     - psoas sign
     - obturator sign
     - cutaneous hyperaesthesia
     - rectal exam
     - Murphy's sign
8. Male genitals and hernias
   - Inspection:
     - skin
     - prepuce
     - glans
     - meatus
     - nits/lice
10. TMJ:
- Inspection: 
  - ROM
  - deviation
- Palpation: 
  - crepitus
  - tenderness

11. Thorax:
- Inspection: 
  - skin
  - shape
  - respiratory distress
  - rhythm (respiratory)
  - depth (respiratory)
  - effort (respiratory)
  - intercostal/supracleavicular retraction
- Palpation: 
  - tenderness
  - masses
  - respiratory expansion
  - tactile fremitus
- Percussion: 
  - lungs (posterior)
  - diaphragmatic excursion
  - kidney punch
- Auscultation: 
  (i) breath sounds
    - vesicular
    - bronchial
  (ii) adventitious sounds
    - crackles (rales)
    - wheezes (rhonchi)
    - rubs
  (iii) voice sounds
    - broncophony
    - whispered pectoriloquy
    - egophony
- Cardiovascular: 
  - auscultation (aortic murmurs)
  - Allen’s test

SUPINE EXAMINATION

1. JVP
- scrotum
- inguinal/femoral bulges

- Palpation:
  - penis (tenderness/induration)
  - testes
  - epididymis
  - inguinal canal
  - femoral canal
  - cremasteric reflex

- Auscultation:
  - scrotal mass

9. Peripheral vasculature:
   - Inspect:
     - skin
     - nail beds
     - pigmentation
     - hair loss

   - Palpation:
     - pulses:
       - femoral
       - popliteal
       - radial
       - post. tibial
       - brachial

     - lymph nodes
     - epitrochlear
     - femoral (horizontal and vertical)
     - temperature (feet and legs)

   - Manual compression test
   - Retrograde filling (Trendelenburg) test
   - Arterial insufficiency test

10. Musculoskeletal:
   (i) RGM
   - Hip

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>flex.</td>
<td>90/120</td>
<td></td>
</tr>
<tr>
<td>ext.</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>abd.</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>add.</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>int rot</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>ext rot</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>
- knee
- ankle

(ii) leg length:

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>flex</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>ext</td>
<td>0/15</td>
<td></td>
</tr>
<tr>
<td>plantar Flex</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>dorsiflex</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>inversion</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>eversion</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Apparent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12. Rectal examination:

- Inspection
- Palpation:
  - Sacrococcygeal & perianal areas
  - Sphincter tone
  - Tenderness
  - Induration
  - Nodules
  - Prostate
  - Seminal vesicles

MENTAL STATUS

(i) Appearance and behaviour:
- Level of consciousness
- Posture and motor behaviour
- Dress, grooming, personal hygiene
- Facial expression
- Affect

(ii) Speech and language:
- Quantity
- Rate
- Volume
- Fluency
- Aphasia (PMT)

(iii) Mood

(iv) Thought processes
(logical, relevant, organised)

(v) Memory and attention:
- Orientation (time, place, person)
- Remote memory
- Recent memory
- New learning ability

(vi) Higher cognitive functions:
- Information and vocabulary (general & specialised knowledge)
- Abstract thinking
APPENDIX H

TECHNIKON WITWATERSRAND
CHIROPRACTIC DAY CLINIC

REGIONAL EXAMINATION
LUMBAR SPINE AND PELVIS

Date: __________

Patient: ___________________________  File No: __________

Clinician: ___________________________  Signature: __________

Intern: ___________________________  Signature: __________

A) STANDING

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

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

<table>
<thead>
<tr>
<th>Movement</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward flexion</td>
<td>40 - 60° (15 cm from floor)</td>
</tr>
<tr>
<td>Extension</td>
<td>20 - 35°</td>
</tr>
<tr>
<td>L/R Rotation</td>
<td>3 - 18°</td>
</tr>
<tr>
<td>L/R Lat Flexion</td>
<td>15 - 20°</td>
</tr>
</tbody>
</table>

![Diagram showing range of motion](image)

\( / = \text{Pain free limitation} \quad \text{II} = \text{Painful limitation} \)

6. **GAIT**

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

7. **MOTION PALPATION - sacroiliac joints**

B. **SITTING**

1. **SPECIAL TESTS**

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

<table>
<thead>
<tr>
<th>Jt. play</th>
<th>Left</th>
<th>Right</th>
<th>Jt. play</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P/A</td>
<td>Lat</td>
<td>Fle</td>
</tr>
<tr>
<td></td>
<td>T10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U L</td>
<td>Si</td>
<td>U L</td>
</tr>
</tbody>
</table>

3) **SUPINE**

1. **OBSERVATION**
   - Hair, Skin, Nails
   - Fasciculations

2. **PULSES**
   - Femoral
   - Popliteal
   - Dorsalis Pedis
   - Posterior Tibial

3. **MUSCLE CIRCUMFERENCE**

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>THIGH</td>
<td>cm</td>
<td>cm</td>
</tr>
<tr>
<td>CALF</td>
<td>cm</td>
<td>cm</td>
</tr>
</tbody>
</table>

4. **LEG LENGTH**

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTUAL</td>
<td>cm</td>
<td>cm</td>
</tr>
<tr>
<td>APPARENT</td>
<td>cm</td>
<td>cm</td>
</tr>
</tbody>
</table>
5. ABDOMINAL EXAMINATION

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

Comments: __________________________________________

_____________________________________________________

_____________________________________________________

_____________________________________________________
# Neurological Examination

<table>
<thead>
<tr>
<th>Dermatomes</th>
<th>Left</th>
<th>Right</th>
<th>Myotomes</th>
<th>Left</th>
<th>Right</th>
<th>Reflexes</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>T12</td>
<td></td>
<td></td>
<td>Hip Flexion</td>
<td></td>
<td></td>
<td>Patellar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L1 / L2)</td>
<td></td>
<td></td>
<td>(L3, 4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td></td>
<td></td>
<td>Knee Extension</td>
<td></td>
<td></td>
<td>Medial Hamstring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L2, 3, 4)</td>
<td></td>
<td></td>
<td>(L5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td></td>
<td>Knee Flexion</td>
<td></td>
<td></td>
<td>Lateral Hamstring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L5 / S1)</td>
<td></td>
<td></td>
<td>(S1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td></td>
<td>Hip Int. Rot</td>
<td></td>
<td></td>
<td>Tibialis Posterior</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L4 / L5)</td>
<td></td>
<td></td>
<td>(L4, 5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td></td>
<td></td>
<td>Hip Ext. Rot</td>
<td></td>
<td></td>
<td>Achilles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L5 / S1)</td>
<td></td>
<td></td>
<td>(S1 / S2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td></td>
<td>Hip Adduction</td>
<td></td>
<td></td>
<td>Plantar Refl</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L2, 3, 4)</td>
<td></td>
<td></td>
<td>ex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td></td>
<td></td>
<td>Hip Abduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L4 / 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td></td>
<td></td>
<td>Ankle Dorsiflexion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L4 / L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td>Hallux Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ankle Plantar Flexion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(S1 / S2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eversion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inversion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hip Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(L5 / S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. SPECIAL TESTS

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

LATERAL RECUMBENT

- Sacroiliac Compression
- Ober's Test
- Femoral Nerve Stretch Test

- Myotomes:  
  - Quadratus Lumborum Strength
  - Gluteus Medius Strength
PRONE

- Facet joint challenge
- Myofascial Trigger points:
  - Quadratus Lumborum
  - Gluteus Medius
  - Gluteus Maximus
  - Piriformis
  - Tensor Fascia Lata
  - Hamstrings

- Skin Rolling
- Erichsen’s Test
- Sacroiliac Tenderness
- Pheasant’s Test
- Gluteal Skyline
- Myotomes:
  - Gluteus Maximus strength

NON-ORGANIC SIGNS

- Pin-point pain
- Axial Compression
- Trunk Rotation
- Burn’s Bench Test
- Flip Test
- Hoover’s Test
- Ankle Dorsiflexion Test
- Pin-point pain
Appendix I

The Test Procedure

Paired T-test

In general the Paired T-Test compares two paired groups. It calculates the difference between each set of pairs, and analyses the list of differences based on the assumption that the differences in the entire population follow a Gaussian (normal) distribution.

If $d_i = x_i - y_i$ is the difference for the $i$-th pair ($i=1, ..., n$ pairs) the $t$ statistic for comparing the differences is:

$$ t = \frac{\bar{d}}{s_{\bar{d}}} $$

where $\bar{d}$ is means of the differences and $s_{\bar{d}}$ is the standard error. In the context the analysis in the hypothesis of interest is:

$H_0$: There is no effect of treatment over time based on algometer readings
Against the alternative hypothesis that

\[ H_1: \text{there is significant treatment effect of over time.} \]

**Two sample t-test between groups**

The sample t test is applied in this paper to determine the differences between the two groups, straight manipulation and manipulation with piriformis ice-and-stretch on postpartum females. The test assumes that data was sampled from Gaussian populations.

If \( \bar{x}_1 \) and \( \bar{x}_2 \) are the sample means from straight manipulation and manipulation with piriformis ice-and-stretch, the t statistic for testing the differences between the two groups is:

\[
t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{\text{var}(\bar{x}_1)}{n_1 - 1} + \frac{\text{var}(\bar{x}_2)}{n_2 - 1}}}
\]

where \( \text{var}(\bar{x}_1) \) and \( \text{var}(\bar{x}_2) \) are the variances of the sample means and \( n_1 \) and \( n_2 \) are the corresponding sample sizes.
Nonparametric paired test - Sign test

The sign test is the simplest nonparametric technique applied to the data with a non-normal distribution. The test is generally designed for testing hypotheses about the median of any continuous population.

In the context of our study the null hypotheses is:

\[ H_0: \text{The difference between any pair of treatments (over time) is zero} \]

Against the alternative hypothesis:

\[ H_1: \text{there is effect over time} \]

For each pair of observations calculate the difference \( d_i = x_i - y_i \). The test statistics are based on the normal approximation:

\[ t = \frac{|n_+ - n_-|}{\sqrt{N}} \]

where \( n_+ \) and \( n_- \) are the number of positive and negative counts respectively and \( N = \text{total number of observation}. \)
Mann-Whitney test

The Mann-Whitney U-test is a nonparametric test used to determine the difference between the two groups when the assumption of normal distribution does not hold. That is, a test of the null hypothesis:

\[ H_0: \text{that the two samples arise from distributions with the same mean} \]

Against the alternative hypothesis:

\[ H_1: \text{that the distribution means differ.} \]

The test statistic \( U \) is formed using ranks found from the combined data set, and is taken to be the smaller of \( U_1 \) and \( U_2 \), where

\[ U_k = n_1 x n_2 + n_k x (n_k+1) / 2 - R_k; k=1,2 \]

and \( n_k \) is the size of sample \( k \), \( R_k \) is the sum of ranks for sample \( k \). This score \( U_k \) can be interpreted as the number of times a rank score in the other sample precedes a score in sample \( k \) in the ranking. So the sample with the lowest score has, on average, smaller rank scores.

The normal approximation to this statistic, \( U=\text{Mia}(U_1,U_2) \) is

\[ t = \left( n_1 x n_2 / 2 - U \right) / \left\{ n_1 x n_2 x (n_1+n_2+1) / 12 \right\} \]

and is valid when both samples sizes are at least 5. If ties are present, then the standard error of the normal approximation (i.e. the denominator) must be calculated by:
\[ \sqrt{\left\{ \frac{n_1 \times n_2}{(N \times (N-1))} \times \left( \frac{N^3-N}{12} - \sum_k T_k \right) \right\}} \]

where \( T_k = \left( t_k^2 - t_k \right)/12 \) and \( t_k \) is the number of observations with rank \( k \).

To test the null hypothesis in each of the tests described above techniques we compute the probability value

\[ \text{Prob}>|t| = \text{Prob}(t>T) \]

If \( \text{Prob}>|t| \) is small (less than 0.05 for paired tests and less than 0.025 for two sample tests), then it is unlikely that the treatment effect you observed is due to a coincidence of random sampling. In this paper the hypothesis, \( H_0 \), is rejected at the 5% level of significance if:

- for the paired tests (sign tests and paired t-tests) \( \text{Prob}>|t| < 0.05 \);  
- for two sample tests (Mann-Whitney test and two sample t tests) \( \text{Prob}>|t|<0.025 \).

(Lind, Mason and Marchal, 2000: 300-345).