COPYRIGHT AND CITATION CONSIDERATIONS FOR THIS THESIS/ DISSERTATION

o Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

o NonCommercial — You may not use the material for commercial purposes.

o ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.

How to cite this thesis
EFFECTIVENESS OF CHIROPRACTIC TREATMENT OF CHRONIC MECHANICAL LOWER BACK PAIN IN CONJUNCTION WITH THE USE OF THE CORY KNEE CUSHION

By Bronwen Lynn King
EFFECTIVENESS OF CHIROPRACTIC TREATMENT OF CHRONIC MECHANICAL LOWER BACK PAIN IN CONJUNCTION WITH THE USE OF THE CORY KNEE CUSHION

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

by

Bronwen Lynn King
(Student number: 9528818)

Supervisor: Dr C. Yelverton
(M. Tech Chiropractic)
DECLARATION

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

Bronwen Lynn King

On this the 12th Day of SEPTEMBER 2002
ABSTRACT

This study was undertaken to evaluate the effectiveness of chiropractic treatment of chronic lower back pain in conjunction with the use of the Cory knee cushion during sleep as compared with chiropractic treatment alone. The cushion is used in an attempt to improve sleeping posture. It was proposed that both treatment protocols would be effective, but that the combined therapy would show better results.

An unblinded, controlled pilot study was conducted. Patients responding to advertisements were recruited from the general population. Thirty patients who conformed to the specified criteria and delimitations were accepted into the study and placed randomly in one of two possible treatment groups. One group received chiropractic adjustments in conjunction with the use of the Cory knee cushion during sleep, the other received chiropractic adjustments alone. Comparisons were performed by means of objective (lumbar spine range of motion) and subjective (Oswestry Pain and Disability Questionnaire, MCGil Pain Questionnaire and Visual Analogue Scale) assessments over the eight-week treatment period, with comparisons made at treatments one, four, seven, nine and ten.

The results were recorded and the data was statistically analysed using two-sample t-tests, paired t-tests, sign rank tests and Mann-Whitney tests. The results indicated that there was a generalised improvement in both of the treatment groups in terms of lumbar spine range of motion and pain relief. While group one attained a better range for rotation after the month break, this was an isolated improvement. Under the circumstances of the research, neither group showed considerably superior results over the other, as there was no statistically significant difference between the groups.

Thus, the full benefit of sleeping with a cushion between the knees in an attempt to improve sleeping posture will need additional investigation in order to be of use as an adjunct to chiropractic treatment.
DEDICATION

TO MY PARENTS

For their continual support, encouragement and love throughout my studies
for giving me roots to ground me, and wings so that I may fly
ACKNOWLEDGEMENTS

My thanks go to all who contributed to this project.
To Dr C. Yelverton for his guidance, advice and time which is greatly appreciated.
To Professor Boyd and Dr E. Senaona for their assistance with the statistics.
To Cory Gouws for allowing me to carry out research on the cushion.
And a special thanks to all the patients who volunteered and gave of their time – this would have been impossible without you.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Page</td>
<td>i</td>
</tr>
<tr>
<td>Declaration</td>
<td>ii</td>
</tr>
<tr>
<td>Abstract</td>
<td>iii</td>
</tr>
<tr>
<td>Dedication</td>
<td>iv</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>v</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>vi</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xi</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xii</td>
</tr>
<tr>
<td>List of Appendices</td>
<td>xiii</td>
</tr>
</tbody>
</table>

CHAPTER ONE
INTRODUCTION

1.1 General Introduction 1

CHAPTER TWO
LITERATURE REVIEW

2.1 Chiropractic as a Health Discipline and Science 2
  2.1.1 Chiropractic Manipulative Therapy 2
  2.1.2 Effectiveness of Chiropractic Manipulation 4

2.2 Anatomy 5
  2.2.1 The Vertebral Column 5
  2.2.2 Lumbar Spine Vertebrae 6
    i) Zygaphyseal Joints 8
  2.2.3 Intervertebral Discs 9
  2.2.4 Ligaments 10
  2.2.5 The Vertebral Canal and Spinal Cord 11
  2.2.6 Nerve Roots 12
2.2.7 The Pelvis
   i) The Sacrum
   ii) The Coccyx
   iii) The Innominates
2.2.8 The Sacroiliac Joints

2.3 Biomechanics and Kinesiology
   2.3.1 Axes and Planes of the Body
   2.3.2 Segmental Motion, Degrees of Freedom and Coupling
   2.3.3 Range of Motion of the Lumbar Spine
      i) Flexion and Extension
      ii) Lateral Flexion and Rotation
   2.3.4 Kinematics
      i) Lumbar Spine
      ii) Sacroiliac Joints
   2.3.5 Planes of Articulation
2.4 The Functional Spinal Unit and Three Joint Complex
2.5 Posterior Facet Syndrome
   2.5.1 The Articular Fixation and Compensation
   2.5.2 Motion Palpation
   2.5.3 Aetiology
   2.5.4 Pathology
   2.5.5 Presentation
2.6 Sacroiliac Joint Syndrome
   2.6.1 Aetiology
   2.6.2 Presentation
   2.6.3 Physical Examination
2.7 Posture
   2.7.1 The Cory Knee Cushion
   2.7.2 Lateral Recumbent Posture and Local Muscle Groups
### CHAPTER THREE
**METHODOLOGY**

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Introduction</td>
<td>35</td>
</tr>
<tr>
<td>3.2</td>
<td>Study Design and Protocol</td>
<td>35</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Sample and Selection</td>
<td>35</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Methodology</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>i) Lumbar spine Range of Motion</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>a) The Digital Inclinometer</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>- Flexion and Extension</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>- Lateral Flexion</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>- Rotation</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>b) Motion Palpation</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>- Palpation of lumbar vertebrae in flexion or extension</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>- Palpation of lumbar vertebrae in rotation and lateral flexion</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>- Palpation of sacroiliac joints in flexion and extension</td>
<td>39</td>
</tr>
<tr>
<td>3.2.3</td>
<td>Chiropractic Adjustments</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>i) Transvero-Brachial</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>ii) Thigh Transverso-Deltoid</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>iii) Thigh Ilio-Deltoid</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>iv) Ilio-Sacral Cross</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>v) Ischial Popliteal Deltoid</td>
<td>42</td>
</tr>
<tr>
<td>3.3</td>
<td>Statistical Analysis of Data</td>
<td>43</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Processing of Data</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>i) Processing of Objective Data</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>ii) Processing of Subjective Data</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>a) Oswestry Pain and Disability Questionnaire</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>b) McGill Pain Questionnaire</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>c) Visual Analogue Scale</td>
<td>45</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Analysis of Data</td>
<td>46</td>
</tr>
</tbody>
</table>
CHAPTER FOUR
RESULTS

4.1 Introduction 47
4.2 Data Analysis 47
4.3 Statistical Representation and Explanation of Data 50
4.3.1 Objective Data 50
   i) Lumbar Spine Range of Motion in Extension 53
   ii) Lumbar Spine Range of Motion in Flexion 55
   iii) Lumbar Spine Range of Motion in Lateral Flexion 57
   iv) Lumbar Spine Range of Motion in Rotation 59
4.3.2 Subjective Data 61
   i) Oswestry Pain and Disability Questionnaire 64
   ii) M'Gill Pain Questionnaire 66
   iii) Visual Analogue Scale 68
4.3.3 Demographic Data 70
4.3.4 Cushion Usage by Group 1 71

CHAPTER FIVE
DISCUSSION

5.1 Introduction 72
5.2 Objective Results 72
   5.2.1 Lumbar Spine Range of Motion in Extension 72
   5.2.2 Lumbar Spine Range of Motion in Flexion 72
   5.2.3 Lumbar Spine Range of Motion in Lateral Flexion 73
   5.2.4 Lumbar Spine Range of Motion in Rotation 73
5.3 Subjective Results 75
   5.3.1 Oswestry Low Back Pain and Disability Questionnaire 75
   5.3.2 M'Gill Pain Questionnaire 75
   5.3.3 Visual Analogue Scale 75
5.4 Demographic Data

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion
6.2 Recommendations

REFERENCES
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Schematic representation of the range of motion in mobilization and adjustment of a normal diarthrodial joint</td>
<td>4</td>
</tr>
<tr>
<td>2.2</td>
<td>Schematic representation of lumbar vertebrae, sacrum, nerve roots and ligamentous connections – left lateral view</td>
<td>7</td>
</tr>
<tr>
<td>2.3</td>
<td>Section of lumbar spine showing ligaments – left lateral view</td>
<td>11</td>
</tr>
<tr>
<td>2.4</td>
<td>Planes of the body in the anatomical position</td>
<td>15</td>
</tr>
<tr>
<td>2.5</td>
<td>Correct position for lower limbs during sleep, using a pillow between the knees</td>
<td>32</td>
</tr>
<tr>
<td>4.1</td>
<td>Lumbar spine extension range of motion analysis</td>
<td>53</td>
</tr>
<tr>
<td>4.2</td>
<td>Lumbar spine flexion range of motion analysis</td>
<td>55</td>
</tr>
<tr>
<td>4.3</td>
<td>Lumbar spine lateral flexion range of motion analysis</td>
<td>57</td>
</tr>
<tr>
<td>4.4</td>
<td>Lumbar spine rotation range of motion analysis</td>
<td>59</td>
</tr>
<tr>
<td>4.5</td>
<td>Oswestry Low Back Pain and Disability Questionnaire</td>
<td>64</td>
</tr>
<tr>
<td>4.6</td>
<td>M'Gill Pain Questionnaire</td>
<td>66</td>
</tr>
<tr>
<td>4.7</td>
<td>Visual Analogue Scale Analysis</td>
<td>68</td>
</tr>
<tr>
<td>4.8</td>
<td>Analysis of cushion usage</td>
<td>71</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 4.1: Test of normal distribution of variables 48
Table 4.2: Two-sample t-tests for objective measurement between groups 50
Table 4.3: Paired t-test for objective measurements 51
Table 4.4: Two-sample t-test for objective measurements 52
Table 4.5: Test of difference between groups for subjective measurements 61
Table 4.6: Sign Rank test for subjective measurements 62
Table 4.7: Non-parametric test of difference between groups 62
Table 4.8: Demographic profile 70
## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A</td>
<td>Case history</td>
<td>86</td>
</tr>
<tr>
<td>Appendix B</td>
<td>Lumbar spine regional examination</td>
<td>91</td>
</tr>
<tr>
<td>Appendix C</td>
<td>Physical examination</td>
<td>98</td>
</tr>
<tr>
<td>Appendix D</td>
<td>X-ray consent form</td>
<td>110</td>
</tr>
<tr>
<td>Appendix E</td>
<td>Subject information sheet and consent form</td>
<td>112</td>
</tr>
<tr>
<td>Appendix F</td>
<td>Record of cushion use</td>
<td>113</td>
</tr>
<tr>
<td>Appendix G</td>
<td>SOAP note</td>
<td>114</td>
</tr>
<tr>
<td>Appendix H</td>
<td>Oswestry Low Back Pain and Disability Questionnaire</td>
<td>115</td>
</tr>
<tr>
<td>Appendix I</td>
<td>McGill Pain Questionnaire</td>
<td>117</td>
</tr>
<tr>
<td>Appendix J</td>
<td>Visual Analogue Scale</td>
<td>118</td>
</tr>
<tr>
<td>Appendix K</td>
<td>Range of Motion Analysis Chart</td>
<td>119</td>
</tr>
</tbody>
</table>
CHAPTER ONE

INTRODUCTION

1.1 GENERAL INTRODUCTION

A large percentage of the population will complain of lower back pain at some stage in their lives. Although there are many causes of back pain, biomechanical dysfunction seems to account for a large proportion. According to the literature, this type of pain responds favourably to chiropractic adjustments (Gatterman, 1990).

Faulty posture has also been noted to increase the mechanical stresses placed on the spine. Poor habitual posture can cause structural changes in the spine thus leading to pain and disability. By optimising posture, stress on the spine will be decreased, as will the pain resulting from it (McKenzie, 1981). This study looks specifically at improving posture during sleep in the lateral recumbent (side-lying) position.

The purpose of this study was to investigate chiropractic treatment of chronic lower back pain by comparing two treatment groups. One group would receive chiropractic adjusive treatment alone, the other group, chiropractic treatment in conjunction with the use of the Cory knee cushion.

The patients used the cushion during sleep in the lateral recumbent posture in an attempt to improve the posture of the spine and prevent prolonged spinal rotation and stretching of the muscles caused by one leg lying in front of the other. An unblinded, controlled pilot study was used to investigate the effectiveness of the treatments.

Due to the fact that both groups would be receiving chiropractic treatment, it was anticipated that there would be an improvement to all patients in the study. The study hoped to determine whether the use of the cushion had any added benefit for the patients.
CHAPTER TWO

LITERATURE REVIEW

2.1 CHIROPRACTIC AS A HEALTH DISCIPLINE AND SCIENCE

Chiropractic science is concerned with the relationship between structure, primarily the spine, and function, primarily the nervous system, of the body as that relationship may affect the restoration and preservation of health (Schafer and Faye, 1990).

Chiropractic is that discipline within the healing arts especially concerned with the etiology, pathogenesis, diagnostics, therapeutics, and prophylaxis of functional disturbances, pathomechanical states, pain syndromes, and other neurophysiologic effects related to the statics and dynamics of the neuromusculoskeletal system, particularly those related to the spine and pelvis (Schafer and Faye, 1990).

The chiropractic model is a patient-centred, hands-on approach intent on influencing function through structure. Chiropractic investigates the relationship between structure (primarily of the spine) and function (primarily of the nervous system) of the human body that leads to the restoration and preservation of health. The chiropractic adjustment is the primary therapeutic modality offered by chiropractors. Because the adjustment results in a specific mechanical response in the spine, the understanding of spinal biomechanics is necessary before diagnosing and adjusting can be performed (Haldeman, 1992).

2.1.1 Chiropractic Manipulative Therapy

According to Gatterman (1990), the chiropractic manipulation (adjustment) utilizes specific short levers to which a high-velocity thrust of controlled amplitude is directed, with the aim of restoring mobility to individual articulations.
By using short-lever techniques, the adjustment can be applied specifically to the isolated joint. Long-lever techniques are avoided in order to avoid adjusting hypermobile segments – overflexible links in a series of articulated bodies - of the spine, which may add to irritation and instability (Gatterman, 1990).

While contact and force is exerted on the vertebrae, it is the intervertebral joints that are adjusted and not the actual vertebrae. The upper vertebra is considered to be the mobile one in relation to the lower one that is taken as a point of reference (Sandoz, 1976).

Sandoz, (1976) describes the adjustment as a passive, manual manoeuvre during which an articular element is suddenly carried beyond the usual, physiological limit of movement without however exceeding the boundaries of anatomical integrity (figure 2.1). The thrust is a sudden, manual application of a controlled directional force delivered at the end of normal passive range of motion.

Thus, passive movement takes the joint slightly further than active movement. At the end of this physiological range, a resistance is felt which is the elastic barrier of resistance. Moving beyond this barrier into the paraphysiological zone, the range is slightly greater and a crack will be heard. At the end of this zone is the limit of anatomical integrity. Movement beyond this moves into the pathological zone and will result in ligament damage, sprains, capsular rupture and surgical subluxations (partial or incomplete dislocation) (Sandoz, 1976).

The cracking noise is known as cavitation and occurs due to energy being released when the articular surfaces are separated beyond the limit of soft tissue invagination and dissolved synovial gases are released. The joint surfaces are then maximally separated. The gas will re-dissolve, and the capsule returns to its original length. This takes approximately 15-20 minutes, which is known as the refractory period during which a second crack cannot be elicited (Sandoz, 1976).
2.1.2 Effectiveness of Chiropractic Manipulation

Patients treated with chiropractic manipulative therapy in trials have generally had more immediate response to pain relief than other forms of conservative therapy. This is especially true for lower back pain sufferers, who have also shown improvement in objective measures (Haldeman, 1992).

Patients with lower back pain who have undergone chiropractic manipulation have shown improvement in variables such as range of motion, decrease in pain and improved functional levels, and improved response to clinical tests such as straight leg raising (Herzog, 2000).
Extensive studies have been carried out on lower back pain sufferers treated by chiropractic manipulation, and on a whole the results are positive, showing better results than other forms of treatment. In a study comparing chiropractic manipulation to hospital outpatient treatment using Maitland-type mobilization or manipulation for lower back pain, a statistically significant benefit was found for the patients treated with chiropractic manipulation (Meade, Dyer, Brown, 1990). Patients have shown accelerated recovery from both acute and chronic uncomplicated lower back pain, but recurrence does not seem to be prevented (Herzog, 2000).

In a study of patients with chronic unilateral sacroiliac pain and tenderness, there was a significant reduction in pain and disability following treatment using a series of four to eight chiropractic manipulations (Herzog, 2000).

Lower back pain is a costly problem resulting in injury and illness claims from work. Workmen's compensation studies have shown workers returning to work in a shorter period of time when treated by a chiropractor. The result is more productivity from workers and fewer sick days, thus chiropractic is a cost effective and safe approach to the management of mechanical spinal related disorders (Chiropractic Association, 1999).

2.2 ANATOMY

Knowledge of lumbar spine and bony pelvic anatomy is essential to the understanding of mechanical pain originating in these areas, as well as its treatment with chiropractic therapy.

2.2.1 The Vertebral Column

The vertebral column or spine consists of thirty-three vertebrae that articulate with each other at anterior and posterior joints. It extends inferiorly from the base of the
skull to its connection with the pelvis where it transmits loads to the lower limbs. It provides a strong yet flexible axis with roles in posture, support, movement and protection. The vertebrae constitute about three quarters of the spine and the intervertebral discs the remaining quarter (Moore, 1992).

The vertebrae are divided into cervical, thoracic, lumbar, sacral and coccygeal regions. The sacral vertebrae are fused, as are those of the coccyx. The upright adult exhibits a balanced posture based on the physiological curves, convex anteriorly in the cervical and lumbar regions and convex posteriorly in the thoracic and sacral regions (Gatterman, 1990). These physiological curves develop in order for the human to stand erect and maintain a balanced posture. The postural muscles then strengthen to maintain the curvatures. Due to an injury, a loss of curvature may occur when there is muscle spasm in the area (Gatterman, 1990).

2.2.2 Lumbar Spine Vertebrae

Due to the enhanced weight bearing function of the lumbar spine, it comprises the five largest vertebrae in the body and it forms 25% of the total spinal length. The vertebral body, located anteriorly, is kidney shaped. Posteriorly, the vertebral (neural) arch encloses the oval to triangular vertebral foramen. The arch is formed by two pedicles, which project posteriorly from the body, meeting two laminae, which then meet posteriorly to form the spinous process. When the vertebrae are articulated, an intervertebral foramen is formed between the superior and inferior notches of the pedicles of adjacent vertebrae (Moore, 1992). Figure 2.2 shows the relationships of the lumbar spine structures.
Figure 2.2: Schematic representation of lumbar vertebrae, sacrum, nerve roots and ligamentous connections – left lateral view (Netter, 1997).
Each vertebral arch has a number of processes that act as levers, guides and restraints to different types of movements. Each arch has two transverse processes and one spinous process to which muscles and ligaments attach. Two superior articular processes project upward from the arch and two inferior articular processes project downwards. The articular facets on these processes form zygapophyseal joints that act like guide rails for movement (Twomey and Taylor, 1994).

Lumbar vertebrae have strong pedicles and lamina and short, broad, quadrilateral-shaped spinous processes that project nearly straight posteriorly. The transverse processes arise at the pedicle-lamina junction and project laterally and slightly posteriorly (Coetzee, 1987; Tortora, 2002). Mamillary processes (rounded tubercles) are located on the superior articular process for muscle attachments and are a distinguishing feature of the region (Schafer and Faye, 1990).

The end plates of the vertebrae are the slightly concave superior and inferior surfaces. These articulating surfaces of the vertebral bodies are covered by hyaline cartilage (Jayson, 1992).

i) Zygaphyseal Joints
There are five pairs of zygapophyseal (facet) joints in the lumbar spine. They are characterised as plane diarthrodial (freely moveable) joints (Williams and Warwick, 1980; Tortora, 2002). A superior and an inferior articular process arise from the junction of the pedicle and lamina of each vertebra. They have facets, covered with hyaline cartilage, for articulation with the adjacent vertebra (Moore, 1992).

These joints, unlike the discs, are not designed to bear weight, but rather guide and restrict movement. A loose, fibro-elastic articular capsule surrounds each joint and attaches to the articular margin. Within this, the synovial membrane produces synovial fluid to lubricate the joint (Moore, 1992).
The zygapophyseal joints also contain meniscoids. These act as space fillers, increase the surface area and help to transfer loads and allow movement, and cover exposed articular surfaces to help protect the surfaces (Jones, 1989; Tortora, 2002).

Innervation of the joint capsule and adjacent soft tissues is by twigs from the medial branch of the posterior primary rami, with each facet receiving innervation from two spinal levels (Jones, 1989).

2.2.3 Intervertebral Discs

A fibrocartilaginous disc connects adjacent vertebral bodies. The intervertebral discs are thickest in the lumbar region due to their weight bearing role, as well as the increased need for shock absorption. Lumbar intervertebral discs are wedge-shaped, being thickest anteriorly which contributes towards the lordotic curve. The discs provide strong attachment between the vertebrae, while at the same time separating them (Moore, 1992).

The outer layers of the disc, known as the annulus fibrosus, are composed of concentric rings of fibrocartilage. The rings lie in alternating directions helping to increase their strength and accommodate movement. The outer Sharpey’s fibres attach to the periphery of the vertebral bodies. The inner portion of the disc is the nucleus pulposus, a semifluid mucopolysaccharide gel with a strong hydrophilic capacity, especially in the young. With age, this is gradually replaced by fibrocartilage and has lower water content and thus it resembles the annulus fibrosus (Bogduk, 1999). The elastic properties of the young healthy disc, as well as the ability of the nucleus to shift positions, allows movement of one vertebra on another (M¢Kenzie, 1981). The dehydration and degeneration of the disc account in part for a loss of height and decreased movement seen in the aged (Moore, 1992).
2.2.4 Ligaments

A broad, strong fibrous band known as the anterior longitudinal ligament covers the anterior aspects of the vertebral bodies and discs from the occiput to the sacrum. Its fibres are firmly fixed to the disc and vertebral body periosteum. It aids stability between vertebrae and prevents hyperextension of the spine (Moore, 1992).

A similar band, the posterior longitudinal ligament, runs over the posterior aspect of the bodies from the second cervical vertebra to the sacrum. This ligament lies inside the vertebral canal and is weaker and narrower than the anterior ligament. It attaches to the discs and posterior edges of the bodies and helps prevent hyperflexion of the spine, but to a lesser degree than the anterior ligament in preventing extension (Hutcheson, 1997). This ligament is widest opposite the discs and narrow opposite the vertebral bodies thus helping to prevent posterior disc protrusion (Twomey and Taylor, 1994).

Adjacent laminae are connected by ligamentum flava. These help preserve curvature and straighten the spine after flexion. Figure 2.3 shows the interspinous, intertransverse and supraspinous ligaments, which also aid vertebral connections (Moore, 1992).
Figure 2.3: Section of lumbar spine showing ligaments – left lateral view (Netter, 1997).

2.2.5 The Vertebral Canal and Spinal Cord

The vertebral (spinal) canal is formed by the succession of vertebral foramina in an articulated vertebral column. It is larger in the lumbar spine than in the thoracic spine, but smaller than in the cervical spine. This is due to enlargements in the cervical and lumbosacral regions of the spinal cord for innervation of the limbs. The vertebral canal contains the spinal cord and the spinal meninges - its protective membranes - as well as nerve roots and blood vessels embedded in loose connective and fatty tissue. Thus the vertebrae, ligaments, muscles, meninges and cerebrospinal fluid protect the spinal cord (Moore, 1992).
The spinal cord begins as a continuation of the medulla oblongata, the inferior part of the brain stem, and it extends to the second lumbar vertebra. It tapers to a point here known as the conus medullaris, and continues only as a thin fibrous strand, the filum terminale, that lies among the nerve rootlets. Because the spinal cord is shorter than the vertebral column, the nerve roots have to be longer to reach their respective intervertebral foramina, and they are collectively known as the cauda equina. (Moore, 1992).

2.2.6 Nerve Roots

There are thirty-one pairs of spinal nerves that attach to the spinal cord by dorsal and ventral roots. The ventral roots contain efferent or motor fibres that are distributed to muscles and glands. The dorsal roots contain afferent or sensory fibres that convey sensation from sensory nerve endings. The roots unite just outside each intervertebral foramen to form a spinal nerve, which then branches into a ventral and dorsal primary ramus (Moore, 1992).

There are about twice as many sensory fibres than motor fibres in the lumbar roots. When the anterior root is irritated, pain is felt in the peripheral distribution of the fibres affected. When the posterior root is irritated, the pain can be perceived to be in the dermatome (area of skin innervated by a single nerve root), myotome (group of muscles innervated by a single nerve root), sclerotome (area of bone or fascia innervated by a single nerve root), or possibly the viscerotome (organs innervated by a single nerve root) (Schafer and Faye, 1990).

2.2.7 The Pelvis

The bony pelvis is a basin-shaped structure. It is composed of four bones – the sacrum and coccyx posteriorly and the two innominates anteriorly and laterally. The bones unite at four joints – two sacroiliac and the sacroccocygeal posteriorly, and the
pubic symphysis anteriorly. Numerous ligaments unite the bones of the pelvis (Hutcheson, 1997).

i) The Sacrum
The sacrum, a large triangular bone with its broad base directed upward and forward, forms the posterior wall of the pelvis and supports the vertebral column. The five sacral vertebrae unite from the mid-teen years to form the sacrum (Tortora, 2002; Coetzee, 1987). Superiorly it articulates with the fifth lumbar vertebra by means of the lumbosacral intervertebral disc and forms the lumbosacral angle. Inferiorly it articulates with the coccyx (Moore, 1992). The lateral portion of the superior surface is known as the sacral ala (wing), which is formed by the fusion of the first sacral vertebrae transverse processes. The alae articulate with the ilia of the innominates to form the sacroiliac joints (Tortora, 2002).

The border of the base projects anteriorly and is known as the sacral promontory, which is the apex of the sacrovertebral angle. Posterior to this lies the opening of the sacral canal, which is a continuation of the vertebral canal. The dorsal surface is convex, with a median sacral crest representing the fused sacral spines. The spine and lamina of the fifth sacral segment are absent, thus a gap – the sacral hiatus – is formed and bound by projections called the sacral cornua. Passage for blood vessels and nerves is allowed via the four sacral foramina that penetrate the sacrum (Coetzee, 1987; Tortora, 2002). The sacrum provides strength, stability and transmission of weight through the pelvis (Moore, 1992).

ii) The Coccyx
The coccyx is triangular in shape and formed by the fusion of vertebrae – usually four, but three to five may be present. It forms a small triangular shape and articulates with the sacrum, but plays no role in support (Tortora, 2002; Coetzee, 1987).
iii) The Innominates

The innominates are formed by a fusion of three bones namely ilium, ischium and pubis. They fuse at the acetabulum, which is the receptacle for the head of the femur (Moore, 1992).

2.2.8 The Sacroiliac Joints

These strong joints have an auricular or C-shape at an oblique orientation to the sagittal plane, with the convexity facing anteriorly and slightly inferiorly. There is wide variation in the joint from individual to individual and even from side to side in the same individual with respect to size, shape and contour. Loads are transmitted from the trunk to the lower extremities through these joints (Bernard and Cassidy, 1991).

Two articulations are found, one opposite the first sacral segment and one opposite sacral segments two and three. The upper joint is more influenced by body weight and the lower one by forces through the lower limb. The iliac side of the joint develops a convexity, while on the sacral side a corresponding concavity forms. By puberty, elevations and depressions develop that aid stability and limit motion to some degree, but because the sides are not always reciprocal, stability is gained mainly through ligamentous support (Schafer and Faye, 1990).

2.3 BIOMECHANICS AND KINESIOLOGY

Biomechanics is the application of mechanical laws to biological tissues while kinesiology refers to the study of movement (Gatterman, 1990). In order to understand the mechanisms, diagnosis and treatment of the mechanical spinal conditions presented here, an understanding of some basic principles and terminology is necessary.
2.3.1 Axes and Planes of the Body

Axes and planes are described with the body in the anatomical position. Motions of the vertebrae are described based on a three-dimensional, rectangular coordinate system - the orthogonal system - using the X-, Y- and Z-axes (Gatterman, 1990). Interaction of the perpendicular axes determines planes as illustrated in figure 2.4. The sagittal plane is formed by the Y- and Z-axes, dividing the body into left and right sections. The frontal (coronal) plane is formed by the X- and Y-axes, dividing the body into anterior and posterior portions. The horizontal (transverse) plane is formed by the X- and Z-axes, dividing the body into superior and inferior sections (Greenstein, 1997).

![Diagram of planes of the body](image)

**Figure 2.4:** Planes of the body in the anatomical position (Greenstein, 1997).
2.3.2 Segmental Motion, Degrees of Freedom and Coupling

Any motion that occurs in an anatomic joint can be described by motion around or along a plane (Greenstein, 1997). Whole body or segmental motion can be described, where the superior vertebra is taken as being mobile relative to the lower fixed one (Gatterman, 1990).

Six degrees of freedom are possible for a typical motion segment, as there is potential for translation along and rotation around the three perpendicular axes. The six degrees are possible due to the intervertebral disc that separates the vertebral bodies (Gatterman, 1990).

Motions of the spine are typically described individually for simplicity, but due to the anatomical structure of the joints, coupling of more than one degree of freedom occurs. Thus rotation or translation about one axis is consistently associated with rotation or translation about another axis. The motion in the direction of the external load is termed the main motion and the accompanying motions are termed coupled (Jayson, 1992).

2.3.3 Range of Motion of the Lumbar Spine

i) Flexion and Extension
The maximum range of motion for flexion is 40-60°, while extension is limited to 20-35°. Most of the motion occurs in the lower segments of the lumbar spine (Magee, 1997). Flexion and extension occur accompanied by pelvic rotation, allowing flexion at the waist to total 90°. Therefore, after lumbar spine flexion has occurred, pelvic rotation at the sacroiliac and hip joints occurs to achieve the remaining 30° (Greenstein, 1997).
ii) Lateral Flexion and Rotation

The total lumbar spine lateral flexion is 15-20°. Axial rotation is 3-18°, being accomplished by a shearing movement of the vertebrae on each other (Magee, 1997). While the thoracic and lumbosacral levels show significant amounts of rotation, facet orientation at the other lumbar spine levels restricts movement. Rotation is coupled with lateral flexion and the vertebral bodies rotate towards the convexity of the curve (Hourigan and Basset, 1989).

2.3.4 Kinematics

Normal vertebral motion segment movement is dependant upon a healthy intervertebral disc (Gatterman, 1990). The primary determinants of gross lumbar motion are the sum of the individual intervertebral disc resistance to distortion, the thickness of the discs, and the angle and size of the articular surfaces (Schafer and Faye, 1990).

i) Lumbar Spine

The lumbar vertebrae are required to provide stability in load bearing and a wide range of mobility. While each segment has only a limited range of motion allowing the spine to remain stable, the five lumbar segments together provide large ranges of movement (Twomey and Taylor, 1994).

The large lumbar spine range of motion is proportionate to the thickness of the intervertebral discs, so that with disc degeneration, a significant amount of motion may be lost (Gatterman, 1990).

The lumbar spine is placed under great mechanical demands due to the large superimposed body weight, which interacts with additional forces generated by lifting and other activities involving powerful forces. This is especially true for the area of
lumbar vertebra four on five and lumbar vertebra five on the first sacral segment, which bear the highest loads and undergo the most motion (Jayson, 1992).

ii) Sacroiliac Joints

Sacroiliac motion is slight and affected by age, sex and joint space configuration (Gatterman, 1990). The double articulation allows for sliding of the sacrum antero-inferiorly or postero-superiorly as well as rotation (sacral nutation) (Schafer and Faye, 1990). Nutation refers to forward flexion of the sacrum within the ilia and occurs about the X-axis, and counternutation refers to an extension movement. Sacroiliac motion in reference to sacral nutation has been estimated at between 0-4° (Porterfield and DeRosa, 1991).

The articulations act as a unit, so when one rotates, so does the other, but in the opposite direction. When one joint becomes fixated, that is, there is a loss of segmental mobility of the joint in a position of motion, the other joint is forced to pivot in an arc on the newly formed abnormal axis. During motion, reciprocal movement is seen between the sacrum and ilium on the ipsilateral side to the lower limb in motion (Schafer and Faye, 1990).

Sacroiliac motion is directly influenced by force and motion from the hip and trunk. When the trunk is flexed forward, the sacral base pivots anteriorly and inferiorly, and the apex moves posteriorly and superiorly. Simultaneously, the posterior superior iliac spines of the ilia move posteriorly and inferiorly, thus the space between the ilia is decreased while the space between the ischia is increased. This allows for a wider base of support during sitting than when standing (Schafer and Faye, 1990).

2.3.5 Planes of Articulation

The superior facets in the lumbar spine face posteromedially and are slightly concave. The inferior facets face anterolaterally and are slightly convex. Generally speaking,
they can be said to be facing at 90° to the transverse plane and at 45° to the frontal plane, although they face more sagitally in the upper lumbar spine and more coronally in the lower segments. The orientation of the facets dictates movement of the region (Gatterman, 1990). They also help prevent anterior movement of one vertebra on another (Moore, 1992).

2.4 THE FUNCTIONAL SPINAL UNIT AND THREE JOINT COMPLEX

The functional spinal unit or motion segment is the smallest structure of the spine that contains all spinal components, namely two adjacent vertebrae, the two posterior joints, the intervertebral disc, muscle, ligaments, neural and vascular elements, and connective tissues. All these tissues work together as a unit to transfer loads through the spine (Porterfield and DeRosa, 1991).

A central factor to the understanding of mechanical lower back pain is the three joint complex. This comprises the two posterior facet joints and the intervertebral disc. Any factor influencing one of these structures will have an effect on its function and on that of the other two. An influential fourth component often included in the complex is the muscles crossing the functional spinal unit (Kirkaldy-Willis and Mierau, 1995).

The functional spinal unit concept stresses the importance of the interdependence of the articulations. Pathology will therefore affect the entire unit. Disc pathology for example will affect kinematics above and below that level, leading to asymmetrical movements and loads, and predisposing the spine to degeneration. No pathological process whether congenital or acquired, can exist which does not affect the function of the other aspects of the functional spinal unit (Porterfield and DeRosa, 1991).

Even though the structure of a component may initially be normal, dysfunction can severely affect it. Dysfunction implies that at one anatomical level, the three
components of the joint are not functioning normally or optimally. Over time, structural changes may occur leading to instability and then stabilisation. Rotational and compressive strains may cause injury to the complex, usually affecting the facet joints and the disc or vertebral end plate respectively. Unguarded motion to the extremes of range can lead to locking of the facets, which may later lead to degenerative changes in both facet and disc (Kirkaldy-Willis and Mierau, 1995).

Three phases of degeneration have been identified for the motion segment. Phase I is the phase of dysfunction, which usually starts with a trauma or uncoordinated muscle contraction or unusual activity which compromises normal function. The pathological changes here are relatively minor and usually reversible. There is joint fixation or hypomobility and normal movement is restricted in one or other direction. The paraspinal muscles are seen to be in a state of hypertonic contraction to try and protect the joint by limiting movement. This leads to ischaemia, altered muscle metabolism with metabolite accumulation and further aggravation, resulting in splinting of the joint. Injury to the posterior joint synovium leads to synovitis, which may persist with the formation of a synovial fold that projects into the joint between the cartilage surfaces. The result is pain and the typical symptoms of facet dysfunction (Kirkaldy-Willis and Burton, 1992).

Phase II is the unstable phase. There is increased abnormal movement, along with capsular and ligamentous laxity, and anatomical changes such as cartilage degeneration and decreased disc height. Aberrant segmental motion and loading patterns cause early stage osteophyte and traction spur development at the margins of the vertebral body (Kirkaldy-Willis and Burton, 1992).

Phase III is the phase of stabilisation. Here, an advancement of degeneration leads to osteophyte development and fibrosis. The joint becomes grossly degenerated with almost complete loss of articular cartilage and bulbous facets. The changes produce a stable segment with much reduced movement (Kirkaldy-Willis and Burton, 1992).
2.5 POSTERIOR FACET SYNDROME

Facet syndrome describes dysfunction of the posterior facet joints and the facets override in extension (Gatterman, 1990). Depending on applied loads and the direction of force, injury can occur to various extents and causes a painful restriction of motion (Yang and King, 1984). Thus in a facet syndrome, there is pain or dysfunction of the posterior facet joints and their adjacent soft tissues (Panzer, 1995).

Although the posterior elements of the lumbar spine collectively constitute over half the mass of the lumbar spine, their role in causation of lower back pain syndromes has often been overshadowed by disc disorders. However, prompted by a failure of disc-related surgery to effectively deal with the problem of back pain, there has been an increased interest in lower back pain caused by disorders of the posterior elements of the spine (Bogduk, 1988).

While loads on the lumbar spine are usually borne largely by the body-disc-body anteriorly and only partially by the articular facets posteriorly, in the case of dysfunction, or similarly with degenerative disc disease, more weight is placed on the facets (Cox, 1985). Under optimal conditions, the facet joints help to distribute loads over a broader area and to limit excessive motion and thereby protect the intervertebral disc. With lumbar spine extension, contact of the inferior articular process on the lamina below normally limits movement. When an excessive force is applied however, the segment rotates around the articular process, drawing the contralateral articular process backwards. This causes increased loads on the bony structures, as well as stretching of the joint capsule, which results in pain (Yang and King, 1984).

Pain arising from the posterior elements of the spine seems to be relatively common and all three aspects of the previously discussed three-joint complex need to be
considered. Pain occurs mainly due to stretching of the articular capsules, or due to bone-on-bone contact, which causes periosteal pain (Plaugher, 1993).

The entrapment of menisci between the articular surfaces has also been implicated as a cause of the back pain. This explains why the distraction of the surfaces releases the entrapment and allows resolution of subsequent muscle spasm (Jones, 1989).

The facet joints between the fifth lumbar and first sacral segment are common site of problems in the vertebral column. Some factors contributing to this are the fact that they bear more weight, the centre of gravity passes through these vertebrae, a transition occurs here between the mobile pre-sacral vertebrae and the relatively stable pelvic girdle, and there is also a significant angulation between the lumbar vertebrae and the sacrum (Cox, 1985).

2.5.1 The Articular Fixation and Compensation

Schafer and Faye (1990) state that for an articulation to remain in an abnormal state of ‘subluxation,’ something must be holding it there to restrict its mobility — otherwise it would spontaneously reduce itself and produce little clinical concern. This ‘holding’ or ‘mobility hindrance’ mechanism is commonly called a ‘fixation’. Thus there is a loss of segmental mobility within its normal physiologic range of motion (Schafer and Faye, 1990). A fixation has also been defined as “a state whereby a vertebra or pelvic bone has become temporarily immobilised in a position that it may normally occupy during any phase of physiological spinal movement” (Gatterman, 1990).

Compensatory excessive motion occurs in at least one other articulation whenever an articulation is deprived of carrying out its normal motion. This additional role leads to irritation and subsequent inflammation once its homeostatic reserves are surpassed (Schafer and Faye, 1990).
2.5.2 Motion Palpation

Motion palpation is used in order to determine which joints are fixated. During motion palpation it must be remembered that each vertebra has six degrees of freedom. These are utilized in daily motions and are often coupled movements. A healthy joint can be moved through its planes of motion without causing pain (Schafer and Faye, 1990).

Static methods of palpation are commonly used to reveal information about tissue texture, inflammation, static alignment, muscle spasm and vascular function. Chiropractic therapy is however a dynamic process that deals with joints that lack motion to their full degree. It was for this reason that motion techniques were developed. Thus the levels of the joints that are fixated and the direction in which they fail to function can be palpated. The line of drive for the adjustive thrust can be determined, and is usually directed into the resistance (Haldeman, 1992).

An initial scan of the entire spine is usually performed first to locate those areas that need a more specific analysis. During motion palpation, the examiner guides that patient through the ranges of motion while feeling for resistance to motion (Schafer and Faye, 1990). The examiner notes interssegmental range of motion as well as end-feel (Plaugher, 1993). Gatterman (1990) defines end-feel as discrete, short-range movements of a joint, independent of the action of voluntary muscles, determined by springing each vertebra at the limit of its passive range of motion. The patient will often report pain when the restricted segments are moved towards the end range of motion, and they may resist motion. This alone is not however a base for adjustment as compensatory mechanisms must be considered (Plaugher, 1993).
2.5.3 Aetiology

Aetiological factors include trauma, degeneration, and faulty posture. Trauma affecting the posterior facet articulations of the lower back may result from hyperflexion of the lumbar spine. Inflammation of the vertebral joint capsule results, giving rise to increased intra-articular pressure and subsequent acute pain (Gatterman, 1990).

Postural changes with an increased angulation of the sacral base and increased lumbar lordosis result in posterior displacement of the centre of gravity. This can result from causes such as chronic occupational strain and obesity (Banks, 1997). The increased sacral base angle with a resultant hyperlordosis places additional compressive and shearing stresses on the posterior joints, which are not designed to withstand this (Hourigan and Basset, 1989). These biomechanical changes forcing the facet joints to become more weight bearing predispose to facet syndrome (Banks, 1997).

Extension and rotation can result in impingement of synovial folds or menisci between the facet joints. This initial pain causes a reflex multifidus muscle spasm, which can cause facet joint fixation in this position. The multifidus muscle is a deep-seated rotator muscle of the lumbar spine. It is involuntarily controlled and mainly a postural muscle. With a lumbar spine injury, a compensatory reflex multifidus muscle spasm occurs. This is often a sustained contraction, which results in joint sprain and damage. Once the lesion is initiated, each strong contraction thereafter causes further joint damage (Banks, 1997).

2.5.4 Pathology

Degenerative or pathological changes may effect spinal kinematics above and below that level which in turn leads to asymmetrical movements and loading at the lumbar facet joints. Excessive or asymmetrical loading patterns to the articulations results in functional changes that are typically followed by structural adaptations. The facet
response to abnormal loading and direct injury may be cartilage degeneration, facet atrophy, and if excessive forces are maintained over a long period, bony adaptation in the form of sclerosis or osteophyte formation (Twomey and Taylor, 1994).

2.5.5 Presentation

Patients suffering with posterior facet syndrome usually present in the phase of dysfunction (discussed under 2.3). Although presentation is varied, it usually occurs after an activity that is unusual for that patient, after a strain, or as a recurrence of pain from a minor trauma (Kirkaldy-Willis and Burton, 1992).

Facet syndrome can present with isolated, localised back pain, or there may be pain into one or both legs, which is not along a specific dermatomal distribution. This is referred pain (pain presenting in an area other than that which produces it), and not radicular pain (sharp pain radiating along a specific nerve distribution) (Banks, 1997).

Findings in facet syndrome tend to be non-specific and varied depending on which facets are involved. Although there is no specific pain pattern in all patients, perceived pain is often felt in one or more of the typical referred sites (Mooney, 1996). There is usually some pain located over the joint, presenting as an ache or sometimes a sharp pain that improves in the morning after rest and becomes worse after prolonged weight bearing. Pain may refer to the ipsilateral iliac crest or buttock, groin, scrotum or labium occasionally, or to the thigh (posteriorly or laterally) — usually not below the knee. No conclusive neurological signs are present, thus normal reflexes (+2) are seen, and sensory and motor signs are negative (Schafer and Faye, 1990). The pain may cause a hamstring spasm and thus straight leg raising ability would be reduced (Mooney, 1996).

Sustained postures may aggravate the pain and temporary relief may be felt with movement. However, hyperextension of the back increases the pain whereas rest and
flexion reduce it. Other activities which may increase the pain include sleeping on the abdomen, sitting in an upright position, lifting a load in front of the body at or above the waistline, working with the hands and arms above the head, and arising from sitting. When acute, sneezing and coughing may accentuate the pain, although this is generally a more common finding from disc pathology (Gatterman, 1990).

The patient may report a "catch" with particular movements causing an aggravation of the pain. There is tenderness to palpation over the lumbosacral junction, and muscle contraction on one side, especially over the multifidus and paraspinal muscles. Movement restriction due to hypomobility is seen. Lateral flexion to one side is restricted more than to the other and extension is usually painful. The absence of nerve root tension signs help distinguish a posterior facet syndrome from a nerve root entrapment lesion (Kirkaldy-Willis and Burton, 1992).

2.6 SACROILIAC JOINT SYNDROME

Mechanical irritation of the sacroiliac joint results in a collection of symptoms and signs known as sacroiliac syndrome (Kirkaldy-Willis and Hill, 1979). The main pathology has been implicated as being the altered mobility or dysfunction of the sacroiliac joint so that there is either too much motion (hypermobility) or too little motion (hypomobility/fixation). This has been a controversial topic however, because it is difficult to measure sacroiliac motion, and the biomechanics of the joint are poorly understood (Haldeman, 1992).

The sacroiliac joint has been recognised as a synovial joint and is thus a moving, weight-bearing joint, which is subject to the same inflammatory, infectious and dysfunctional conditions affecting other synovial joints. As such, it is susceptible to fixation within its range of motion (Panzer and Gatterman, 1996). It is more susceptible to axial compression and torsion created for example by forward bending,
lifting and twisting than are the lumbar spine motion segments (Bernard and Cassidy, 1991).

There may be locking/fixation of the sacroiliac joint alone, or there may be hypermobility of the adjacent articulations as compensation for the lack of movement. The increased demands on the adjacent articulations may cause pain and irritation there, thus pain is not necessarily an indicator of the site of joint fixation, as it may be the contralateral joint that is fixated. It is also important to note whether the superior or inferior joint surface is involved (Gatterman, 1990).

Stiffness of the sacroiliac joints is not clinically important unless there is associated ‘locking’ in some position beyond or at the end of their physiological range, thus giving rise to sustained ligamentous stress (Paris, 1997).

Branches from the second lumbar to third sacral dorsal rami provide the innervation to the sacroiliac joints. Pain may therefore be referred through any of these dermatomal or sclerotomal areas and mimic other pain patterns. Because there are also many nerves running close to the joints, they may become involved in the pathological process and pain may be referred down the lower extremities and even cause motor deficits (Gatterman, 1990).

2.6.1 Aetiology

Several processes may damage the joint and these are usually determined in the history. Typically there has been a direct blow, a fall or lifting injury accompanied by a torsional stress that leads to joint locking at the extreme of motion. Females seem to be more vulnerable to fixation, firstly because of the different structure of the pelvis being shorter and wider than in the male, and also due to hormonal influences (Panzer and Gatterman, 1996). Laxity of the pelvic ligaments typically occurs during
pregnancy under the influence of the hormone relaxin, as well as being influenced by oestrogen before menstruation (Moore, 1992).

2.6.2 Presentation

Dysfunction in the sacroiliac joint can cause localised pain in the region of the joint and referred pain into the extremity, thus mimicking other causes of lower back pain. The pain is typically unilateral and described as a dull ache. It may be referred over the buttocks, down the thigh posteriorly or to the groin and anterior thigh. Occasionally, pain may be felt below the knee. Sitting and bending aggravate pain, while standing or walking frequently alleviates the pain (Bernard and Cassidy, 1991). The patient may occasionally report paraesthesia or subjective decreased light touch sensation, but temperature, pain and position sense is maintained. Loss of muscle power is usually due to pain and not neurological deficit unless an associated piriformis syndrome occurs (Haldeman, 1992). On supine examination, a patient with piriformis syndrome will have external rotation of the thigh on the affected side, which is a positive piriformis sign. They typically complain of a deep, boring-type buttock pain which radiates to the thigh and often affects sleep quality (Gatterman, 1990).

A hypermobile sacroiliac joint may cause ipsilateral hip pain due to contraction of the piriformis muscle, as this attaches onto the sacrum and ilium (Panzer and Gatterman, 1996).

2.6.3 Physical Examination

On examination, the patient may present with a slight limp as bearing weight on the affected side may cause pain (Robinson, Herzog and Nigg, 1987). Pain will frequently be reported at a certain phase in the gait cycle (Banks, 1997). The posterior superior iliac spines are frequently asymmetrical in position due to fixation
of one side, and one leg may appear shorter on supine examination (Gatterman, 1990).

Tenderness is noted over the posterior superior iliac spine and along the joint line as well as over the posterior sacroiliac ligaments. Accompanying lumbar spine dysfunction results in decreased range of motion and tenderness. Associated muscle spasms are common, with trigger points commonly found in the gluteal, piriformis and paraspinal muscle groups. Hamstring hypertonicity is also commonly found (Haldeman, 1992).

When lumbosacral spine range of motion is performed, flexion and extension may elicit sacroiliac joint pain, but lateral flexion does not usually cause pain unless there is an associated posterior facet syndrome (Bernard and Cassidy, 1991).

As there is no direct method of isolating the joint during examination, provocative manoeuvres are selected (Bernard and Cassidy, 1991). In determining sacroiliac involvement the joints are stressed, which elicits pain if there is a sacroiliac syndrome. These tests can however also cause pain if there is hip joint or lumbar pathology and therefore these should be ruled out before the results are interpreted (Haldeman, 1992). Positive tests are thus only significant in conjunction with the clinical history and remaining physical findings, and other syndromes being ruled out (Bernard and Cassidy, 1991).

Sacroiliac joint involvement can be identified using the following tests:

i) Pelvic compression in side lying, prone and supine postures can provoke pain in an irritated or inflamed joint (Panzer and Gatterman, 1996);

ii) Patrick Faber test stresses the hip and sacroiliac joint by flexion, abduction and external rotation of the hip. A positive test is indicated with the test leg remaining above the opposite leg, as well as by pain, usually localised to the ipsilateral sacroiliac joint (Panzer and Gatterman, 1996);
iii) Gaenslen's test stresses both the sacroiliac joints simultaneously by counter-rotation at the extreme range of motion. Pain in the sacroiliac joint is a positive test (Bernard and Cassidy, 1991);

iv) Yeoman's (Erichsen's) test stresses the joint by extending the hip and rotating the ilium. Positive findings result in pain under the examiner's hand that applies pressure to the sacroiliac joint (Bernard and Cassidy, 1991);

v) Straight leg raise (Laségues' sign) usually tests sciatic nerve irritation by flexing the hip until the patient complains of pain. Pain from the stretched sciatic nerve extends from the back down into the leg along the sciatic nerve, but this test can indicate sacroiliac involvement if pain is localised to the joint between 70° and 90° of flexion (Panzer and Gatterman, 1996).

Palpation of the joints using joint play can identify mobility or lack thereof (dysfunction). Joint play is defined as discreet, short-range movements of a joint, independent of the action of the voluntary muscles, determined by springing each vertebrae in the neutral position (Gatterman, 1990). The plane of motion restriction is determined by palpating the relative motion between the sacrum and ilium as the patient alternately flexes each hip maximally. Lack of movement at a joint is an indication for manipulation (Schafer and Faye, 1990).

2.7 POSTURE

According to Gatterman (1990), posture is defined as the position of the body, the distribution of body mass in relation to gravity, the attitude of the body, or the relative arrangement of the parts of the body. Optimal posture is that state of muscular and skeletal balance that protects the supporting structures of the body against injury or progressive deformity irrespective of the attitude (erect, lying, squatting, stooping) in which these structures are working or resting (Gatterman, 1990).
Human posture is based on an erect column of functional segments and it is a
dynamic organ of posture. The counter forces of the pervasive pull of gravity are
made more efficient by good body alignment, but because the living body is in
constant motion, the biomechanical forces of the muscles, ligaments and bones must
be considered. Even with the recumbence of sleep, the body frequently changes
position, therefore good postural support is essential for good spinal hygiene
(Gatterman, 1990).

Chiropractors emphasise that postural distortion regularly gives rise to a generalised
pattern of symptoms, with localised foci producing diffuse effects. Faulty posture
creates mechanical stress and weakness of the human spine. Although there is no
single best posture for all individuals, for each person the best posture is one in which
the body segments are balanced in the position of least strain and maximum support
(Gatterman, 1990). Thus the ideal sleeping posture is one where the normal
curvatures of the spine are maintained and a minimum amount of strain is placed on
the joints (Liebenson, 1996). When a poor posture is held for a period of time,
discomfort, fatigue, strain and ultimately pain results (Plaugher, 1993).

In addition to the intrinsic mechanisms which influence posture, principally the
muscular system, extrinsic factors such as sleeping surface and position also have to
be considered, as they play an important role in influencing spinal postures, which
may aggravate or relieve symptoms arising from spinal pathology. The lowest levels
of back muscle activity and intradiscal pressure are found in the lying position. The
position of the lumbar spine is affected by the angulation of the pelvis and the
position of the limbs. Due to the hamstring muscles acting over both the hip and
knee joints, the amount of knee extension may affect the position of the hips, and
ultimately the lumbar spine (Oliver and Middleditch, 1991).

Pain is the natural result of adopting a position in which one or a group of muscles or
ligaments are kept in a state of tension for a sustained period. A common initiating
cause of chronic backache is postural pain. Because good posture is a component of restful sleep, when lying on your side in a foetal position with the hips and knees flexed at a comfortable angle, a small pillow should be placed between the knees (figure 2.5) to help prevent hip rotation and twisting of the spine (Tanner, 1994). According to Jayson (1992), this position helps to reduce lumbosacral rotary stresses. Sleeping in the foetal position with a pillow also helps prevent rolling onto the abdomen, which can accentuate lumbar spine lordosis causing facet approximation and pain (Liebenson, 1996).

Figure 2.5: Correct position for lower limbs during sleep, using a pillow between the knees (Travell and Simons, 1983).
2.7.1 The Cory Knee Cushion

Corrie Gouws designed the Cory knee cushion. It is designed to fit between the knees during sleep in the lateral recumbent position. It is small enough not to cause disruptions to sleep when one turns and is shaped not to fall out during the night. The cushion helps to maintain the lumbar spine and pelvis in their normal alignment and thus relieve pressure on these joints (Gouws, 1999).

No research is as yet available on the cushion, but claims have been made as to the benefit of sleeping with a pillow between the knees and supporting spinal posture (Travell and Simons, 1983).

2.7.2 Lateral Recumbent Posture and Local Muscle Groups

Sleeping conditions can have a profound influence on quadratus lumborum trigger points. Lying on the side in a semi-flexed and rotated position can create additional tension on already taut muscles and encourage further disc derangement, thus adding to facet strain. A semi-foetal position can also cause uncomfortable tension on an irritable sacroiliac joint. These complications are avoided by placing a pillow between the knees and legs to support the uppermost lower limb thus avoiding excessive flexion of the hip. With a pillow appropriately placed, the lumbar spine can retain its normal curvature, protecting both the quadratus lumborum and the disc (Travell and Simons, 1983).

To guide the position of the gluteus muscle group, a pillow should also be placed between the knees to prevent the uppermost hip from assuming an excessively flexed and adducted position. Poor limb position can place the gluteus maximus in a painful, sleep disturbing stretch if it harbours trigger points. Similarly, when lying on the side opposite to the gluteus medius trigger points, a pillow should be placed between the knees to prevent excessive adduction that painfully stretches taut bands
in the muscle. Gluteus minimus is kept in a neutral position if a pillow helps maintain the uppermost thigh in a horizontal position (Travell and Simons, 1983). To avoid maintaining the quadriceps in a shortened position at night, it is important to avoid marked hip flexion for the rectus femoris and also to avoid full knee extension, especially for the vasti group of muscles. A pillow placed between the knees can reduce pressure on the area of referred tenderness over the knee, as well as on the muscle itself (Travell and Simons, 1983).

Without the use of the pillow, the muscles discussed above can remain in a state of contraction overnight. As noted previously, an uncoordinated muscle contraction or muscles in a state of hypertonic contraction for prolonged periods can lead to a compromise of the normal function of the surrounding joints as they try to protect the joint by limiting movement (Kirkaldy-Willis and Burton, 1992).
CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter serves to explain the project construction and protocol as well as the way in which it was conducted and analysed.

The study was conducted at the Technikon Witwatersrand Chiropractic Day Clinic.

3.2 STUDY DESIGN AND PROTOCOL

3.2.1 Sample and Selection

Patients who had been suffering with chronic lower back pain for six weeks or more were encouraged to participate in the study. [Gatterman (1990) defines chronic as long-standing - weeks, months or years - but not necessarily incurable]. Patients were recruited through local advertising as well as patients entering the Technikon Witwatersrand Chiropractic Day Clinic. All proposed treatments were provided free of charge. A sample of 30, aged between 18 and 60 years of age were chosen. Both male and female patients were selected for inclusion in the study.

Patients were excluded from the study if any known contraindications to chiropractic adjustments existed. These included vascular complications eg. aneurysms, tumours, bone infections, traumatic injuries, arthritides, neurological complications eg. cauda equina syndrome, paresis, disc lesions, metabolic disorders, and psychological conditions (Gatterman, 1990).
3.2.2 Methodology

A complete case history (appendix A) was taken from all patients. Lumbar spine regional examinations (appendix B) and physical examinations (appendix C) were performed to determine if the patients were eligible (suffering from sacroiliac syndrome and/or posterior facet syndrome), and to rule out any contraindications. Patients were required to sign an X-ray consent form (appendix D) prior to lumbar spine X-rays being taken, to rule out any contraindications that the orthopaedic and neurological examinations did not reveal.

Eligible patients were then required to read, sign and date the 'subject information sheet and consent form' (appendix E) before treatments began. They were randomly divided between the two treatment groups as they entered the study until each group had 15 patients.

Group 1 received chiropractic adjustments as detailed below. They were also required to sleep with the Cory knee cushion on a daily basis from the onset of the treatment. Group 2 received the chiropractic adjustments alone. Patients assigned to the group 1 were issued the Cory knee cushion at their first treatment. They were instructed in its placement between the knees during sleep in the lateral recumbent position, and were instructed to use it for the duration of the study. Each morning, they were required to note (appendix F) whether or not they made use of the cushion the entire night.

All patients received chiropractic adjustments as follows: three treatments a week for two weeks, two treatments in the third week and one treatment in the fourth week. A final treatment was conducted after a one month break to determine the lasting effectiveness of the treatment. At every treatment, the relevant fixated segments were identified using motion palpation and recorded on a SOAP (subjective, objective,
assessment, plan) note (appendix G) for adjustment. Cushions were recalled at the one month follow-up treatment.

Patients were required to complete subjective information sheets before treatments 1, 4, 7, 9 and 10 i.e. at the first treatment of each week. These were Oswestry Low Back Pain and Disability Questionnaire (appendix H), McGill Pain Questionnaire (appendix I) and the Visual Analogue Scale (appendix J).

i) Lumbar Spine Range of Motion

Lumbar spine range of motion in all ranges was assessed using the electronic inclinometer for objective measurements. The Saunders Group, Inc. manufactures the electronic inclinometer.

a) The Digital Inclinometer

The patient was instructed to stand in the erect posture, with their feet approximately 15 cm apart in the neutral position. Measurements were taken at the end range of motion at the L5-S1 interspace (mark A) and the T12-L1 interspace (mark B) according to the AMA Guides method (Saunders and Stultz, 1997). Measurements were recorded on a range of motion analysis chart (appendix K).

- Flexion and Extension

For flexion and extension measurements, the inclinometer was placed at mark A and the patient was asked to complete full forward flexion where a reading was taken, and then full extension (making sure the patient does not bend their knees as this would affect the apparent extension mobility) where a second reading was taken. This was repeated at mark B. The inclinometer was zeroed before each range was taken. In order to calculate each range of motion, the reading at A was subtracted from the reading at B (Saunders and Stultz, 1997).
- Lateral Flexion
For lateral flexion readings, the patient stood in the same position and the inclinometer was zeroed at A. The patient flexed laterally to their full range by running the respective arm down their leg and keeping their legs straight. Recordings were taken at A and B for left and right sides. The range was calculated by subtracting the readings at A from the readings at B for each side (Saunders and Stultz, 1997).

- Rotation
To measure rotation ranges, the patient stood in 90° of forward flexion and the inclinometer was zeroed at point A. The patient rotated their left shoulder maximally forward for left rotation and a recording was taken. This was repeated on the opposite side and again at point B. Ranges are calculated by subtracting readings at A from readings at B for each side (Saunders and Stultz, 1997).

b) Motion Palpation
- Palpation of lumbar vertebrae fixed in flexion or extension:
Motion was restricted in a sagittal plane around the X-axis. The patient was seated in front of and away from the researcher. The palpating thumb or finger was placed between the spinous processes. When the patient was passively extended, the spinous processes were felt approximating each other. When the patient was passively flexed, the spinous processes were felt separating from each other. At the extremes of motion, a springy joint play should be felt. When a vertebra was fixated in flexion or extension, the respective approximation or separation did not occur, and the joint play was diminished (Gatterman, 1990).

- Palpation of lumbar vertebrae fixed in rotation and lateral flexion:
These are coupled movements around the Y- and Z-axes. The patient was seated facing away from the researcher. The palpating thumb was placed against the side of the spinous process, and the patient was rotated to the extreme range of motion
toward the ipsilateral side. Segmental motion was felt as well as a springy joint play while the spinous process was sprung into further rotation. This palpation was facilitated by spanning two spinous processes with the thumb contact to give a reference point immediately below the segment being tested, thus the superior segment could be felt moving relatively away from the thumb. The patient was then laterally flexed ipsilaterally, where the spinous processes were felt moving slightly toward the thumb, and there was a springy end-feel. Absence of these movements indicated a fixation. Rotation and lateral flexion palpation was repeated on both sides (Gatterman, 1990).

- Palpation of the sacroiliac joints fixed in flexion and extension:

(Tests are performed bilaterally)

To screen iliac flexion and extension, the patient was instructed to stand facing away from the researcher, steadying him/herself with their hands against the wall. Palpating thumbs were placed on the patient's posterior superior iliac spines, and the patient raised the right knee as high as possible. For normal movement, the right posterior superior iliac spine was felt moving posteriorly and inferiorly. After about a 20° leg raise, the left posterior superior iliac spine also rotated backward and downward. In a fixated joint, the pelvis tended to move as a whole with the ipsilateral thumb remaining level or possibly rising (Schafer and Faye, 1990).

When the sacroiliac joint was fixed in flexion, motion in the upper joint was restricted around the X-axis (Gatterman, 1990). Thumbs were placed over the right posterior superior iliac spine and the 2nd sacral tubercle, and the patient raised the right knee as high as possible. With normal motion, the thumbs would separate. The posterior superior iliac spine would move posteriorly and inferiorly with the sacrum moving anteriorly initially and later both would move posteriorly. In a fixated joint, the sacrum and ilium moved as a unit and the thumbs would not separate (Schafer and Faye, 1990).
When the sacroiliac joint was fixated in extension, motion in the lower joint was restricted around the X-axis (Gatterman, 1990). Thumbs were placed on the sacral apex and the right ischial tuberosity. As the patient raised the knee as high as possible, the ischial tuberosity moved antero-superior and laterally. A fixated joint caused movement of the sacrum and ilium as a unit (Schafer and Faye, 1990).

3.2.3 Chiropractic Adjustments

The following chiropractic adjustments were identified from States Manual of Spinal, Pelvic and Extavertebral Technics (Kirk, Lawrence and Valvo, 1985), and used for the treatments. Listings for each technique describe the fixation that the technique is suitable for and the appropriate spinal levels that can be adjusted.

i) Transverso-Brachial
Listing: Anterior right-anterior left (AR-AL): T10-T12; all lumbars.
Patient Position: Patient was seated on headpiece facing caudad; straddling table, knees were held tight into table; back, neck and head held erect. Fingers were interlaced and placed behind neck with elbows in front of patient.
Doctor Position: Behind patient, facing caudad at a 90 degree angle to patient. Doctor was in close contact to the patient; contralateral shoulder was placed inferior to patient’s contralateral shoulder. Homolateral elbow (of contact hand) was placed in inguinal region for support.
Contact Hand (CH): Homolateral; pisiform contact on transverse process (TP) or mamillary process (MP) of homolateral side.
Indifferent Hand (IH): Contralateral hand reached underneath patient’s contralateral arm and grasped brachium of homolateral arm.
Thrust: Doctor tractioned up on patient using shoulder-to-shoulder contact and legs. (IH arm is not used to traction up). Slack was taken out by rotating patient’s torso with IH. Thrust came through CH via hip.
ii) Thigh Transverso-Deltoid

Listing: AR-AL; low thoracics and all lumbers

Patient Position: Side-lying with listing up; lower shoulder was anterior with hand under head; upper shoulder was posterior with forearm resting on lateral thoracic wall; lower thigh and leg were straight up; upper thigh and leg were flexed with dorsum of foot in popliteal space of lower limb. Pelvis was brought to edge of table. Patient’s upper torso was centred on table.

NOTE: Patient’s arm could be placed as above or arms could be crossed or both hands placed on upper anterior aspect of shoulder.

Doctor Position: Anterior to patient; fencer’s stance facing cephalad; lateral thigh-to-thigh contact; caudad foot off floor.

Contact Hand: Caudad hand; pisiform contact on TP or MP of listed segment; fingers parallel to spine (fingers not crossing spine). Forearm at right angles to the CH.

Indifferent Hand: Cephalad hand; palmar contact was on anterior aspect of upper shoulder.

Thrust: Body slack was removed with CH, IH and thigh. IH stabilizes. CH thrusted anterior on TP or MP with a simultaneous body drop.

iii) Thigh Ilio-Deltoid

Listing: Right upper sacroiliac joint-left upper sacroiliac joint (RUSI-LUSI)

Patient Position: Side-lying with listing up; lower shoulder was placed anteriorly with hand under head; upper shoulder was posterior with forearm resting on lateral thoracic wall; lower thigh and leg were straight; upper thigh and leg were flexed with the dorsum of the foot in the popliteal space of the lower limb. Pelvis was brought towards edge of table. Pelvis was positioned so that the upper anterior superior iliac spine was anterior to lower anterior superior iliac spine or the pelvis was vertical.

Doctor Position: Anterior to patient; fencer’s stance facing cephalad; lateral thigh-to-thigh contact; caudad foot off floor.
Contact Hand: Caudad hand; pisiform contact medial and inferior to posterior superior iliac spine; fingers pointed obliquely cephalad and medial across the spine. Elbow was flexed. Forearm was at right angles to CH.

Indifferent Hand: Cephalad hand; palmar contact on anterior aspect of upper shoulder.

Thrust: IH stabilized. CH drove posterior superior iliac spine anteriorly with slight torque (ulnar deviation) and simultaneous body drop.

iv) Ilio-Sacral Cross

Listing: RUSI-LUSI

Patient Position: Prone

Doctor Position: Standing at side of table; contralateral to listing, facing towards patient at right angle with feet shoulder width apart, knees into table in slight flexion (toggle stance), at level of patient's pelvis.

Contact Hand: Caudad hand; placed first; pisiform contact over listed posterior superior iliac spine, fingers pointed obliquely cephalad and lateral.

Indifferent Hand: Cephalad hand; placed second; pisiform contact on contralateral sacral apex, fingers pointed caudal.

Thrust: Three types of thrusts:

1. Holding technic for a few to several minutes.
2. One or two body drop thrusts
3. Multiple light, quick thrusts.

Thrust or traction was applied in a posterior to anterior direction through both contacts (emphasis on CH), with thrust ending with the CH torquing into ulnar deviation and the IH into radial deviation.

v) Ischial Popliteal Deltoid

Listing: Right lower sacroiliac joint-left lower sacroiliac joint (RLSI-LLSI)

Patient Position: Side-lying with listing up. Hand of lower arm was underneath head. Upper arm was flexed at elbow and resting on upper lateral chest wall. Lower thigh and leg were straight. Upper thigh was flexed and brought off the table anteriorly.
Doctor Position: anterior to patient; fencer's stance, facing cephalad standing between patient's legs; patella of cephalad leg placed in popliteal space of patient's upper leg. Caudad thigh against table bracing patient's lower thigh.

Contact Hand: Caudad hand; pisiform-calcaneal (across heel of hand) contact on posterior aspect of ischial tuberosity; forearm and fingers pointing down line of femur.

Indifferent Hand: Cephalad hand; palmar contact on anterior surface of deltoid of upper arm.

Thrust: IH stabilized by tractioning cephalad on shoulder. CH drove in line of femur as the doctor's cephalad leg tractioned patient's upper thigh into further flexion.

3.3 STATISTICAL ANALYSIS OF DATA

3.3.1 Processing of Data

i) Processing of Objective Data
The degrees of flexion, extension, lateral flexion and rotation were noted as described by Saunders and Stultz (1997) and measurements were calculated and recorded for comparison and statistical evaluation.

ii) Processing of Subjective Data
This took the form of questionnaires, which the patients completed before treatments as noted above.

a) Oswestry Low Back Pain and Disability Questionnaire
The Oswestry Low Back Pain and Disability Questionnaire (appendix H) was used to indicate the extent to which a person's functional level was restricted by pain. It assesses the degree of pain and disability perceived by the patient and how it affects their daily life. Once it was explained to patients how to fill in the questionnaire, they were asked to complete it as accurately and honestly as possible.
The questionnaire is divided into ten sections, each containing six items. Patients were required to mark in each section the statement that most accurately described the effect of their pain. If two items were marked, the more severe was used and if sections were left out, the score was marked out of the total of completed sections. The statements were scored on a one to five scale with the first statement in each section scoring zero points, the second two points, etc. The sum of the ten scores was then expressed as a percentage of the maximum score. Therefore, if all sections were completed, a maximum of fifty was possible. If patients failed to complete one section, the percentage was adjusted accordingly (Fairbank et al., 1980).

e.g. \[ \frac{12 \text{ (total score)}}{50 \text{ (maximum possible)}} \times 100 = 38\% \]

if one section was missed,

\[ \frac{12 \text{ (total score)}}{45 \text{ (maximum score)}} \times 100 = 42\% \]

This value could then be compared to a disability rating as follows:

0 – 20 minimal disability,
20 – 40 moderate disability,
40 – 60 severe disability,
60 – 80 crippled and
80 – 100 bed-bound/exaggerated (Fairbank et al., 1980).

b) M'Gill Pain Questionnaire
The M'Gill Pain Questionnaire (appendix I) was designed to provide information regarding the extent of pain. It pertains specifically to sensory and affective dimensions of pain expression. Here, patients were asked to rate each type of pain description as truthfully as possible. Each pain description was marked using
columns labelled none, mild, moderate and severe. Using a pain rating intensity score, with none worth zero, mild worth one, moderate two and severe three, marks were scored. Therefore, the higher the score, the more severe the pain was perceived to be. The sum of the eleven scores was expressed as a percentage of the maximum, which if all sections were completed was 45. This decreased by three for each section not completed, and the percentage was adjusted accordingly (Melzack, 1987).

e.g. \( \frac{21 \text{ (total scored)}}{45 \text{ (total possible)}} \times 100 = 47 \% \)

if one section was left out,

\( \frac{21 \text{ (total scored)}}{42 \text{ (total possible)}} \times 100 = 50 \% \)

c) Visual Analogue Scale
The visual analogue scale (appendix J) was used to assess pain severity and patient progress. It is straight line, 10 cm long, the limits of which carry a verbal description of each extreme of pain. The extremes of the range are “no pain” and “most severe pain”. Patients were required to place a mark on the line between the two extremes indicating their pain severity for that particular day. The scale has good constancy for a particular patient and is valuable in marking progress. Comparisons cannot however be done between patients with apparently the same pain as they would mark different places. Pain relief scores were calculated by measuring the distance from the lower end of the scale to the mark. The score was then converted to a percentage and recorded for analysis (Bowsher, 1994).
CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

This chapter describes how the statistical analysis was conducted and which values from the raw data were used. It includes column statistics of the data as well as graphs of the mean values, and is followed by an explanation of the data.

4.2 DATA ANALYSIS

In this section, the treatment effect of both groups for the following variables was determined:

- lumbar spine range of motion in extension,
- flexion,
- lateral flexion and rotation;
- Oswestry Low Back Pain and Disability Questionnaire;
- M'Gill Pain Questionnaire and the Visual Analogue Scale (VAS).

In the following tables, the premise is rejected at the 5% level of significance if:

- for the test of normal distribution Prob Normal > 0.05;
- for the period effect (sign rank tests) Prob > N sign < 0.05;
- for the Mann-Whitney tests (test of difference between the two treatment groups) Prob > CHISQ < 0.05.

Effects significant at the 5% level are indicated by *** in the tables below for both group 1 (who received chiropractic adjustments and the cushion) and for group 2 (who received chiropractic adjustments alone).
Evaluation of the treatments was accomplished by comparisons between initial values and values later in the treatment process so that changes could be noted. Thus values from the initial treatment (Rx 1) were compared to values at the ninth treatment (Rx 9), to determine changes that took place during treatment. Initial values were also compared to values at the tenth or one month follow-up treatment (Rx 10), to determine if any changes occurred during the month that no treatment was received.

Table 4.1: Test of normal distribution of variables

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>EFFECT</th>
<th>N</th>
<th>MEAN</th>
<th>STD</th>
<th>SKEWNESS</th>
<th>PROB&lt; Normal</th>
<th>MEDIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension</td>
<td>Rx10 - Rx1</td>
<td>30</td>
<td>1.23</td>
<td>4.7101</td>
<td>0.08</td>
<td>0.8003***</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>30</td>
<td>1.67</td>
<td>5.5915</td>
<td>-0.45</td>
<td>0.6726***</td>
<td>2.00</td>
</tr>
<tr>
<td>Flexion</td>
<td>Rx10 - Rx1</td>
<td>30</td>
<td>4.20</td>
<td>4.7663</td>
<td>-0.24</td>
<td>0.9167***</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>30</td>
<td>1.43</td>
<td>5.7696</td>
<td>-0.07</td>
<td>0.1080***</td>
<td>1.50</td>
</tr>
<tr>
<td>Lateral Flexion</td>
<td>Rx10 - Rx1</td>
<td>30</td>
<td>-0.17</td>
<td>4.9608</td>
<td>-0.04</td>
<td>0.8736***</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>30</td>
<td>-0.57</td>
<td>4.7375</td>
<td>-0.13</td>
<td>0.7938***</td>
<td>-0.50</td>
</tr>
<tr>
<td>Rotation</td>
<td>Rx10 - Rx1</td>
<td>30</td>
<td>2.28</td>
<td>3.3623</td>
<td>-0.26</td>
<td>0.3398***</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>30</td>
<td>1.12</td>
<td>3.9690</td>
<td>-0.25</td>
<td>0.1662***</td>
<td>1.75</td>
</tr>
<tr>
<td>McGill</td>
<td>Rx10 - Rx1</td>
<td>30</td>
<td>-15.73</td>
<td>11.9133</td>
<td>-0.61</td>
<td>0.1069***</td>
<td>-13.50</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>30</td>
<td>-12.50</td>
<td>13.3720</td>
<td>0.06</td>
<td>0.8570***</td>
<td>-12.00</td>
</tr>
<tr>
<td>Oswestry</td>
<td>Rx10 - Rx1</td>
<td>30</td>
<td>-11.57</td>
<td>6.5951</td>
<td>-0.61</td>
<td>0.0683***</td>
<td>-10.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>30</td>
<td>-9.50</td>
<td>6.8064</td>
<td>-0.54</td>
<td>0.0454</td>
<td>-7.50</td>
</tr>
<tr>
<td>VAS</td>
<td>Rx10 - Rx1</td>
<td>30</td>
<td>-3.83</td>
<td>2.3937</td>
<td>-0.16</td>
<td>0.1188***</td>
<td>-4.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>30</td>
<td>-3.20</td>
<td>2.3104</td>
<td>-0.30</td>
<td>0.3038***</td>
<td>-3.00</td>
</tr>
</tbody>
</table>

Table 4.1 shows that Prob Normal < 0.05 only for the Oswestry Low Back Pain and Disability Questionnaire for Rx9 - Rx 1. This means that all the variables but Oswestry (9 - 1) are approximately normally distributed. Non-parametric analysis was however still applied to the Oswestry Low Back Pain and Disability Questionnaire, McGill Pain Questionnaire and the Visual Analogue Scale, as
measurements on these variables were all subjective. Parametric analyses were performed on the range of motion variables.

Since the assumption of normal distribution was attained for the range of motion variables, the following analyses (based on parametric techniques) were performed:

a) Two sample t-tests to determine the difference between the groups at the following treatments: Rx1, Rx9 and Rx10 (table 4.2).

b) Paired t-tests to determine the effect of treatment over time (Rx10-Rx1 and Rx9-Rx1). That is, to determine the difference between treatment 10 and treatment 1 on the one hand and treatment 9 and treatment 1 on the other (table 4.3).

c) Two sample t-tests based on the calculated differences between the groups (table 4.4).

With regard to the Oswestry Low Back Pain and Disability Questionnaire, M\'Gill Pain Questionnaire and the Visual Analogue Scale, non-parametric techniques were applied. These were:

a) Kruskal-Wallis test to determine the group effect on the following treatments: Rx1, Rx9 and Rx10 (table 4.5)

b) Sign rank tests to test the treatment effect. That is, to determine the difference between treatment 10 and treatment 1 on the one hand and treatment 9 and treatment 1 on the other (table 4.6).

c) Two-sample Mann-Whitney tests were performed to determine the difference between the groups (table 4.7).
The graphs below represent the results for the relevant ranges of motion and questionnaire totals, which were recorded at treatments 1, 4, 7, 9 and 10. The mean values from the respective treatments are plotted against the treatment number so that changes could easily be seen. Group 1 is represented in blue and group 2 in red.

4.3 STATISTICAL REPRESENTATION AND EXPLANATION OF DATA

4.3.1 Objective Data

Table 4.2: Two-sample t-tests for objective measurement between groups

| Variable     | Treatment | Group 1 Mean | Group 2 Mean | Group 1 Std Dev. | Group 2 Std Dev. | t Value | DF | Pr > |t| |
|--------------|-----------|--------------|--------------|------------------|------------------|---------|----|------|---|
| Extension    | Rx1       | 13.333       | 14.733       | 6.0906           | 7.5542           | -0.56   | 28 | 0.5808 |
|              | Rx10      | 14.267       | 16.267       | 7.2157           | 6.3072           | -0.81   | 28 | 0.4258 |
|              | Rx9       | 15.133       | 16.267       | 6.9268           | 6.135            | -0.47   | 28 | 0.6389 |
| Flexion      | Rx1       | 50.6         | 50.6         | 9.97             | 7.7809           | 0.00    | 28 | 1.0000 |
|              | Rx10      | 54.6         | 55           | 9.8908           | 6.6548           | -0.13   | 28 | 0.8975 |
|              | Rx9       | 51.4         | 52.667       | 9.9197           | 8.7641           | -0.37   | 28 | 0.7137 |
| Lateral Flexion | Rx10   | 26.467       | 26.033       | 5.7273           | 5.3267           | 0.21    | 28 | 0.8317 |
|              | Rx9       | 27.1         | 24.6         | 6.2169           | 6.2627           | 1.10    | 28 | 0.2819 |
| Lateral Rotation | Rx1 | 8.0667       | 9.1333       | 2.8839           | 3.3619           | -0.93   | 28 | 0.3590 |
|              | Rx10      | 11.233       | 10.533       | 3.8166           | 3.1818           | 0.55    | 28 | 0.5897 |
|              | Rx9       | 9.8333       | 9.6          | 4.8905           | 3.0426           | 0.16    | 28 | 0.8764 |

In table 4.2 we note that the analysis of the range of motion variables at the 5% level showed no significant difference based on treatments Rx1, Rx9 and Rx10 for either group.
Table 4.3: Paired t-test for objective measurements

| Variable  | Effect          | Group | N Obs | Mean  | Std Dev | T    | Prob>|T| |
|-----------|----------------|-------|-------|-------|---------|------|------|-----|
| Extension | Rx10 – Rx1     | 1     | 15    | 0.93  | 5.1056  | 0.71 | 0.4906 |
|           |                | 2     | 15    | 1.53  | 4.4379  | 1.34 | 0.2022 |
|           | Rx9 – Rx1      | 1     | 15    | 1.80  | 4.8727  | 1.43 | 0.1745 |
|           |                | 2     | 15    | 1.53  | 6.4016  | 0.93 | 0.3693 |
| Flexion   | Rx10 – Rx1     | 1     | 15    | 4.00  | 4.5826  | 3.38 | 0.0045*** |
|           |                | 2     | 15    | 4.40  | 5.0962  | 3.34 | 0.0048*** |
|           | Rx9 – Rx1      | 1     | 15    | 0.80  | 5.2536  | 0.59 | 0.5647 |
|           |                | 2     | 15    | 2.07  | 6.3636  | 1.26 | 0.2290 |
| Lateral   | Rx10 – Rx1     | 1     | 15    | -1.63 | 3.9752  | -1.59| 0.1339 |
| Flexion   |                | 2     | 15    | 1.30  | 5.5285  | 0.91 | 0.3779 |
|           | Rx9 – Rx1      | 1     | 15    | -1.00 | 3.4589  | -1.12| 0.2817 |
|           |                | 2     | 15    | -0.13 | 5.8416  | -0.09| 0.9308 |
| Rotation  | Rx10 – Rx1     | 1     | 15    | 3.17  | 3.4727  | 3.53 | 0.0033*** |
|           |                | 2     | 15    | 1.40  | 3.1122  | 1.74 | 0.1034 |
|           | Rx9 – Rx1      | 1     | 15    | 1.77  | 4.6440  | 1.47 | 0.1628 |
|           |                | 2     | 15    | 0.47  | 3.1874  | 0.57 | 0.5797 |

Table 4.3 shows that the difference between Rx10 (one month follow-up treatment) and Rx1 (initial) is significant for flexion (for both group 1 and 2) and for rotation (group 1). Thus these are the only ranges of motion that showed significant change over the treatment period. Differences for all of the other variables are not significant at the 5% level.
Table 4.4: Two-sample t-test for objective measurements

| Variable   | Effect     | Group | N  | Mean | Std Error | T   | DF | Prob>|T| |
|------------|------------|-------|----|------|-----------|-----|----|--------|
| Extension  | Rx10-Rx1   | 1     | 15 | 0.93 | 1.3182    |     |    |        |
|            |            | 2     | 15 | 1.53 | 1.1459    | -0.34 | 28 | 0.7338 |
|            | Rx9-Rx1    | 1     | 15 | 1.80 | 1.2581    |     |    |        |
|            |            | 2     | 15 | 1.53 | 1.6529    | 0.13 | 28 | 0.8988 |
| Flexion    | Rx10-Rx1   | 1     | 15 | 4.00 | 1.1832    |     |    |        |
|            |            | 2     | 15 | 4.40 | 1.3158    | -0.23 | 28 | 0.8228 |
|            | Rx9-Rx1    | 1     | 15 | 0.80 | 1.3565    |     |    |        |
|            |            | 2     | 15 | 2.07 | 1.6431    | -0.59 | 28 | 0.5570 |
| Lateral    | Rx10-Rx1   | 1     | 15 | -1.63| 1.0264    |     |    |        |
| Flexion    |            | 2     | 15 | 1.30 | 1.4275    | -1.67 | 28 | 0.1064 |
|            | Rx9-Rx1    | 1     | 15 | -1.00| 0.8931    |     |    |        |
|            |            | 2     | 15 | -0.13| 1.5083    | -0.49 | 28 | 0.6249 |
| Rotation   | Rx10-Rx1   | 1     | 15 | 3.17 | 0.8966    |     |    |        |
|            |            | 2     | 15 | 1.40 | 0.8036    | 1.47 | 28 | 0.1534 |
|            | Rx9-Rx1    | 1     | 15 | 1.77 | 1.1991    |     |    |        |
|            |            | 2     | 15 | 0.47 | 0.8230    | 0.89 | 28 | 0.3790 |

In Table 4.4, we notice that for the range of motion variables, there is no significant noted difference between groups at the 5% level. Thus one group did not outperform the other in this regard. This is the same conclusion as was reached in Table 4.2.
Figure 4.1: Lumbar spine extension range of motion analysis

i) Lumbar Spine Range of Motion in Extension

Statistical comparisons were performed on the extension data to determine if there was an effect of treatment over time. In comparing the difference between the initial and follow-up treatments (Rx10 - Rx1), no statistically significant difference was found for either group. For group 1 $P = 0.4906$ and group 2 $P = 0.2022$. There was also no significant difference for either group between the initial and final treatments (Rx9 - Rx1), where group 1 $P = 0.1745$ and group 2 $P = 0.3693$ (table 4.3).

When the groups were compared to each other, no significant differences were revealed. For Rx10 - Rx1, $P = 0.7338$ and for Rx9 - Rx1, $P = 0.8988$ (table 4.4).

Looking at the graphical representation of the data (figure 4.1) and taking the mean values (in degrees) of both groups into account:
a) Group 1 had a mean value of 13.33° at the initial treatment. This increased to 15.13° at the final treatment and decreased to 14.27° at the follow-up treatment.

b) Group 2 had a mean value of 14.73° at the initial treatment. This increased to 16.27° at the final treatment and remained at 16.27° at the follow-up treatment.

Therefore, when comparing the difference in change in extension range of motion from the initial to the follow-up treatment, group 2 had a greater improvement (1.54°) than group 1 (0.94°), although these differences are not statistically significant.
ii) Lumbar Spine Range of Motion in Flexion

Statistical comparisons were performed on the flexion data to determine if there was an effect of treatment over time. In comparing the difference between the initial and follow-up treatment (Rx10 – Rx1), a statistically significant difference was found for both groups. For group 1 P = 0.0045 and group 2 P = 0.0048. No statistical difference was noted for either group between the initial and final treatment (Rx9 – Rx1), where group 1 P = 0.5647 and group 2 P = 0.2290 (table 4.3).

When the groups were compared to each other, no significant differences were revealed. For Rx10 – Rx1, P = 0.8228 and for Rx9 – Rx1, P = 0.5570 (table 4.4).

Looking at the graphical representation of the data (figure 4.2) and taking the mean values (in degrees) of both groups into account:
a) Group 1 had a mean value of 50.60° at the initial treatment. This increased to 51.40° at the final treatment and to 54.60° at the follow-up treatment.

b) Group 2 had a mean value of 50.60° at the initial treatment. This increased to 52.67° at the final treatment and to 55.00° at the follow-up treatment.

Therefore, when comparing the difference in change in flexion range of motion from the initial to the follow-up treatment, group 2 had marginally greater improvement (4.4°) than group 1 (4.0°), although these differences are not statistically significant.
Figure 4.3: Lumbar spine lateral flexion range of motion analysis

![Graph showing lateral flexion range of motion for Group 1 and Group 2.]

iii) Range of Motion in Lateral Flexion

Statistical comparisons were performed on the lateral flexion data to determine if there was an effect of treatment over time. In comparing the difference between the initial and follow-up treatments (Rx10 – Rx1), no statistically significant difference was found for either group. For group 1 P = 0.1339 and group 2 P = 0.3779. There was also no significant difference for either group between the initial and final treatments (Rx9 – Rx1), where group 1 P = 0.2817 and group 2 P = 0.9308 (table 4.3).

When the groups were compared to each other, no significant differences were revealed. For Rx10 – Rx1, P = 0.1064 and for Rx9 – Rx1, P = 0.6249 (table 4.4).
Looking at the graphical representation of the data (figure 4.3) and taking the mean values (in degrees) of both groups into account:

a) Group 1 had a mean value of 28.10° at the initial treatment. This decreased to 27.10° at the final treatment and to 26.47° at the follow-up treatment.

b) Group 2 had a mean value of 24.73° at the initial treatment. This decreased to 24.60° at the final treatment and increased to 26.03° at the follow-up treatment.

Therefore, when comparing the difference in change in lateral flexion range of motion from the initial to the follow-up treatment, group 2 had a greater improvement (1.3°) than group 1 (-1.63°), although these differences are not statistically significant.
iv) Lumbar Spine Range of Motion in Rotation

Statistical comparisons were performed on the rotation data to determine if there was an effect of treatment over time. In comparing the difference between the initial and follow-up treatments (Rx10 – Rx1), a statistically significant difference was found for group 1, where $P = 0.0033$. No statistical difference was noted for group 2, where $P = 0.1034$, or between the initial and final treatment (Rx9 – Rx1), where group 1 $P = 0.1628$ and group 2 $P = 0.5797$ (table 4.3).

When the groups were compared to each other, no significant differences were revealed. For Rx10 – Rx1, $P = 0.1534$ and for Rx9 – Rx1, $P = 0.3790$ (table 4.4).
Looking at the graphical representation of the data (figure 4.4) and taking the mean values (in degrees) of both groups into account:

a) Group 1 had a mean value of 8.07° at the initial treatment. This increased to 9.83° at the final treatment and to 11.23° at the follow-up treatment.

b) Group 2 had a mean value of 9.13° at the initial treatment. This increased to 9.60° at the final treatment and to 10.53° at the follow-up treatment.

Therefore, when comparing the difference in change in rotation range of motion from the initial to the follow-up treatment, group 1 had a greater improvement (3.16°) than group 2 (1.4°), although these differences are not statistically significant.
4.3.2 Subjective Data

Table 4.5: Test of difference between groups for subjective measurements

<table>
<thead>
<tr>
<th>Variable</th>
<th>Treatment</th>
<th>Group Mean</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Chi-Square</th>
<th>DF</th>
<th>Pr &gt; Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>McGil</td>
<td>Rx1</td>
<td>20.53</td>
<td>25.87</td>
<td>0.8366</td>
<td>1</td>
<td>0.3604</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rx10</td>
<td>8.80</td>
<td>6.13</td>
<td>0.1778</td>
<td>1</td>
<td>0.6733</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rx9</td>
<td>12.93</td>
<td>8.47</td>
<td>1.4154</td>
<td>1</td>
<td>0.2342</td>
<td></td>
</tr>
<tr>
<td>Oswestry</td>
<td>Rx1</td>
<td>23.60</td>
<td>25.07</td>
<td>0.9162</td>
<td>1</td>
<td>0.3385</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rx10</td>
<td>13.27</td>
<td>12.27</td>
<td>0.1404</td>
<td>1</td>
<td>0.7079</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rx9</td>
<td>14.80</td>
<td>14.87</td>
<td>0.5335</td>
<td>1</td>
<td>0.4651</td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>Rx1</td>
<td>3.93</td>
<td>6.13</td>
<td>7.6659</td>
<td>1</td>
<td>0.0056***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rx10</td>
<td>1.40</td>
<td>1.00</td>
<td>0.221</td>
<td>1</td>
<td>0.6383</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rx9</td>
<td>2.13</td>
<td>1.53</td>
<td>0.9324</td>
<td>1</td>
<td>0.3342</td>
<td></td>
</tr>
</tbody>
</table>

With regard to the Kruskal-Wallis test of difference between groups, table 4.5 shows that significant group differences were only found for the VAS at Rx1. The McGill Pain Questionnaire and Oswestry Low Back Pain and Disability Questionnaire showed no group differences at any treatment at the 5% level.
Table 4.6: Sign rank test for subjective measurements

<table>
<thead>
<tr>
<th>Variable</th>
<th>Effect</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std</th>
<th>MSign</th>
<th>Prob &gt; MSign</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>McGill</td>
<td>Rx10 - Rx1</td>
<td>1</td>
<td>15</td>
<td>-11.73</td>
<td>8.4892</td>
<td>-7.50</td>
<td>0.000061***</td>
<td>-12.00</td>
</tr>
<tr>
<td></td>
<td>Rx10 - Rx1</td>
<td>2</td>
<td>15</td>
<td>-19.73</td>
<td>13.6981</td>
<td>-6.50</td>
<td>0.000977***</td>
<td>-23.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>1</td>
<td>15</td>
<td>-7.60</td>
<td>11.7583</td>
<td>-5.00</td>
<td>0.012939***</td>
<td>-9.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>2</td>
<td>15</td>
<td>-17.40</td>
<td>13.4419</td>
<td>-5.50</td>
<td>0.007385***</td>
<td>-15.00</td>
</tr>
<tr>
<td>Oswestry</td>
<td>Rx10 - Rx1</td>
<td>1</td>
<td>15</td>
<td>-10.33</td>
<td>6.5973</td>
<td>-7.50</td>
<td>0.000061***</td>
<td>-8.00</td>
</tr>
<tr>
<td></td>
<td>Rx10 - Rx1</td>
<td>2</td>
<td>15</td>
<td>-12.80</td>
<td>6.5814</td>
<td>-7.50</td>
<td>0.000061***</td>
<td>-12.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>1</td>
<td>15</td>
<td>-8.80</td>
<td>6.9096</td>
<td>-6.00</td>
<td>0.001831***</td>
<td>-8.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>2</td>
<td>15</td>
<td>-10.20</td>
<td>6.8681</td>
<td>-7.50</td>
<td>0.000061***</td>
<td>-7.00</td>
</tr>
<tr>
<td>VAS</td>
<td>Rx10 - Rx1</td>
<td>1</td>
<td>15</td>
<td>-2.53</td>
<td>2.1996</td>
<td>-5.50</td>
<td>0.003418***</td>
<td>-2.00</td>
</tr>
<tr>
<td></td>
<td>Rx10 - Rx1</td>
<td>2</td>
<td>15</td>
<td>-5.13</td>
<td>1.8465</td>
<td>-7.50</td>
<td>0.000061***</td>
<td>-5.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>1</td>
<td>15</td>
<td>-1.80</td>
<td>1.6125</td>
<td>-5.00</td>
<td>0.006348***</td>
<td>-2.00</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>2</td>
<td>15</td>
<td>-4.60</td>
<td>2.0633</td>
<td>-7.50</td>
<td>0.000061***</td>
<td>-5.00</td>
</tr>
</tbody>
</table>

In table 4.6, Prob > M sign is less than 0.05 for all the variables. This means that the effect of treatment 9 and treatment 10 over treatment 1 is significant for both group 1 and group 2. Therefore, in terms of the subjective measurements, both groups showed an improvement.

Table 4.7: Non-parametric test of difference between groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Effect</th>
<th>CHISQ</th>
<th>DF</th>
<th>Prob &gt; CHISQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>McGill</td>
<td>Rx10 - Rx1</td>
<td>2.2386</td>
<td>1</td>
<td>0.1346</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>3.7266</td>
<td>1</td>
<td>0.0536</td>
</tr>
<tr>
<td>Oswestry</td>
<td>Rx10 - Rx1</td>
<td>1.2655</td>
<td>1</td>
<td>0.2606</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>0.31786</td>
<td>1</td>
<td>0.5729</td>
</tr>
<tr>
<td>VAS</td>
<td>Rx10 - Rx1</td>
<td>10.231</td>
<td>1</td>
<td>0.0014***</td>
</tr>
<tr>
<td></td>
<td>Rx9 - Rx1</td>
<td>11.418</td>
<td>1</td>
<td>0.0007***</td>
</tr>
</tbody>
</table>

Table 4.7 shows that the difference between the groups in non-parametric testing is significant only for VAS. A similar finding was noted in table 4.5 when comparing
individual treatments. It can be inferred from Table 4.6 that Rx1 has a smaller mean
difference than Rx9 and Rx10. No significant difference between the groups was
found on the Oswestry Low Back Pain and Disability Questionnaire or the McGill
Pain Questionnaire at the 5% level.
i) Oswestry Low Back Pain and Disability Questionnaire

Statistical comparisons were performed on the Oswestry Low Back Pain and Disability Questionnaire data to determine if there was an effect of treatment over time. In comparing the difference between the initial and follow-up treatments (Rx10 – Rx1), a statistically significant difference was found for both groups, where group 1 P = 0.000061 and group 2 P = 0.000061. A statistical difference was also noted between the initial and final treatment (Rx9 – Rx1), where group 1 P = 0.001831 and group 2 P = 0.000061 (table 4.6).

When the groups were compared to each other, no significant differences were revealed. For Rx10 – Rx1, P = 0.2606 and for Rx9 – Rx1, P = 0.5729 (table 4.7).
Looking at the graphical representation of the data (figure 4.5) and taking the mean values (in percentages) of both groups into account:

a) Group 1 had a mean value of 23.60° at the initial treatment. This improved (percentage pain and disability decreased) to 14.80° at the final treatment and to 13.27° at the follow-up treatment.

b) Group 2 had a mean value of 25.07° at the initial treatment. This improved (percentage pain and disability decreased) to 14.87° at the final treatment and to 12.27° at the follow-up treatment.

Therefore, when comparing the difference in change in pain and disability from the initial to the follow-up treatment, group 2 had a greater improvement (12.8°) than group 1 (10.33°), although these differences are not statistically significant.
ii) M'Gill Pain Questionnaire

Statistical comparisons were performed on the M'Gill Pain Questionnaire data to determine if there was an effect of treatment over time. In comparing the difference between the initial and follow-up treatments (Rx10 – Rx1), a statistically significant difference was found for both groups, where group 1 $P = 0.000061$ and group 2 $P = 0.000977$. A statistical difference was also noted between the initial and final treatment (Rx9 – Rx1), where group 1 $P = 0.012939$ and group 2 $P = 0.007385$ (table 4.6).

When the groups were compared to each other, no significant differences were revealed. For Rx10 – Rx1, $P = 0.1346$ and for Rx9 – Rx1, $P = 0.0536$ (table 4.7).
Looking at the graphical representation of the data (figure 4.6) and taking the mean values (in percentages) of both groups into account:

a) Group 1 had a mean value of 20.53° at the initial treatment. This improved (percentage pain decreased) to 12.93° at the final treatment and to 8.80° at the follow-up treatment.

b) Group 2 had a mean value of 25.87° at the initial treatment. This improved (percentage pain decreased) to 8.47° at the final treatment and to 6.13° at the follow-up treatment.

Therefore, when comparing the difference in change in pain from the initial to the follow-up treatment, group 2 had a greater improvement (19.74°) than group 1 (11.73°), although these differences are not statistically significant.
iii) Visual Analogue Scale

Statistical comparisons were performed on the Visual Analogue Scale data to determine if there was an effect of treatment over time. In comparing the difference between the initial and follow-up treatments (Rx10 – Rx1), a statistically significant difference was found for both groups, where group 1 $P = 0.003418$ and group 2 $P = 0.000061$. A statistical difference was also noted between the initial and final treatment (Rx9 – Rx1), where group 1 $P = 0.006348$ and group 2 $P = 0.000061$ (table 4.6).

When the groups were compared to each other, no significant differences were revealed. For Rx10 – Rx1, $P = 0.0014$ and for Rx9 – Rx1, $P = 0.0007$ (table 4.7).
Looking at the graphical representation of the data (figure 4.7) and taking the mean values (in percentages) of both groups into account:

a) Group 1 had a mean value of 3.93° at the initial treatment. This improved (percentage pain decreased) to 2.13° at the final treatment and to 1.40° at the follow-up treatment.

b) Group 2 had a mean value of 6.13° at the initial treatment. This improved (percentage pain decreased) to 1.53° at the final treatment and to 1.00° at the follow-up treatment.

Therefore, when comparing the difference in change in pain from the initial to the follow-up treatment, group 2 had a greater improvement (5.13°) than group 1 (2.53°), although these differences are not statistically significant.
4.3.3 Demographic Data

Table 4.8: Demographic profile

<table>
<thead>
<tr>
<th>DATA</th>
<th>GROUP 1</th>
<th>GROUP 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Distribution</td>
<td>20 – 60</td>
<td>33 – 60</td>
</tr>
<tr>
<td>Average Age</td>
<td>46.8</td>
<td>47.5</td>
</tr>
<tr>
<td>Gender Distribution</td>
<td>7 males</td>
<td>10 males</td>
</tr>
<tr>
<td></td>
<td>8 females</td>
<td>5 females</td>
</tr>
<tr>
<td>Race</td>
<td>13 Caucasian</td>
<td>10 Caucasian</td>
</tr>
<tr>
<td></td>
<td>1 Indian</td>
<td>3 Black</td>
</tr>
<tr>
<td></td>
<td>1 Chinese</td>
<td>2 Coloured</td>
</tr>
</tbody>
</table>

The demographic profile (table 4.8) indicates the differences in patient distribution between the two groups. Although patients were placed randomly into groups, it is interesting to note the divisions of age, gender and race. These differences are further noted in the discussions chapter.
4.3.4 Cushion Usage by Group 1

Figure 4.8: Analysis of cushion usage

From figure 4.8, we can see that of the patients in group 1 using the cushion, 70.3% of the time they slept with the cushion between their knees the entire night as required. 28.1% of the time, they used the cushion when they went to sleep, but they were unable to sleep with the cushion for the entire night. 1.6% of the time they forgot to use it at all.
CHAPTER FIVE

DISCUSSION

5.1 INTRODUCTION

This chapter consists of a discussion of the statistical results obtained from the analysis of the objective and subjective data. The tables and graphs presented in chapter four will be utilized as a reference.

5.2 OBJECTIVE RESULTS

5.2.1 Lumbar Spine Range of Motion in Extension

According to the analysis of the extension range of motion results, neither group obtained statistically significant results, nor did they outperform the other or could be said to have gained added benefit from their treatment. However, if we look at the graph of the mean values (figure 4.1), we can see that at the final and one month follow-up treatments, the range of motion had improved for both groups compared to initial readings. Although group 1’s extension decreased slightly between the final and follow-up treatment, the trend toward increased range of motion was established and would most likely have continued for both groups with further assessment. The lack of major change may be attributed to the fact that the adjustments are specific and directed towards the range of dysfunction of the joints, and there was not necessarily a fixation in extension that was limiting joint motion (Gatterman, 1990).

5.2.2 Lumbar Spine Range of Motion in Flexion

According to the analysis of the flexion range of motion results, at the final treatment neither group had obtained statistically significant results. After the one month break
however, statistically significant results were noted for both groups and to much the same extent, showing that their levels of improvement were very similar. Looking at the graph of the mean values (figure 4.2), it can be noted that there was an initial improvement, especially in group 1, and then a plateau was reached through to the final treatment. During the month break, the results improved significantly, thus it is likely that this trend would have continued in both groups with further attention.

5.2.3 Lumbar Spine Range of Motion in Lateral Flexion

According to the analysis of the lateral flexion range of motion results, neither group obtained statistically significant results, nor did they outperform the other group. However, if we look at the graph of the mean values (figure 4.3), we note some changes over the treatment period. There was an initial increase in range of motion for group 2, while group 1 remained constant. After treatment 4, both groups showed a decrease in range of motion, which then remained constant to the end of the study. At the one month follow-up, the ranges were at approximately the same values as at treatment 1, thus no significant lateral flexion improvement occurred for either group. The reason for this lack of motion change is difficult to determine because although the adjustment techniques chosen, as detailed in section 3.2.3, were rotary methods, these should have an influence on lateral flexion range of motion due to coupled motion (Jayson, 1992).

5.2.4 Lumbar Spine Range of Motion in Rotation

According to the analysis of the rotation range of motion results, there was no statistically significant difference at the final treatment. Group 1 did however show a significant difference at the one month follow-up treatment indicating that this treatment has added benefit in the longer term. Looking at the graph of the mean values (figure 4.4), we note that the range for both groups improved after the first treatment. During the treatment period, the range remained fairly constant, and then
there was a further improvement at the one month follow-up. The trend toward
increased range of motion would most likely have continued with further assessment.
The initial improvement in range of motion correlates with other findings that noted
improvement over a seven to ten day treatment process (Gatterman, 1990). This may
explain why a plateau phase was noted after the initial improvement had been
achieved. It would appear that group 1 was able to continue their improvement over
the month break, possibly due to the postural correction with the cushion.

Based on these results, one can conclude that there was a general overall
improvement in the lumbar spine ranges of motion for both groups. Statistically,
rotation was the only range where one group fared better than the other, with group 1
achieving a better result than group 2. However, because this was an isolated result,
it cannot conclusively be said that one group substantially out-performed the other
overall.

The response may be explained by the fact that both groups received the chiropractic
adjustments, which have proven to have a positive influence on facet syndrome
(Gatterman, 1990). The treatment of choice for posterior facet syndrome and
sacroiliac syndrome is chiropractic manipulation. Because these syndromes involve
pain as well as joint dysfunction, treatment should relieve the pain and deal with the
underlying dysfunction to prevent recurrence of symptoms (Gatterman, 1990).
Patient improvement after manipulation is consistent with findings by Cox (1985)
who reported excellent results in 69% of patients and good results in 15% of patients
treated by manipulation for facet syndrome.

While group 1 slept with the cushion, this may not have assisted the patients involved
in this study. Previous literature relating to sleeping with a cushion between the
knees describes only muscular influences (Travell and Simons, 1983). Because of the
inter-relationship between the joints and the muscles it was thought there would be
more of an influence when sleeping with the cushion. The disappointing results here
may have been affected by some patient variables such as muscle stiffness and patient motivation. Some patients would notably try to reach their end range whereas others were more apathetic in this task.

5.3 SUBJECTIVE RESULTS

5.3.1 Oswestry Low Back Pain and Disability Questionnaire

Both groups showed a statistically significant decrease in pain and disability levels between the initial and final treatments as well as between the initial and follow-up treatment (table 4.6). From the graph (figure 4.5), we note that the pain and disability levels for both groups decreased significantly after each treatment. The considerable change from the initial to the final treatment and again to the follow-up treatment shows that the treatment had lasting effect in terms of pain relief. Both groups reported similar levels of pain at the follow-up treatment.

5.3.2 M€Gill Pain Questionnaire

Both groups showed a statistically significant decrease in pain levels between the initial and final treatment as well as between the initial and follow-up treatment (table 4.6). From the graph (figure 4.6), we note that the pain levels for both groups decreased significantly after each treatment. The considerable change from the initial to the final treatment and again to the follow-up treatment shows that the treatment was effective in terms of pain relief and it had lasting effect.

5.3.3 Visual Analogue Scale

Both groups showed a statistically significant decrease in pain levels between the initial and final treatment as well as between the initial and follow-up treatment (table 4.6). From the graph (figure 4.7), we note that the pain and disability levels for both
groups decreased significantly after each treatment. The considerable change from the initial to the final treatment, and again to the follow-up treatment shows that the treatment was effective and had lasting effect in terms of pain relief. Although the groups ended the treatment at a similar level, it is interesting to note that group 2 began the treatment indicating more pain than group 1, but ended with less pain.

For all of the questionnaires, although the results were significant in comparing the initial to the final and follow-up treatments, both groups showed this result and therefore one group was not consistently stronger than the other. Thus the results were somewhat disappointing on the whole as neither group substantially outperformed the other and could be said to have achieved a significantly greater end result. The reason for this may again be hypothesised to be due to the fact that both groups were receiving the adjustments, which have been shown to have a pain relieving effect as well as dealing with the underlying joint dysfunction (Plaugher, 1993). Therefore, in terms of the conditions under which this study was conducted, the cushion did not have a notably significant effect on decreasing pain levels or affecting range of motion.

5.4 DEMOGRAPHIC DATA

From the demographic profile in table 4.8, few differences are noted between the patients representing each group. With respect to age, when comparing the average age, there was no obvious age difference between the groups. However, it must be noted that group 1 had some patients falling into an age bracket that was younger than the youngest group 2 patients by thirteen years. This may be of significance as it could by hypothesised that these patients have perhaps not experienced the same repetitive stresses to the low back and may therefore respond differently to treatment.

There were slightly more males in the study, with an overall male: female ratio of 17:13. There was also a slightly higher ratio of males to females in group two. The
results however were calculated without noting how the genders performed comparatively. A possible different response to treatment would be noted by performing gender specific or occupation specific studies, which would isolated patients who experience the same levels of daily stresses on their lumbar spines.

The predominant race group in the study was Caucasian, with 23 Caucasians compared to only 7 of other races. This was not thought to have profound effects on the results of this study.
CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The effectiveness of chiropractic treatment for mechanical low back pain patients has been demonstrated in previous research (Twomey and Taylor, 1994). Postural studies have also shown that there is a need for control of posture in all positions, including during the recumbence of sleep (Liebenson, 1996).

This study indicated that both groups responded to the treatment procedure, showing a reduction in pain levels on all questionnaires evaluated and a generalised increase in lumbar spine range of motion, although the group differences were not all significant. Range of motion improvements were only significant for flexion after the month break (in both groups) and for rotation after the month break (for group I). However, neither group exhibited superiority over the other, as there was no statistically significant difference between the groups. Thus, under the circumstances of the research, no added benefit of the cushion was displayed. This study has however pointed out the importance of sleeping posture, and additional investigation is required in order to determine the full benefit of sleeping with a cushion between the knees as an adjunct to chiropractic treatment.

6.2 RECOMMENDATIONS

In terms of patient compliance, it was difficult to monitor those patients using the cushion. Although they were required to complete a daily diary of usage and questioned about it at appointments, lack of full use could have resulted in the poor results obtained. While the ideal situation would be a controlled sleeping environment, this is difficult to achieve. Therefore, a future study could possibly
make use of a strapping technique to ensure use of the cushion for the entire night. Patients also seemed to have difficulty using the cushion in the first week while they were getting used to sleeping with it, and thus a period of adapting to it may have been necessary before the study started.

Since both groups in this study received chiropractic adjustments, the benefits of the cushion alone could not fully be evaluated. Thus, adding a control group that used only the cushion would be helpful in monitoring the effects thereof.

A study that has a focus more on muscular activity may reveal results based on the cushion usage, which was not revealed in this study as all the patients received chiropractic treatment.

A future study should attain reliability of range of motion measurements by strictly following the guidelines set out in the manual.

As the final results of the study were positive, by extending the time frame of the research, significant results may have been demonstrated. A longer follow-up may demonstrate whether there was a lasting effect to the treatments.

In order to attain relevance to the population as a whole, a larger sample size needs to be used in future studies.
REFERENCES


Chiropractic Association of South Africa. (1999) Is there any research to show that chiropractic treatment is successful? http://www.chiropractic.co.za/success


# TECHNIKON WITWATERSRAND
## CHIROPRACTIC DAY CLINIC
### CASE HISTORY

<table>
<thead>
<tr>
<th>Date:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td></td>
</tr>
<tr>
<td>Age:</td>
<td></td>
</tr>
<tr>
<td>Sex:</td>
<td></td>
</tr>
<tr>
<td>Occupation:</td>
<td></td>
</tr>
<tr>
<td>Intern:</td>
<td></td>
</tr>
<tr>
<td>Signature:</td>
<td></td>
</tr>
</tbody>
</table>

**FOR CLINICIAN’S USE ONLY**

<table>
<thead>
<tr>
<th>Initial visit clinician:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Case History:</td>
<td></td>
</tr>
<tr>
<td>Examination:</td>
<td></td>
</tr>
<tr>
<td>Previous:</td>
<td></td>
</tr>
<tr>
<td>TWR</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Current:</td>
<td></td>
</tr>
<tr>
<td>TWR</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>X-ray Studies:</td>
<td></td>
</tr>
<tr>
<td>Previous:</td>
<td></td>
</tr>
<tr>
<td>TWR</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Current:</td>
<td></td>
</tr>
<tr>
<td>TWR</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Clinical path. lab:</td>
<td></td>
</tr>
<tr>
<td>Previous:</td>
<td></td>
</tr>
<tr>
<td>TWR</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Current:</td>
<td></td>
</tr>
<tr>
<td>TWR</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Case status:</td>
<td></td>
</tr>
<tr>
<td>PTT:</td>
<td>Conditional:</td>
</tr>
<tr>
<td>Signed off:</td>
<td></td>
</tr>
<tr>
<td>Final sign out:</td>
<td></td>
</tr>
</tbody>
</table>

**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 & 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

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>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward flexion</td>
<td>40° - 60° (15cm 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>

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 Manoeuvre
### 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>P/A</td>
<td>Lat</td>
<td>Flle</td>
<td>Ext</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>L</td>
<td>SI</td>
<td>U</td>
</tr>
</tbody>
</table>

### C) 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: ______________________________________________________________

__________________________________________________

__________________________________________________

__________________________________________________
<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></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>(L2,3,4)</td>
<td></td>
<td>Medial Hamstring</td>
<td>(L5)</td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td></td>
<td>Knee Flexion</td>
<td>(L5 / S1)</td>
<td></td>
<td>Lateral Hamstring</td>
<td>(S1)</td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td></td>
<td>Hip Int. Rot</td>
<td>(L4 / L5)</td>
<td></td>
<td>Tibialis Posterior</td>
<td>(L4,5)</td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td></td>
<td></td>
<td>Hip Ext. Rot</td>
<td>(L5 / S1)</td>
<td></td>
<td>Achilles</td>
<td>(S1 / S2)</td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td></td>
<td>Hip Adduction</td>
<td>(L2,3,4)</td>
<td></td>
<td>Plantar</td>
<td></td>
<td>Reflex</td>
</tr>
<tr>
<td>S1</td>
<td></td>
<td></td>
<td>Hip Abduction</td>
<td>(L4 / 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td></td>
<td></td>
<td>Ankle Dorsiflexion</td>
<td>(L4 / L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td>Hallux Extension</td>
<td>(L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ankle Plantar Flexion</td>
<td>(S1 / S2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eversion</td>
<td>(S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inversion</td>
<td>(L4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hip Extension</td>
<td>(L5 / S1)</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
- Bum's Bench Test
- Flip Test
- Hoover's Test
- Ankle Dorsiflexion Test
- Pin-point pain
APPENDIX C

TECHNIKON WITWATERSRAND
CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Underline abnormal findings in RED.

Date: __________

Patient: ___________________________ File No: __________

Clinician: ___________________________ Signature: __________

Intern: ___________________________ Signature: __________

Height: _______ Weight: _______ Temp: _______

Rates: Heart: _______ Pulse: _______ Respiration: _______

Blood pressure: Arms: L R

Legs: L R

General Appearance:

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
STANDING EXAMINATION

1. Minor’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.: ≤5°
   - Rot.to L.: 35°

/ = pain-free limitation // = 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 squat
10. Scapular winging
11. Muscle tone
12. Spasticity/Rigidity
13. Shoulder:  
- skin  
- symmetry  
- ROM - glenohumeral  
- scapulo-thoracic  
- acromioclavicular  
- elbow  
- wrist

14. Chest measurement:  
- inspiration  
- expiration

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm</td>
<td>cm</td>
<td></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>
</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

<table>
<thead>
<tr>
<th>Movement</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward flexion</td>
<td>45° chin to larynx or sternum</td>
</tr>
<tr>
<td>Extension</td>
<td>55° forehead parallel to ground</td>
</tr>
<tr>
<td>L/R Rotation</td>
<td>70°</td>
</tr>
<tr>
<td>L/R Lat Flexion</td>
<td>40°</td>
</tr>
</tbody>
</table>

- lymph nodes
- trachea
- thyroid
- carotid arteries (thrills, bruit)
- Cranial Nerves
  - CN V
  - CN VII
  - CN VIII (nystagmus)
  - CN IX
  - CN XI
  - CN XII
<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>Neck Flexion</td>
<td>C1/2</td>
<td>Biceps</td>
<td>C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Lat. Neck Flexion</td>
<td>C3</td>
<td>Brachio - radialis</td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Shoulder Elevation</td>
<td>C4</td>
<td>Triceps</td>
<td>C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>Shoulder Abduction</td>
<td>C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>Elbow Flexion</td>
<td>C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td>Elbow Extension</td>
<td>C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td>Elbow Flexion at 90°</td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Forearm Pronation</td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forearm Supination</td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrist Extension</td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrist Flexion</td>
<td>C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finger Flexion</td>
<td>C8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finger Abduction</td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finger Adduction</td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10. TMJ:
- Inspection: - ROM
- deviation
- Palpation: - crepitus
- tenderness

11. Thorax:
- Inspection: - skin
- shape
- respiratory distress
- rhythm (respiratory)
- depth (respiratory)
- effort (respiratory)
- intercostal/supraclavicular 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
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
• Palpation:
  - scrotum
  - inguinal/femoral bulges
  - penis (tenderness/induration)
  - testes
  - epididymis
  - inguinal canal
  - femoral canal
  - cremasteric reflex

• Auscultation:
  - scrotal mass

9. Peripheral vasculature:
• Inspection:
  - 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:
(l) ROM
• 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>106</td>
</tr>
<tr>
<td>ext rot</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>
- **knee**

<table>
<thead>
<tr>
<th>flex.</th>
<th>130</th>
</tr>
</thead>
<tbody>
<tr>
<td>ext.</td>
<td>0/15</td>
</tr>
</tbody>
</table>

| L | R |

- **ankle**

<table>
<thead>
<tr>
<th>plantar Flex</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>dorsiflex</td>
<td>20</td>
</tr>
<tr>
<td>inversion</td>
<td>30</td>
</tr>
<tr>
<td>eversion</td>
<td>20</td>
</tr>
</tbody>
</table>

| L | R |

(ii) **leg length:**

<table>
<thead>
<tr>
<th>Apparent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td></td>
</tr>
</tbody>
</table>

---

UNIVERSITY OF JOHANNESBURG
12. Rectal examination:
- Inspection: sacrococcygeal & perianal areas
- Palpation: 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 (pm)

(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
<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>Left</td>
<td>Right</td>
<td>Patellar</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>L1</td>
<td></td>
<td></td>
<td>Knee Extension</td>
<td>L1 / L2</td>
<td></td>
<td>Medial Hamstring</td>
<td>L3</td>
<td>L4</td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td></td>
<td>Knee Flexion</td>
<td>L2,3,4</td>
<td></td>
<td>Lateral Hamstring</td>
<td>L5</td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td></td>
<td>Hip Int. Rot</td>
<td>L5 / S1</td>
<td></td>
<td>Tibialis Posterior</td>
<td>L4,5</td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td></td>
<td></td>
<td>Hip Ext. Rot</td>
<td>L4 / L5</td>
<td></td>
<td>Achilles</td>
<td>L1</td>
<td>L2</td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td></td>
<td>Hip Adduction</td>
<td>L2,3,4</td>
<td></td>
<td>Plantar Reflex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td></td>
<td></td>
<td>Hip Abduction</td>
<td>L4 / L5</td>
<td></td>
<td>Ankle Dorsiflexion</td>
<td>L4</td>
<td>L5</td>
</tr>
<tr>
<td>S2</td>
<td></td>
<td></td>
<td>Ankle Dorsiflexion</td>
<td>L4 / L5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td>Hallux Extension</td>
<td>L5</td>
<td></td>
<td>Ankle Plantar Flexion</td>
<td>S1</td>
<td>S2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Eversion</td>
<td>S1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Inversion</td>
<td>L4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hip Extension</td>
<td>L5</td>
<td>S1</td>
</tr>
</tbody>
</table>
# HEALTH CLINIC
## X-RAY DEPARTMENT

### PATIENT INFORMATION

<table>
<thead>
<tr>
<th></th>
<th>MRS</th>
<th>MS</th>
<th>MST</th>
<th>DR</th>
<th>PROF</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FILL IN ALL NAMES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NAME</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AGE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STATE ANY ALLERGIES:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MALE PATIENTS:** Please tick the appropriate block

- [ ] I AM PREGNANT
- [x] I AM NOT PREGNANT

This is to certify that should I find that I was pregnant at the time of X-rays, I take full responsibility for any radiation effect that may result.

**FERRING DOCTOR:**

**TEL. NO.**

### PERSON RESPONSIBLE FOR PAYMENT

<table>
<thead>
<tr>
<th></th>
<th>MRS</th>
<th>MS</th>
<th>DR</th>
<th>PROF</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FILL IN ALL NAMES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NAME</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>INITIALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ENTITY NUMBER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DICAL AID NAME</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NUMBER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STAL ADDRESS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CODE</td>
</tr>
<tr>
<td><strong>IDENTIAL ADDRESS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CODE</td>
</tr>
<tr>
<td><strong>HOME</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CODE</td>
</tr>
<tr>
<td><strong>WORK</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CODE</td>
</tr>
<tr>
<td><strong>CELL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CODE</td>
</tr>
<tr>
<td><strong>LOYER’S NAME AND ADDRESS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CODE</td>
</tr>
</tbody>
</table>
DECLARATION

I agree to the performance of any additional or alternative procedure which may be considered necessary by the radiologist during the mentioned examination and I absolve the X-ray Department of any liability arising therefrom.

I declare that I am the legal guardian / custodian of the abovementioned child.

I declare that all the personal details listed above are true and correct.

Please note that even if you are a member of a medical aid fund the X-ray Department may claim directly from your medical aid fund, you remain personally responsible for full payment of your account. It is your duty at all times to ensure that your account is paid on the due date.

I hereby declare that I have read this document, that I understand it and that I accept the contract.

[Signature]

REQUEST AND CLINICAL HISTORY

<table>
<thead>
<tr>
<th>NAME</th>
<th>TIME SCHEDULE</th>
<th>FILMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IN</td>
<td>OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EXPOSURE FACTORS:

PROJECTION	KV	MA	TIME	FOCUS	SCREENS
Dear Patient

Please read the following form carefully as it contains important information about the treatment you will receive at the Technikon Witwatersrand for chronic mechanical lower back pain.

The treatment you will receive will be used for research purposes to further and improve our understanding of the treatment of lower back pain. All treatments received will be free of charge. Participation in the study is entirely voluntary and you may withdraw at any time. It is requested that participants enter the study with the intent of completing the treatments, however, withdrawal will not effect further treatments in any way.

The study will take place over a two month period during which you will receive a total of ten chiropractic treatments. Prior to commencement of treatment, you will have a case history taken, a physical examination and an examination of your lumbar spine. A set of X-rays will be taken to assist in eliminating possible contraindications to chiropractic adjustments.

You will be randomly assigned to one of two possible treatment groups where treatment will take the form of chiropractic adjustments alone or in combination with a knee cushion.

During the course of the study, you will be asked to fill in questionnaires about your pain in order for your progress to be monitored. It is requested that during the course of the study, you make no alterations to your current lifestyle as these may influence the results of the study.

Please feel free to ask questions should you have any concerns regarding the study. A signed copy of this information sheet and consent form will be made available to you.

I, ___________________________________________ (please print name)

• Agree to partake in the above research, have been informed of treatment procedures and will comply with the above conditions
• I will answer the questionnaires honestly and to the best of my ability
• I undertake to keep all my appointments punctually and according to the treatment schedule as far as possible to allow maximum benefit from the treatment and for the research
• I have read the above document and understand all that is contained therein

Signed ____________________________ Date _______________________

I have explained the procedures of the treatment and their purpose. I have asked whether any questions have arisen regarding the research, and answered these to the best of my ability.

Signed ____________________________ Date _______________________
(Researcher)
Patient: ________________

Please date and cross the appropriate block on a daily basis for the duration of the study.

<table>
<thead>
<tr>
<th>Date</th>
<th>Used cushion entire night</th>
<th>Awoke without cushion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Used cushion entire night</th>
<th>Awoke without cushion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PATIENT:</td>
<td>PAGE</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>FILE #:</td>
<td>VISIT #</td>
<td></td>
</tr>
<tr>
<td>DATE:</td>
<td>CLINICIAN:</td>
<td></td>
</tr>
<tr>
<td>INTERN:</td>
<td>(PTT)</td>
<td></td>
</tr>
</tbody>
</table>

S:  
A:  

O:  
P:  

SPECIAL ATTENTION TO:  

DATE:  

S:  
A:  

O:  
P:  

SPECIAL ATTENTION TO:
APPENDIX H

The Oswestry Disability Index for Low Back Pain

NAME: ___________________________ DATE OF BIRTH: ___________________________

ADDRESS: ___________________________ DATE: ___________________________

OCCUPATION: ___________________________________________________________________

DATE OF BIRTH: ___________________________ DATE: ___________________________

AGE: ___________________________

OCCUPATION: ___________________________________________________________________

How long have you had back pain? __________ Years _______ Months _______ Weeks

How long have you had leg pain? __________ Years _______ Months _______ Weeks

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 ONE BOX that applies to you. We realize you may consider that two of the statements in any one section relate to you, but please just mark the box that most closely describes your problem.

SECTION 1 - PAIN INTENSITY

☐ My pain is mild to moderate: I do not need pain killers.
☐ The pain is bad, but I manage without taking pain killers.
☐ Pain killers give complete relief from pain.
☐ Pain killers give moderate relief from pain.
☐ Pain killers give very little relief from pain.
☐ Pain killers have no effect on the pain.

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

☐ I can look after myself normally without causing extra pain.
☐ I can look after myself normally, but it causes extra pain.
☐ It is painful to look after myself, and I am slow and careful.
☐ I need some help but manage most of my personal care.
☐ I need help everyday in most aspects of self-care.
☐ I do not get dressed; I wash with difficulty; and I 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 weights if they are conveniently positioned.
☐ I can lift only very light weights.
☐ I cannot lift or carry anything at all.

SECTION 4 - WALKING

☐ I can walk as far as I wish.
☐ Pain prevents me walking more than 1 mile.
☐ Pain prevents me walking more than ½ mile.
☐ Pain prevents me walking more than ¼ mile.
☐ I can walk only if I use a stick or crutches.
☐ I am in bed or in a chair for most of every day.

SECTION 5 - SITTING

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

**SECTION 6 - STANDING**
- I can stand as long as I want without extra pain.
- I can stand as long as I want, but it gives me extra pain.
- Pain prevents me from standing for more than 1 hour.
- Pain prevents me from standing for more than 30 minutes.
- Pain prevents me from standing for more than 10 minutes.
- Pain prevents me from standing at all.

**SECTION 7 - SLEEPING**
- Pain does not prevent me from sleeping well.
- I sleep well but only by using tablets.
- Even when I take tablets I have less than 6 hours sleep.
- Even when I take tablets I have less than 4 hours sleep.
- Even when I take tablets I have less than 2 hours sleep.
- Pain prevents me from sleeping at all.

**COMMENTS:**

**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 causes no extra pain.
- My social is normal but increases the degree of pain.
- Pain affects my social life by limiting only my more energetic interests (dancing etc.).
- Pain has restricted my social life, and I do not go out as often.
- Pain has restricted my social life to my home.
- I have no social life because of pain.

**SECTION 10 - TRAVELING**
- I can travel anywhere without extra pain.
- I can travel anywhere but it gives me extra pain.
- Pain is bad, but I manage journeys over 2 hours.
- Pain restricts me to journeys of less than 1 hour.
- Pain restricts me to short necessary journeys under 30 minutes.
- Pain prevents me traveling except to the physician or hospital.
## McGill Pain Questionnaire

**Patient name:** 

**File number:** 
**Date:**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throbbing</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Shooting</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Stabbing</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Sharp</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Cramping</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Gnawing</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Hot-burning</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Aching</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Heavy</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Tender</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Splitting</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Exhausting</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Sickening</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Fearful</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
<tr>
<td>Punishing-cruel</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
<td>3)</td>
</tr>
</tbody>
</table>
VISUAL ANALOGUE SCALE

Patient name: ________________________________

Date: ________________________________

Please mark on the line provided where your “pain status” is today.

No Pain  Most Severe Pain
<table>
<thead>
<tr>
<th>Patient</th>
<th>Treatment 1</th>
<th>Treatment 4</th>
<th>Treatment 7</th>
<th>Treatment 9</th>
<th>Treatment 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing hip flexion</td>
<td>AF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing hip extension</td>
<td>AE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar flexion</td>
<td>BF - AF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar extension</td>
<td>BE - AE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar right lateral flexion</td>
<td>BR - AR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar left lateral flexion</td>
<td>BL - AL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar right rotation</td>
<td>BR - AR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar left rotation</td>
<td>BL - AL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>