COPYRIGHT AND CITATION CONSIDERATIONS FOR THIS THESIS/ DISSERTATION

- 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.

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

- 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

THE EFFECT OF CHIROPRACTIC MANIPULATION OF THE HIP AND SACROILIAC JOINT ON ACCELERATION AND SPRINTING TIME OF MALE RUGBY PLAYERS THAT PRESENT WITH A POSITIVE MODIFIED THOMAS TEST

A dissertation submitted to the

Faculty of Health Sciences, University of Johannesburg, in partial fulfillment of the requirements for the degree Master of Technology:

Chiropractic by

TONY KENNETH BLEEKERS

Supervisor: ___________________________ Date: _______________

Dr D. M Landman
DECLARATION

I, Tony Bleekers, declare that this dissertation is my own, unaided work. It is being submitted in partial fulfillment for the Master’s degree in Technology, in the programme of Chiropractic, at the University of Johannesburg. It has not been submitted before for any degree in any other Technikon or University.

_________________________________
Tony Bleekers

On this day the ______ of the month of _______________2015
DEDICATIONS

This is dedicated to my mother and father for all their support, time and belief in me.

Secondly I would like to thank all my chiropractic class mates for all their support, advice and help.

Thirdly to my supervisor who tirelessly gave me time and effort and without whom this would not have been possible.
ACKNOWLEDGEMENTS

To Dr. Landman, my supervisor, thank you for helping me complete this dissertation. You were always available and gave your advice and time freely.

To all the participants that took part in my research, I thank you from the bottom of my heart for giving up your time and showing patience when necessary. Without you this would not have been possible.

To all my fellow chiropractic students thanks for the all the support and friendship over the years.
Objective

The objective of this study was to determine the effect of chiropractic manipulative therapy of the sacroiliac and hip joint on performance indicators (acceleration, sprint times, Modified Thomas Test and hip range of motion) that was performed on rugby players. Tight hip flexors are a cause of limited hip extension. Limited hip extension has been proposed as a means of limiting running performance by decreasing the length of stride an athlete can achieve. Another method an athlete can use to improve sprint speed is by increasing stride frequency. This means increasing the amount of strides taken which is controlled by the nervous system. Chiropractic manipulative therapy aims to improve biomechanics and in doing so has an effect on not only the skeletal system but also on the muscles and nervous system. Thus chiropractic manipulative therapy may have an effect on the above mentioned performance indicators through effects on the nervous system and/or by improving range of motion and/or biomechanics.

Methods

This study consisted of 20 male participants. They were required to have played rugby in the varying forms in the last year and were required to present at the first consultation with a positive for the Modified Thomas Test. All the participants received chiropractic manipulation aimed at the sacroiliac and hip joints. This study was based on a pre and post test model. The participant’s acceleration and sprint speed were measured pre and post treatment. The participants received six treatments. At the first and seventh consultations; acceleration, sprint speed, hip range of motion and the Modified Thomas Test were tested. The fourth consultation included only measurements of hip range of motion and the Modified Thomas Test. These
tests were used to assess acceleration and sprinting capabilities as well as hip range of motion. The data was analysed by statisticians at statkon.

Results

The results obtained from the statistical analysis showed that statistically significant improvements were found in both the Modified Thomas Test and in hip flexion on the left hand side. The Modified Thomas Test was 100% positive at the first consultation for all participants. At the fourth consultation 9 participants achieved a positive score and 11 achieved a negative score. At the seventh consultation 3 participants achieved a positive score and 17 achieved a negative score. This indicated an 85% improvement in the repeated testing of the Modified Thomas Test. Left Hip flexion changed from 95° at the first consultation to 97.7° at the fourth consultation and to 101.8° at the final consultation. This showed an overall improvement of 6.8°. No other statistically significant changes were noted. Acceleration changed from 2.14 seconds to 2.03 seconds and improved by 0.11 seconds. The sprint speed changed from 4.55 seconds to 4.64 seconds thus being slower by 0.09 seconds.

Hip flexion on the right hand side changed from 99.5° at the first and fourth consultations and was 103.4° at the seventh consultation. This improved by 3.9° overall. Hip extension on the left hand side showed an overall improvement of 2.3° and on the right hand side of 2°.

Conclusion

The study showed statistically significant improvements in the performance of the modified Thomas Test and in hip flexion on the left hand side. The other tests all showed minor improvements except sprint speed which showed an increase in time and these improvements or
changes seen were statistically insignificant. It can be deduced that chiropractic manipulation was a possible cause of the noted benefits. This could be due to the changes that occur in the biomechanics caused by correcting leg length inequalities and anterior pelvic tilt; post chiropractic manipulation.
TABLE OF CONTENTS

DECLARATION........................................................................................................... ii
AFFIDAVIT.................................................................................................................. ii
DEDICATIONS........................................................................................................... iii
ACKNOWLEDGEMENTS.......................................................................................... iv
ABSTRACT................................................................................................................ v
TABLE OF CONTENTS........................................................................................... vi
LIST OF FIGURES.................................................................................................... xii
LIST OF TABLES....................................................................................................... xiii
APPENDICES............................................................................................................ xi

CHAPTER ONE - INTRODUCTION........................................................................ 1
1.1 Introduction....................................................................................................... 1
1.2 Aim of this Study............................................................................................ 3
1.3 Benefit of Study.............................................................................................. 3

CHAPTER TWO - LITERATURE REVIEW.......................................................... 4
2.1 Introduction...................................................................................................... 4
2.1.1 Definition of Chiropractic.......................................................................... 4
2.1.2 Vertebral Subluxation Complex................................................................. 4
2.1.3 Subluxation................................................................................................ 5
2.1.4 The Chiropractic Manipulation.................................................................... 5
   A. The effects of chiropractic manipulation..................................................... 6
   B. Mechanical effects...................................................................................... 6
   C. Soft tissue effects....................................................................................... 6
   D. Neurological effects................................................................................... 6
   E. Psychological effects.................................................................................. 7
2.1.5 Chiropractic and Sport................................................................................ 7
2.2 Sacral and Hip Anatomy................................................................................ 8
2.2.1 The Osteology of the Sacroiliac and Hip Joints....................................... 8
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Osteology of the sacral region</td>
<td>8</td>
</tr>
<tr>
<td>B. Osteology of the hip bone</td>
<td>9</td>
</tr>
<tr>
<td>2.2.2 The Joints of the Sacroiliac and Hip Joints</td>
<td>9</td>
</tr>
<tr>
<td>A. The sacroiliac joint</td>
<td>9</td>
</tr>
<tr>
<td>B. The hip joint</td>
<td>10</td>
</tr>
<tr>
<td>2.2.3 Movements of the Sacroiliac and Hip Joints</td>
<td>10</td>
</tr>
<tr>
<td>A. Movements of the sacroiliac joint</td>
<td>10</td>
</tr>
<tr>
<td>B. Movements of the hip joint</td>
<td>11</td>
</tr>
<tr>
<td>2.2.4 Ligaments of the Sacroiliac and Hip Joints</td>
<td>11</td>
</tr>
<tr>
<td>A. Sacroiliac ligaments</td>
<td>11</td>
</tr>
<tr>
<td>B. Hip joint ligaments</td>
<td>12</td>
</tr>
<tr>
<td>2.2.5 Muscular Anatomy related to Sports</td>
<td>12</td>
</tr>
<tr>
<td>A. Musculature associated with acceleration and sprinting</td>
<td>14</td>
</tr>
<tr>
<td>2.2.6 Innervation of the Sacroiliac and Hip Joint</td>
<td>19</td>
</tr>
<tr>
<td>A. Innervation of the sacroiliac joint</td>
<td>19</td>
</tr>
<tr>
<td>B. Innervation of the hip joint</td>
<td>19</td>
</tr>
<tr>
<td>2.3 Running</td>
<td>19</td>
</tr>
<tr>
<td>2.3.1 Phases of Running</td>
<td>19</td>
</tr>
<tr>
<td>2.3.2 Running Biomechanics</td>
<td>21</td>
</tr>
<tr>
<td>2.3.3 Specific Rugby Biomechanics and Common Injuries</td>
<td>21</td>
</tr>
<tr>
<td>2.4 Conclusion</td>
<td>23</td>
</tr>
<tr>
<td>CHAPTER THREE - METHODOLOGY</td>
<td>24</td>
</tr>
<tr>
<td>3.1 Introduction</td>
<td>24</td>
</tr>
<tr>
<td>3.2 Study Design</td>
<td>24</td>
</tr>
<tr>
<td>3.2.1 Aim of Study</td>
<td>24</td>
</tr>
<tr>
<td>3.2.2 Participant Recruitment</td>
<td>25</td>
</tr>
<tr>
<td>3.2.3 Sample Size and Selection</td>
<td>25</td>
</tr>
<tr>
<td>3.2.4 Inclusion Criteria</td>
<td>26</td>
</tr>
<tr>
<td>3.2.5 Exclusion Criteria</td>
<td>26</td>
</tr>
<tr>
<td>3.3 Treatment Approach</td>
<td>27</td>
</tr>
<tr>
<td>3.3.1 Consultation Procedure</td>
<td>27</td>
</tr>
</tbody>
</table>
3.4 Objective Data
3.4.1 Smartspeed Timing Lights
3.4.2 Range of Motion
  A. Hip flexion procedure
  B. Hip extension procedure
3.4.3 Modified Thomas Test
3.5 Intervention
  3.5.1 Chiropractic Techniques
3.6 Data Analysis
3.7 Ethical Considerations

CHAPTER FOUR - RESULTS
4.1 Introduction
4.2 Demographic Analysis
  4.2.1 Age
4.3 Intra-Group Analysis
  4.3.1 Modified Thomas Test
    A. Cochran test
    B. Wilcoxon Signed Ranks test
  4.3.2 Hip Range of Motion
    A. Hip range of motion-flexion
    B. Friedman test
    C. Hip range of motion-extension
    D. Friedman test
  4.3.3 Acceleration
    A. Wilcoxon Signed Ranks test
4.3.4 Sprint Speed
  A. Wilcoxon Signed Ranks test

CHAPTER FIVE - DISCUSSION
5.1 Introduction
5.2 Demographic Data Analysis
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3 Intra-Group Analysis</td>
<td>51</td>
</tr>
<tr>
<td>5.3.1 Modified Thomas Test</td>
<td>51</td>
</tr>
<tr>
<td>5.3.2 Hip Range of Motion</td>
<td>52</td>
</tr>
<tr>
<td>5.3.3 Acceleration and Sprint Speed</td>
<td>53</td>
</tr>
<tr>
<td><strong>CHAPTER SIX - CONCLUSION AND RECOMMENDATIONS</strong></td>
<td>55</td>
</tr>
<tr>
<td>6.1 Conclusion</td>
<td>55</td>
</tr>
<tr>
<td>6.2 Recommendations</td>
<td>55</td>
</tr>
<tr>
<td><strong>REFERENCES</strong></td>
<td>57</td>
</tr>
<tr>
<td><strong>APPENDICES</strong></td>
<td>63</td>
</tr>
<tr>
<td>Appendix A: Advertisement</td>
<td>63</td>
</tr>
<tr>
<td>Appendix B: Information Form</td>
<td>64</td>
</tr>
<tr>
<td>Appendix C: Consent Form</td>
<td>70</td>
</tr>
<tr>
<td>Appendix D: Contra-Indication to Spinal Manipulative Therapy</td>
<td>72</td>
</tr>
<tr>
<td>Appendix E: Case History</td>
<td>74</td>
</tr>
<tr>
<td>Appendix F: Full Physical Examination</td>
<td>80</td>
</tr>
<tr>
<td>Appendix G: Lumbar Spine Regional</td>
<td>92</td>
</tr>
<tr>
<td>Appendix H: Hip Regional</td>
<td>98</td>
</tr>
<tr>
<td>Appendix I: SOAP Note</td>
<td>103</td>
</tr>
<tr>
<td>Appendix J: Score Sheet</td>
<td>105</td>
</tr>
<tr>
<td>Appendix K: Error Correction</td>
<td>107</td>
</tr>
<tr>
<td>Appendix L: Chiropractic Techniques</td>
<td>108</td>
</tr>
<tr>
<td>Appendix M: Ethics Clearance Letter</td>
<td>117</td>
</tr>
<tr>
<td>Appendix N: Turnitin Originality Report</td>
<td>118</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 2.1: Phases of Walking ................................................................. 20
Figure 4.1: A Bar Graph Representing the Number of Participants and their Ages ........................................................................................................................................... 37
Figure 4.2: A Bar Graph illustrating the Frequency of the Scores obtained with the Modified Thomas Test .................................................................................................................................................. 39
Figure 4.3: A Bar Graph illustrating the Frequency of Scores obtained for the Acceleration Test Pre Treatment ............................................................................................................................................... 47
Figure 4.4: A Bar Graph illustrating the Frequency of Scores obtained for the Acceleration Test Post Treatment ............................................................................................................................................... 47
Figure 4.5: A Bar Graph illustrating the Frequency of Scores obtained for the Sprint Speed Test Pre Treatment .................................................................................................................................................. 49
Figure 4.6: A Bar Graph illustrating the Frequency of Scores obtained for the Sprint Speed Test Post Treatment .................................................................................................................................................. 49
LIST OF TABLES

Table 2.1: Summary of the Musculature of the Hip Flexors................................. 15
Table 2.2: Summary of the Musculature of the Knee Extensors............................ 16
Table 2.3: Summary of the Musculature of the Hip Extensors and Abductors........... 17
Table 2.4: Summary of the Musculature of the Hamstring Muscles....................... 17
Table 2.5: Summary of the Musculature of the Calf and Posterior Legs.................. 18
Table 4.1: Showing the P-Value for the Modified Thomas Test as determined by the Cochran Test........................................................................................................... 40
Table 4.2: Showing the P-Value for the Modified Thomas Test as determined by the Wilcoxon Signed Ranks Test............................................................................. 40
Table 4.3: Hip Range of Motion in Flexion (in degrees) for the LHS and RHS........ 41
Table 4.4: Showing the P-Value for Hip Flexion on the RHS as determined by the Friedman Test.................................................................................................................. 43
Table 4.5: Showing the P-Value for Hip Flexion on the LHS as determined by the Friedman Test.................................................................................................................. 43
Table 4.6: Hip Range of Motion in Extension (in degrees) for the LHS and RHS...... 44
Table 4.7: Showing the P-Value for Hip Extension on the RHS as determined by the Friedman Test................................................................................................................ 45
Table 4.8: Showing the P-Value for Hip Extension on the LHS as determined by the Friedman Test................................................................................................................ 46
Table 4.9: Showing the P-Value for Acceleration as determined by the Wilcoxon Signed Ranks Test .......................................................... 48
Table 4.10: Showing the P-Value for Sprint Speed as determined by the Wilcoxon Signed Ranks Test.......................................................... 50
1.1 Introduction

There has been a massive increase in professionalism in sports. Professional athletes are defined as people who make a living from playing sports. These athletes all want to be that second faster, that inch stronger and are always pushing the envelope to achieve new levels of performance. The pressure on these players to perform is increasing due to the money involved, expectations from supporters and the progressively higher standards achieved (Watson, 2013). Athletes seek any competitive advantage available to them (Smart, 2011).

Consequently chiropractic has become important in sports as the list of banned substances is ever increasing and players require optimal performances. This is seen to be achieved through chiropractic spinal manipulation which has become a necessity for many athletes today because they believe it works or it has become a ritual for them (Brolinson, 2003). The chiropractic manipulation of the spine and extremities is seen to be the greatest role of a sport chiropractor. Many people view sport chiropractors as spine and musculoskeletal injury specialists but this is not the only recommended role. Sport chiropractors can have a role in sport health care as: emergency care providers, pre participation examiners and sport injury specialists. Many coaches and athletes perceive that chiropractors have a role in enhancing performance by detecting and correcting any deficits that are present prior to athletic performance (Miners, 2010).
Rugby entered the world of professional sport in 1996 and this has dramatically increased the demand for optimal performance over opponents (Smart, 2011).

Rugby involves many different physical aspects such as the use of aerobic and anaerobic energy sources which play a vital role in players’ abilities to perform feats of strength, power, stability, speed, agility, acceleration, the ability to recover quickly and perform many repetitions of these abilities (Luger and Pook, 2004; Pook, 2012). Murphy, Lockie and Coutts (2003) mention that acceleration and sprint speed or maximal sprinting are essential components of field sports like rugby. This makes acceleration and speed crucial aspects to a rugby player (Luger and Pook, 2004).

Pook (2012) stated that the most important running distances in rugby are 10 and 30 metres. With those distances in mind, acceleration is deemed more important than maximal sprinting. In rugby sprint speed is important for backline players as they are more likely to use top end speeds. Acceleration is measured over shorter distances and therefore will be reflected over 10 metres and maximal sprinting will be tested most effectively over the distance of 30 metres. These distances are frequently utilised to test athletic performance in rugby (Pook, 2012).

Acceleration and speed are determined by stride length and stride frequency (Luger and Pook, 2004; Hamilton and Luttgens, 2002). Stride length is influenced by range of motion of the hip, specifically hip extension. Chiropractic spinal manipulative therapy (SMT) has been shown to increase hip extension in athletes with decreased hip extension and to have an influence on the sensorimotor integration with the central nervous system. Thus, chiropractic spinal manipulative therapy may have a positive influence on improving acceleration and maximal sprinting time through influencing stride length by improving hip range of motion, and stride frequency through
activation of the nervous system (Sandell, Palmgren and Bjorndahl, 2008; Holt, Taylor and Murphy, 2010).

1.2 Aim of this Study

The aim of this study was to determine the effect of chiropractic spinal manipulative therapy of the hip and/or sacroiliac joint on athletic performance of rugby players that presented with decreased hip extension using acceleration, maximal sprinting and range of motion of the hip joint as performance indicators.

1.3 Benefit of Study

The possible outcomes of this study were that chiropractic manipulative therapy applied to the sacroiliac and/or hip joint may enhance athletic performance in rugby players.

This study could have indicated if chiropractic spinal manipulative therapy had an influence on the running capabilities of rugby players by increasing hip range of motion and therefore improve acceleration and sprinting times. If chiropractic spinal manipulative therapy is shown to have had a beneficial impact on rugby players it could change or alter the training programs and could be applied to a wide variety of sports to improve performance.

This study’s results may indicate and show the role chiropractic can play in enhancing sporting performance (specifically in acceleration and sprinting) and possible effects of chiropractic treatment on rugby players and its possible impact on improving range of motion of the hip joint.
CHAPTER TWO - LITERATURE REVIEW

2.1 Introduction

2.1.1 Definition of Chiropractic

Chiropractic is defined by the Oxford South African Concise Dictionary (2014) as a system of treating diseases by manipulation, mainly of the vertebrae of the spinal column. It is based on the theory that nearly all disorders can be traced to the incorrect alignment of bones, with consequent malfunctioning of nerves and muscle throughout the body.

The World Health Organization (2005) defines chiropractic as a health care profession that is concerned with the diagnosis, treatment and prevention of disorders of the neuromusculoskeletal system and the effects of these disorders on general health. There is an emphasis on manual techniques, including joint adjustment and/or manipulation, with a particular focus on the subluxation.

2.1.2 Vertebral Subluxation Complex

A subluxation complex is a theoretical model. This model describes a motion segment, were a unit is composed of two adjacent vertebrae and all tissue that connects these adjacent surfaces. This model involves dysfunction of the motion segment, which involves all pathological changes that are found in nerves, muscles, ligaments, vascular and connective tissue (WHO, 2005; Esposito and Philipson, 2005).
2.1.3 Subluxation

A subluxation is defined by Esposito and Philipson (2005) as a motion segment in which the alignment, movement integrity and or physiological function are altered although contact between joint surfaces remains intact. This presents as hypo-mobility at the motion segment and can lead to restricted movement, and possibly influence the normal functioning of biomechanics and neural tissue (WHO, 2005; Esposito and Philipson, 2005).

2.1.4 The Chiropractic Manipulation

The primary goal of Chiropractic treatment is to treat manipulable subluxations and restore normal functioning or body biomechanics of these dysfunctional motional segments. This is achieved through manipulative procedures called chiropractic manipulations. The primary focus of chiropractic manipulations is on influencing the facet joints of two adjacent vertebrae (Gatterman, 2005). The chiropractic manipulation is described as a manual technique that uses high velocity low amplitude thrust to these specific restricted segments of the spine or pelvis (Haldeman, 2005).
A. The effects of chiropractic manipulation

There are numerous effects of a chiropractic manipulation. The main effects of manual therapy are as follows (Gatterman, 2005):

B. Mechanical effects

These techniques create changes in joint alignment, dysfunctional motion segments, spinal curvature dynamics and entrapment of the synovial folds.

C. Soft tissue effects

The soft tissue effects that are achieved through chiropractic manipulation are restoration of the dysfunctional segments that results in changes in tone and strength of the surrounding musculature and an influence on the connective tissue of the surrounding capsules and ligament structures.

D. Neurological effects

The neurological effects of chiropractic manipulation are a reduction in pain, changes in the motor and sensory functions and an influence on the autonomic nervous systems regulations as well as the spinal and peripheral nerve conduction.

Studies have identified four different types of joint receptors. These studies state that spinal manipulative therapy of the joints stimulates these receptors and affect joint pain. The four types of joint receptors are Types I, II and III, which are mechanoreceptors and type IV joint receptors which are nociceptors. The mechanoreceptors respond mainly to tension developed in the joint, whereas the nociceptors are active only when pain is perceived in a joint. The mechanoreceptors are found throughout the entire joint capsule whereas the nociceptors are not found in the synovial tissue, intraarticular menisci and articular cartilage (Christensen, 2003). Thus spinal manipulative therapy aimed at restoring joint functioning will have an effect
on the type I and II mechanoreceptors and cause pre-synaptic inhibition of type IV nociceptors. This may result in a reduction of pain and may ultimately affect performance.

E. Psychological effects

The psychological effects seen are patient satisfaction, the benefit of touch which is achieved through placing of hands on the patient and the placebo effect.

2.1.5 Chiropractic and Sport

Chiropractic related studies on asymptomatic individuals have shown improved function and/or performance in hip and ankle range of motion and muscular strength, post chiropractic manipulation (Sandell, Palmgren and Bjorndahl, 2008).

A study performed by Smith and Cox (2000) concluded that spinal manipulative therapy affects all three factors that determine muscular strength. Other studies have found that a single performance of spinal manipulative therapy can decrease paraspinal muscle electromyography activity (DeVocht, Pickar and Wilder, 2005).

Sher (2002) concluded that chiropractic manipulation of the sacroiliac joint provided a short term increase in quadriceps femoris muscle strength. According to chiropractic research there are three contributors to spinal misalignment which are cervical syndrome, pelvic torsion and leg length inequality. Correct functioning of these factors is crucial for dancing performance and the suggested means of eliminating these spinal misalignments and improving performance can be achieved through chiropractic care (Miners, 2010).
A study was performed on athletes to determine athletic performance in a wide variety of sporting capabilities. This was a pre and post test study design with a chiropractic intervention. The study concluded that a significant improvement was noted clinically over all tests but not when compared to the control group which also showed the results to be statistically insignificant (Miners, 2010).

Another study showed improvement in sprint times after manipulation of the thoraco-lumbar region down to the mid tarsal region only in a clinical setting as the results were statistically insignificant (Shrier, Macdonald and Uchacz, 2006). The above studies show that chiropractic could play a pivotal role in sports.

2.2 Sacral and Hip Anatomy

2.2.1 The Osteology of the Sacroiliac and Hip Joints

A. Osteology of the sacral region

The adult sacrum is triangular or wedged shaped and is composed of five fused sacral vertebra. The sacrum is located between the lumbar spine and the hip bones. The function of the sacrum is to provide strength and stability to the pelvis and transfer weight of the body to the pelvic girdle which is the ring that is created by the hip bones and sacrum. The sacral canal is the continuation of the vertebral canal in the sacrum. It contains the spinal nerve roots that arise from the cauda equina. There are four pairs of sacral foramina where the anterior and posterior rami of the spinal nerves exit. The sacrum has a base that articulates with L5 vertebrae and an apex that
articulates with the coccyx (Moore, Dalley and Agur, 2010 and Levangie and Norkin, 2011).

B. Osteology of the hip bone

The hip bone is a large flat bone that is created by the fusion of the ilium, ischium and the pubis. This fusion is completed between the ages of 20 to 25 years. The medial portion of the ilium is thicker and functions for weight bearing whereas the posterior lateral part acts as a surface area for muscular attachments. The acetabulum is formed by the body of the ilium which joins the pubis and ischium. The ischium is the posterior inferior part of the hip bone. The pubis is the anterior medial part of the hip bone and functions as a site of muscular attachments. The acetabulum is a large cup shaped socket that lies on the lateral aspect. The hip joint is formed by the head of the femur which articulates with acetabulum, forming the hip joint (Moore, Dalley and Agur, 2010).

2.2.2 The Joints of the Sacroiliac and Hip Joints

A. The sacroiliac joint

There are two sacroiliac joints found in the human body which are formed by the sacrum and the left and right iliac bones. Many ligaments connect these bones (Moore, Dalley and Agur, 2010). According to Magee (2006) the sacroiliac joint is a combination of a synovial joint and syndesmosis fibrous joint. This joint is C-shaped and movement is restricted by the articular surfaces of the joint. The main function of this joint is to transfer weight from the lower limb to the spine (Magee, 2006).
B. The hip joint

The hip joint is classified as a multi axial ball and socket, synovial joint. This joint is located between the lower limb and pelvic girdle and articulations are between the head of the femur and the acetabulum of the pelvis. The function of the hip joint is to support the weight of the body specifically the head, arms and trunk in walking or running (Moore, Dalley and Agur, 2010; Levangie and Norkin, 2011).

2.2.3 Movements of the Sacroiliac and Hip Joints

A. Movements of the sacroiliac joint

The sacroiliac joint allows very small amounts of movement and is limited to minute degrees of rotation and translation. This limitation to movement is very important as this allows the forces that are generated to be transmitted and distributed to the pelvic ring and in doing so it prevents sacral fractures from occurring. The sacroiliac joint consists of two joints thus the movements that occur do so symmetrically or asymmetrically. Symmetrical movement occurs when both sacroiliac joints move together as a unit in the same direction. Asymmetrical movement occurs when the sacroiliac joints move in opposite directions of each other. These movements can be described as nutation and counter nutation. Nutation involves the sacral promontory moving inferiorly and anteriorly while the apex of the sacrum moves posteriorly. Counter nutation is in essence the exact opposite movement of nutation. Thus counter nutation involves the sacral promontory moving superiorly and posteriorly and the apex of the sacrum to move anteriorly (Magee, 2006; Levangie and Norkin, 2011).
B. Movements of the hip joint

The normal degrees of movement expected at the hip joint are as follows:

- Hip flexion 120°
- Hip extension 30°
- Hip abduction 45°
- Hip adduction 30°
- Hip internal and external rotation 45 ° (Mulligan, 2014)

Normal gait requires at least the following hip ranges of motion:

- Flexion 30°
- Extension 10°
- Abduction and adduction 5°
- Lateral and medial rotation 5° (Levangie and Norkin, 2011)

2.2.4 Ligaments of the Sacroiliac and Hip Joints

A. Sacroiliac ligaments

The sacroiliac ligaments include the anterior, interosseous and posterior ligaments along with sacrotuberous and sacrospinous ligaments. The anterior sacroiliac ligaments cover the anterior surface of sacroiliac joint and joins the ilia to the sacrum. This particular ligament is considered a capsular ligament. The posterior sacroiliac ligament attaches superiorly to the inferior superior iliac spine and to the adjacent ilium and inferiorly the ligament attaches to the lateral crest of the 3rd and 4th sacral segments and medially to the deep lamina of the thoracolumbar fascia and aponeurosis of the erector spinae. The sacrotuberous and sacrospinous ligaments limit nutation (Magee, 2006; Levangie and Norkin, 2011).
B. Hip joint ligaments

The hip joint ligaments include the ligamentum teres, iliofemoral, ischiofemoral and pubofemoral ligaments (Moore, Dalley and Agur, 2010).

The ligamentum teres attaches to the head of the femur at the fovea and to the acetabulum at the acetabular notch. This ligament serves to supply blood to the femoral head and has a role in stabilising the hip (Levangie and Norkin, 2011).

The iliofemoral ligament or alternatively called the Y ligament is positioned anteriorly and attaches to the inferior iliac spine and to the femur along the intertrochanteric line (Moore, Dalley and Agur, 2010).

The ischiofemoral ligament is positioned posteriorly and blends with the posterior capsule. This ligament attaches posteriorly to the acetabular rim and labrum where it spirals around the femoral neck and blends with the capsules (Levangie and Norkin, 2011).

The pubofemoral ligament arises anteriorly, attaching to the pubic ramus and passes anteriorly to the surface of the intertrochanteric fossa (Levangie and Norkin, 2011).

2.2.5 Muscular Anatomy related to Sports

Skeletal muscle can be trained to enhance sporting performance (Martini and Nath, 2009). This is seen by either an increase in the size of the muscle called hypertrophy and or a change in the distribution of the type of skeletal muscle. Skeletal muscle has the following functions (Martini and Nath, 2009):

- Produce skeletal movement through contractions of the muscle pulling on the tendons
• Maintain posture and body position by tension developed in skeletal muscle
• Support of the soft tissue structures
• Guards the entrances and exits of the body
• Maintenance of body temperature
• Store reserves of nutrients

Skeletal muscle consists of three fibers: fast, slow and intermediate fibers. Fast fibers contract quickly but fatigue quickly and thus are vital in performances of activities like sprinting and utilise anaerobic energy sources. Slow fibers take longer to contract than the fast twitch fibers but are able to contract for a much longer period of time as they use anaerobic energy sources. Thus they will be important for long distance running. Intermediate fibers are fibers that are between fast and slow fibers, they resemble fast twitch fibers but have more aerobic capability thus can contract for longer than fast twitch but less than slow fibers. The role of intermediate fibers is vital in sports that require a combination and interaction of the two types of fibers, fast and slow twitch (Martini and Nath, 2009).

Acceleration and sprinting are controlled in part by skeletal muscle contraction. Skeletal muscles can only contract when stimulated by the nervous system (Martini and Nath, 2009). Skeletal muscle contraction requires numerous nervous systems input for movement to occur. A single nervous system input can cause a muscle contraction to occur. A contraction occurs when a signal from the nervous system arrives at the neuromuscular junction. This causes acetylcholine to be released by synaptic terminals and bind to the receptors. This causes a change in the trans-membrane potential and generates the production of an action potential that spreads along the surface of the muscle fiber. The sarcoplasmic reticulum is stimulated to release calcium stores. This increase in calcium ions exposes the sites used to form cross bridges. Cross
bridges form and a contraction occurs. This process occurs repeatedly for shortening of the muscles to occur (Martini and Nath, 2009).

A. Musculature associated with acceleration and sprinting

A summary of the muscles involved in sprinting, along with attachments, innervations and movement they produce are found below in the tables 2.1-2.5. The muscles that are important in acceleration and sprinting are hip flexors, hip extensors, knee extensors and leg musculature.

According to Dorn, Schache and Pandy (2012) the ankle plantar flexors namely the soleus and gastrocnemius are important for vertical support in running and shows an increase in contraction from the start of a run till near maximal sprinting is achieved where contractions decrease as the running strategy changes. At this stage of the run to improve speed the athlete must increase the stride of length taken, as running speed increases the involvement of the iliopsoas, gluteus maximus and hamstrings increase. Speed at this stage of a sprint or run is increased rather by stride frequency and occurs by the muscles moving the leg more vigorously (Dorn, Schache and Pandy, 2012; Hughes, Hsu and Matava, 2002).

In the swing phase the hamstring and gluteus maximus actively extend the hip when the foot is ahead of the body. During the stance phase the quadriceps, gastrocnemius and soleus contract to push the body forward by extension of the knee and plantar flexion of the ankle. The hip abductors contract to stabilise the hip and psoas muscle propels the lower limb forward by pulling the thigh (Hughes, Hsu and Matava, 2002).

The hip flexors include the rectus femoris, pectineus, sartorius and the iliopsoas. The iliopsoas is composed of the psoas minor and major and the
iliacus. The knee extensors are a group of muscles called the quadriceps femoris which are made up of the rectus femoris, vastus lateralis, medialis and intermedius. The muscles that abduct the hip include the gluteus medius and minimus and tensor fascia lata. The main muscle that extends the thigh is the gluteus maximus. The extensors of the hip are called the hamstrings they include the semitendinosus, semimembranosus and the biceps femoris (Moore, Dalley and Agur, 2010).

The lower limb musculature that is essential for one to be able to run is the gastrocnemius and soleus (Moore, Dalley and Agur, 2010; Hughes, Hsu and Matava, 2002).

**Table 2.1 Summary of the Musculature of the Hip Flexors (Moore, Dalley and Agur, 2010)**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectineus</td>
<td>Superior ramus of pubis</td>
<td>Pectineal line of femur, just inferior to lesser trochanter</td>
<td>Femoral nerve (L2, L3); may receive a branch from obturator nerve</td>
<td>Adducts and flexes thigh; assists with medial rotation of thigh</td>
</tr>
<tr>
<td>Iliopsoas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psoas major</td>
<td>Sides of T12-L5 vertebrae and discs between them; transverse processes of all lumbar vertebrae</td>
<td>Lesser trochanter of femur</td>
<td>Anterior rami of lumbar nerves (L1, L2, L3)</td>
<td>Act conjointly in flexing thigh at hip joint and in stabilising this joint</td>
</tr>
<tr>
<td>Psoas minor</td>
<td>Sides of T12-L1 vertebrae and intervertebral discs</td>
<td>Pectineal line, iliopsoasal eminence via iliopsoasal arch</td>
<td>Anterior rami of lumbar nerves (L1, L2)</td>
<td>Act conjointly in flexing thigh at hip joint and in stabilising this joint</td>
</tr>
<tr>
<td>Muscle</td>
<td>Proximal Attachment</td>
<td>Distal Attachment</td>
<td>Innervation</td>
<td>Main Action(s)</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Iliacus</td>
<td>Iliac crest, iliac fossa, ala of sacrum, and anterior sacroiliac ligaments</td>
<td>Tendon of psoas major, lesser trochanter, and femur distal to it</td>
<td>Femoral nerve (L2, L3)</td>
<td>Act conjointly in flexing thigh at hip joint and in stabilising this joint</td>
</tr>
<tr>
<td>Sartorius</td>
<td>Anterior superior iliac spine and superior part of notch inferior to it</td>
<td>Superior part of medial surface of tibia</td>
<td>Femoral nerve (L2, L3)</td>
<td>Flexes, abducts, and laterally rotates thigh at hip joint; flexes leg at knee joint, (medially rotating leg when knee is flexed)</td>
</tr>
</tbody>
</table>

Table 2.2 Summary of the Musculature of the Knee Extensors (Moore, Dalley and Agur, 2010)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps femoris</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>Anterior inferior iliac spine and ilium superior to acetabulum</td>
<td>Via common tendinous (quadriceps tendon) and independent attachments to base of patella; indirectly via patellar ligament to tibial tuberosity; medial and lateral vasti also attach to tibia and patella via aponeuroses (medial and lateral patellar retinacula)</td>
<td>Femoral nerve (L2, L3, L4)</td>
<td>Extend leg at knee joint; rectus femoris also steadies hip joint and helps iliopectine flex thigh</td>
</tr>
<tr>
<td>Vastus lateralis</td>
<td>Greater trochanter and lateral lip of linea aspera of femur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vastus medialis</td>
<td>Intertrochanteric line and medial lip of linea aspera of femur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vastus intermedius</td>
<td>Anterior and lateral surfaces of shaft of femur</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 2.3 Summary of the Musculature of the Hip Extensors and Abductors (Moore, Dalley and Agur, 2010)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gluteus maximus</td>
<td>Ilium posterior to posterior gluteal line; dorsal surface of sacrum and coccyx; sacrotuberous ligament</td>
<td>Most fibers end in iliotibial tract, which inserts into lateral condyle of tibia; some fibers insert on gluteal tuberosity</td>
<td>Inferior gluteal nerve (L5, S1, S2)</td>
<td>Extends thigh (especially from flexed position) and assists in its lateral rotation; steadies thigh and assists in rising from sitting position</td>
</tr>
</tbody>
</table>

| Gluteus medius  | External surface of ilium between anterior and posterior gluteal lines | Lateral surface of greater trochanter of femur          | Superior gluteal nerve (L5, S1) | Abduct and medially rotate thigh; keep pelvis level when ipsilateral limb is weight-bearing and advance opposite (unsupported) side during its swing phase |

| Gluteus minimus | External surface of ilium between anterior and inferior gluteal lines | Anterior surface of greater trochanter of femur         |                                      |                                                                             |

| Tensor of fascia lata | Anterior superior iliac spine; anterior part of iliac crest | Iliotibial tract, which attaches to lateral condyle of tibia |                                      |                                                                             |

### Table 2.4 Summary of the Musculature of the Hamstring Muscles (Moore, Dalley and Agur, 2010)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semitendinosus</td>
<td>Ischial tuberosity</td>
<td>Medial surface of superior part of tibia</td>
<td>Tibial division of sciatic nerve part of tibia (L5, S1, S2)</td>
<td>Extend thigh; flex leg and rotate it medially when knee is flexed; when thigh and leg are flexed, these muscles can extend trunk</td>
</tr>
<tr>
<td>Muscle</td>
<td>Proximal Attachment</td>
<td>Distal Attachment</td>
<td>Innervation</td>
<td>Main Action</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------</td>
<td>-----------------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Semimembranosus</td>
<td>Ischial tuberosity</td>
<td>Posterior part of medial condyle of tibia; reflected attachment forms oblique popliteal ligament (to lateral femoral condyle)</td>
<td>Tibial division of sciatic nerve part of tibia (L5, S1, S2)</td>
<td>Extend thigh; flex leg and rotate it medially when knee is flexed; when thigh and leg are flexed, these muscles can extend trunk</td>
</tr>
<tr>
<td>Biceps femoris</td>
<td>Long head: ischial tuberosity Short head: linea aspera and lateral supracondylar line of femur</td>
<td>Lateral side of head of fibula; tendon is split at this site by fibular collateral ligament of knee</td>
<td>Long head: tibial division of sciatic nerve (L5, S1, S2) Short head: common fibular division of sciatic nerve (L5, S1, S2)</td>
<td>Flexes leg and rotates it laterally when knee is flexed; extends thigh (e.g., accelerating mass during first step of gait).</td>
</tr>
</tbody>
</table>

Table 2.5 Summary of the Musculature of the Calf and Posterior Legs (Moore, Dalley and Agur, 2010)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation</th>
<th>Main Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrocnemius</td>
<td>Lateral head: lateral aspect of lateral condyle of femur</td>
<td>Posterior surface of calcaneus via calcaneal tendon</td>
<td>Tibial nerve (S1, S2)</td>
<td>Plantarflexes ankle when knee is extended; raises heel during walking; flexes leg at knee joint</td>
</tr>
<tr>
<td>Soleus</td>
<td>Posterior aspect of head and superior quarter of posterior surface of fibula; soleal line and middle third of medial border of tibia; and tendinous arch extending between the bony attachments</td>
<td>Posterior surface of calcaneus via calcaneal tendon</td>
<td>Tibial nerve (S1, S2)</td>
<td>Plantarflexes ankle when knee is extended; raises heel during walking; flexes leg at knee joint</td>
</tr>
</tbody>
</table>
2.2.6 Innervations of the Sacroiliac Joint and Hip Joint

A. Innervations of the sacroiliac joint

The sacroiliac joint is innervated by the superior gluteal nerve (L4-L5) and the 5th lumbar nerve to the 2nd sacral nerve (L5-S2) (Forst, Wheeler, Fortin and Vilensky, 2006).

B. Innervations of the hip joint

Hilton’s Law states that a nerve that supplies the muscle over a joint also innervates that joint.

- The femoral nerve innervates the anterior aspect of the hip joint, along with the articular rami of the muscular branches of the pectineus and rectus femoris
- The obturator nerve innervates the inferior aspect of the hip joint, along with the articular branches arising from of the obturator externus
- The nerve to the quadratus femoris innervates the posterior aspect of the hip joint
- The superior gluteal nerve (L5-S1) innervates the superior aspect of the hip joint (Moore, Dalley and Agur, 2010)

2.3 Running

2.3.1 Phases of Running

Running and walking are essentially the same. The major difference is the appearance of a period of nonsupport and an increase in the overall range of motion that occurs whilst running. Walking and running can be divided
into two phases called the swing and support phase (Hamilton and Luttgens, 2002).

The swing phase starts with a toe off and completes with the foot landing on the running surface. This phase is mainly muscular (as described in detail in the muscular section). The flexed leg brings the mass of the leg close to the hip. This occurs to minimise inertia and increase the forward movement of the thigh which drives the center of gravity of the body forward (Hamilton and Luttgens, 2002).

The support phase starts with contact of the front part of the foot with the running surface and is completed when toe off occurs. The faster speed one runs at, the shorter this period lasts for (Hamilton and Luttgens, 2002).

Figure 2.1 shows the phases of walking. In running the double support period indicated by A and E do not exist. The rest of the phases occur in running the only difference noted is the speed at which it occurs at and the stance phase is shorter and heel strike may not occur but may rather involve the ball of the foot landing (Moore, Dalley and Agur 2010; Hamilton and Luttgens, 2002).

![Figure 2.1 Phases of Walking](image)

**Figure 2.1 Phases of Walking** (Moore, Dalley and Agur, 2010)
2.3.2 Running Biomechanics

Running is governed by two factors as mentioned previously: stride length and frequency. To influence sprinting capabilities; a change must be made in either stride length or frequency and/or a combination of both. This means that the individual must increase the length of strides taken or increase the amount of steps taken (Magness, 2010).

In running an individual’s style of running is either stride rate dependent or stride frequency dependent. This dependency may alter or change depending on the nature of the activity the individual is participating in. It is crucial that the athlete be able to determine which style they naturally utilise (stride dependent or frequency dependent) because altering natural running gait may increase the energy expenditure and the cost of effort could ultimately decrease performance (Magness, 2010).

Research indicates that hip range of motion is increased through chiropractic spinal manipulative therapy of the hip and sacroiliac joint (Sandell, Palmgren and Bjorndahl, 2008; Holt, Taylor and Murphy, 2010). This means that chiropractic spinal manipulative therapy may influence stride length by increasing the range of motion at the hip joint as well as stimulating the nervous system through spinal manipulative therapy which might have an effect on stride frequency.

2.3.3 Specific Rugby Biomechanics and common injuries

Rugby is a contact sport where injuries occur often and frequently. There are two types of injuries that occur, extrinsic and intrinsic. Extrinsic injuries are injuries that occur when an external force is applied directly to the body, like being tackled. Intrinsic injuries do not result from external forces but
rather from repetitive overuse and are often associated with abnormal body biomechanics which predisposes one to these types of injuries (Kaux et al., 2015).

Thus chiropractic care in this case can only have an impact on intrinsic injuries pre event. Muscular injuries occur frequently and the most common muscular injuries involve the lower limbs musculature. This generally involves the iliopsoas, adductors, quadriceps, hamstrings, gastrocnemius and the soleus muscles. In sprinting, muscles are injured as a result of trying to propel the body forward as fast as possible. The iliopsoas is crucial and one of the most commonly injured muscles. This commonly presents with hip flexor tightness which can be detected by the Modified Thomas Test. This test reveals limited hip extension when positive (Kaux et al., 2015; Pook, 2012).

This has been proposed as a possible cause for decreased performance in running. This can be explained as the effect of decreased hip extension which leads to increased anterior pelvic tilt leading to leg length discrepancies and other abnormal biomechanical faults which all together may decrease optimal sporting performance (Sandell, Palmgren and Bjorndahl, 2008).

Hip range of motion is crucial, thus, limited hip extension as a result of tightness of the anterior structures may limit range of motion impacting on performance. It has been suggested that a chiropractic manipulation of the restricted or dysfunctional segments may improve the biomechanical efficiency and in doing so improve the arthokinematic chain and ideally improving running performances (Sandell, Palmgren and Bjorndahl, 2008).
2.4 Conclusion

Acceleration and sprinting are important aspects of athlete’s participating in field sports such as rugby (Murphy, Lockie and Coutts, 2003).

It has been determined that acceleration is one of the crucial aspects of speed and this is usually obtained over 10 to 15 metre distances whereas maximal speed is achieved at the distances 30 to 50 metres. This means that having a good combination of both will facilitate you greatly as acceleration will allow you to reach high speeds quicker and once sprint speed is achieved one’s ability to be quick is the ability to maintain this speed (Pook, 2012).

Chiropractic manipulations have an effect on both the spine and nervous system and the structures surrounding the joints including the muscles. This is seen through improvements of range of motion, reduction of pain and increased strength post chiropractic manipulation (Smith and Cox, 2000; Sandell, Palmgren and Bjorndahl, 2008; DeVocht, Pickar and Wilder, 2005). Thus chiropractic manipulation may improve the rugby player’s performance of acceleration and sprint speed.
CHAPTER THREE - METHODOLOGY

3.1 Introduction

This chapter serves to explain the participant selection, treatment approach, data obtained, ethical considerations and the analysis of the data.

In this study one group of 20 male rugby players that presented with a positive Modified Thomas Test were chosen as participants. Each participant received chiropractic spinal manipulative therapy which was delivered to the sacroiliac and/or hip joint.

3.2 Study Design

This was a pre and post test study design. This study used one group to determine whether chiropractic spinal manipulative therapy had an impact on pre and post test measures of performance indicators on rugby players that presented with limited hip extension. The performance indicators were tested measuring acceleration over 10 metres and sprint speed over 30 metres, utilising the Smartspeed timing lights and the measurement of hip range of motion using a digital inclinometer and the performance of the Modified Thomas Test.

3.2.1 Aim of Study

The aim of this study was to determine the effect of chiropractic spinal manipulative therapy delivered to the hip and/or sacroiliac joint on athletic
performance of rugby players with specific focus on acceleration, maximal sprinting and range of motion of the hip joint.

3.2.2 Participant Recruitment

Twenty male rugby players that presented with limited hip extension and are between the ages of 18 and 35 were eligible for the study. The participants were required to have played rugby in the last year and were actively recruited from varsity, touch, club and social rugby teams. Other participants were encouraged to take part in the study by an advertisement placed in the University of Johannesburg Chiropractic day clinic on the Doornfontien Campus (Appendix A).

3.2.3 Sample Size and Selection

Twenty participants that were eligible were recruited to be a part of the research. The participants were required to comply with the inclusion and exclusion criteria. The researcher explained the research to the participants and the information sheet (Appendix B) was given to each participant to read. The participants were then required to read and sign the consent form (Appendix C). Each of the twenty participants received a treatment protocol which involved spinal manipulative therapy of the sacroiliac and/or hip joints. All participants were placed in one group as this study was designed as a pre and post test study design.

The sample size was recommended by a study by Sandell, Palmgren and Bjorndahl (2008).
3.2.4 Inclusion Criteria

- Participants were required to be in the 18-35 age category. The reasoning behind a small gap in ages was to minimise other factors that could influence the results. e.g. Those younger than 18 years old were deemed skeletally immature and those older than 35 years old were more likely to have an injury that excluded them from participation.
- The participants had to have played rugby or touch rugby at either school, varsity or at club level for a minimum of one season in the previous year.
- The participants had to test with a positive, for the Modified Thomas Test (Sandell, Palmgren and Bjorndahl, 2008).
- The participants had to be male, as rugby is a male dominant sport and participants were more readily available.
- Participants had to present with at least one motion restriction in the hip and/or sacroiliac joint which was confirmed by motion palpation (Sandell, Palmgren and Bjorndahl, 2008).

3.2.5 Exclusion criteria

- Participants that demonstrated any contra indications to chiropractic spinal manipulative therapy (Gatterman, 2004) (Appendix D).
- Presented with a history of lumbar spine surgery or neuromuscular disease.
- Any current musculoskeletal condition that was likely to affect the outcome of the study or alter the performance of the participants such as a muscular strain or ligament sprain and/or ankle or knee injury.
- Participants were not permitted to receive any other form of treatment that may have interfered with the outcome of the study.
3.3 Treatment Approach

3.3.1 Consultation Procedure

The participants were required to partake in a pre and post test study design with six chiropractic treatments between the tests.

The initial consultation included an explanation of the study to every participant and involved the following:

- The participants were eligible to partake in the study by testing a positive for the Modified Thomas Test and meeting the requirements of the inclusion and exclusion criteria.
- The participants were asked to read the information (Appendix B) and sign the consent forms (Appendix C).
- The researcher completed a case history (Appendix E), full physical examination (Appendix F), lumbar spine and hip regional examination (Appendix G and H) and a Subjective, Objective, Assessment and Plan (SOAP) note (Appendix I).
- The researcher measured and recorded range of motion of the hip joint in flexion and extension, performed the Modified Thomas Test and collected acceleration and sprint speeds times in seconds.
- The mean of two sprints were measured prior to treatment. This was recorded in the score sheet (Appendix J).
- The researcher motion palpated the sacroiliac and hip joints and performed spinal manipulative therapy on restrictions found in the hip and/or sacroiliac joints.

Each participant received seven consultations. One initial consultation mentioned above and five follow up consultations, the seventh consultation was purely for measurements of the objective data (Acceleration, sprint speed, hip range of motion and performance of the Modified Thomas Test).
Two test periods were performed. This included a pre and post chiropractic treatment, measurements of acceleration and maximal sprint speed. Before the sprints were performed the participants were allowed to perform a five minute warm up technique that was non-specific and that the participant was comfortable with.

The follow up consultations included motion palpation of the sacroiliac and hip joints. Chiropractic spinal manipulative therapy was delivered to the identified restrictions. All objective data was recorded at the following intervals: At the first and 7th consultations. At the fourth consultation only the measurements of range of motion and Modified Thomas Test were recorded. The seventh consultation included only measurements of the objective data and included no treatment.

3.4 Objective Data

During the trial period of this study, sprints were performed at the 1st and 7th consultations. A maximum of two sprints were allowed for each participant for each test period.

3.4.1 Smartspeed Timing Lights

The Smartspeed system was used to measure athletic performance over set distances. This system uses beacons, these beacons are timing lights. The timing lights were set up at the 10 and 30 metre marks. The beacons were placed opposite each other at the specified distances and a beam was created between the two beacons. When the beam is broken by the athlete it records the time at the set distances. This system utilised error correction
Error correction helped eliminate false signaling starts. This system worked with a microprocessor that could interpret any number of breaks to the beam but would simply record the largest event or break. This eliminated false starts due to arms and/or hands breaking the beam before the body does and improving overall accuracy (D'Auria, Tanner, Sheppard and Manning, 2006; Earp and Newton, 2010).

The scores of acceleration and maximal sprinting were automatically recorded by the Smartspeed system and were displayed on the screen. The score was provided for each beam the athlete broke. This was in accordance with the set distances and was recorded in the score sheet by the researcher (D'Auria, Tanner, Sheppard and Manning, 2006; Earp and Newton, 2010); (Appendix J). The participants started with a non-specific five minute warm up that they were comfortable with. The participants were instructed to begin the sprint testing from a standing start, then to run as they normally would and then to run as quickly as possible past the last beam. The participants ran as quickly as possible over the 10 and 30 metre distances breaking the beams. The participants performed the sprints twice, and the mean of the two sprints was the participants’ score.

3.4.2 Range of Motion

Hip flexion and extension range of motion measurements were obtained with a digital inclinometer. This device measured the angle between the vertical direction of gravity as a reference point and the body segment surface. Inclinometers have been found to be reliable and are highly recommended by the American Medical Association (AMA) for assessing spinal range of motion (Norkin and White, 2009). According to Roach, Juan, Suprak and Lyda (2013) inclinometers have been proven to demonstrate a
good reliability for measurements of hip range of motion in healthy individuals.

A. Hip flexion procedure

The participant was placed in a supine position on a plinth or chiropractic bed with legs and knees in a neutral position. The participant was stabilised at the pelvis. In the neutral position the digital inclinometer was placed on the side of the femur being tested and the zero button was pressed. The patient was instructed to maximally flex the hip being tested and hold it in that position. The hold button was pressed to record the maximally flexed hip. This test was repeated twice to ensure accuracy. The expected or normal range of motion for hip flexion is $120^\circ$ (Mulligan, 2014; Acumar™, 2008).

B. Hip extension procedure

The participant was positioned in a prone position on a plinth or chiropractic bed. It was essential that the pelvis was stabilised. The digital inclinometer was placed with the patient in a neutral position on the femur being tested. The inclinometer was zeroed. The participant was required to extend the hip joint to the maximal range of hip extension. The hold button was pressed to record the score. It was essential that the anterior superior iliac spine remain on the table or bed. The expected or normal hip extension range of motion is $30^\circ$ (Mulligan, 2014; Acumar™, 2008).
3.4.3 Modified Thomas Test

The Modified Thomas Test is the orthopedic test that was used to assess hip flexibility; specifically indicating tightness of the iliopsoas and quadriceps muscles (Sandell, Palmgren and Björndahl, 2008; Peeler and Anderson, 2008).

This test was proven to be a reliable measure of determining limited hip extension. This indicated that the individuals tested had limited hip extension. Limited hip extension has been accredited to cause tightness of the hip flexor muscles and or decreased elasticity of joints and/or tendons. This could result in increased anterior pelvic tilt causing leg length inequalities and abnormal biomechanics. This indicated that there was a possible dysfunction of the joints, specifically of the sacroiliac joint and this could have been a cause of decreased running performance (Sandell, Palmgren and Björndahl, 2008).

The Modified Thomas Test was performed in the following manor:

- The participant was instructed to lie supine on the bed with their legs hanging off the foot end of the bed
- The participant placed both legs in maximal flexion and hold them in that position
- The leg that was being tested was lowered to the bed whilst the other limb was held in maximal flexion
- A positive score was indicated by a decreased hip extension and was obtained by the lateral femoral condyle being higher than the joint axis of the hip and indicated a positive score (Sandell, Palmgren and Björndahl, 2008; Peeler and Anderson, 2008)
A negative score was given when the lateral femoral condyle was below the hip joint axis giving a score of below zero (Sandell, Palmgren and BJORNDahl, 2008).

A positive score indicated that the participant had tight quadriceps and/or iliopsoas muscles and may have shown decreased range of motion, specifically in hip extension.

3.5 Intervention

Treatment commenced with motion palpation of the sacroiliac and hip joints to determine restrictions to movement which are classified as either fixations or subluxations (WHO, 2005). This was performed in the same manner for all participants with the use of dynamic motion palpation; as this has shown the highest degree of inter examiner reliability over time (Sandell, Palmgren and BJORNDahl, 2008). The restrictions identified received chiropractic spinal manipulative therapy in the form of the diversified technique.

3.5.1 Chiropractic Techniques

The following Chiropractic techniques (Appendix L) were used:

- Thigh ilio-deltoid
- Ischial Popliteal Deltiod
- Sacro-Ilio Cross (Kirk, Lawrence and Valvo, 1985)
- Hip
  - Long axis distraction
  - Internal and External rotation
  - Inferior glide in flexion
Anterior to Posterior Glide
Posterior to Anterior Glide (Bergmann and Peterson, 2011)

3.6 Data Analysis

The raw data gathered from the study was age, a positive or negative score for Modified Thomas Test, hip range of motion and acceleration and sprint speed. This was collected by the researcher and analysed by STATKON.

Frequencies and descriptive statistics of the whole sample were used to interpret the results obtained from the data.

The Modified Thomas Test scores were tested with the following:

- A Shapiro-Wilk test was used to test for normality
- The Cochran’s Q test was used to test the Modified Thomas Test over time at the different consultation intervals 1, 4 and 7
- A post-hoc test called the Wilcoxon Signed Ranks Test was used to compare the Modified Thomas Test results at the consultation intervals 1 and 4, 4 and 7 and 1 and 7, to compare and determine if differences were found and determine where the differences occurred between consultation intervals 1 and 4, 4 and 7 and 1 and 7

The Hip range of motion measurements obtained with the digital inclinometer were tested as the follows:

- A Shapiro-Wilk test was used to test for normality
- A non-parametric test called the Friedman test was performed on the results of the range of motion of the hip joint. This test was used to test over time to note any differences found at the consultation intervals 1, 4 and 7
The acceleration and sprint time’s scores were tested with the following:

- The Shapiro-Wilk test was used to test for normality
- The Wilcoxon Signed Ranks Test was used to test over time the differences between consultation 1 and 7

3.7 Ethical Considerations

This study was approved by the University of Johannesburg’s Higher Degrees and Ethics Committees under ethics number HDC-01-79-2014.

All participants that wished to partake in this particular study, that met the inclusion and exclusion criteria were required to read and sign the information (Appendix B) and consent forms (Appendix C) specific to this study. The information and consent forms outlined the names of the researcher, purpose of the study, benefits of partaking in the study, participant assessment and treatment procedures. Any risks, benefits and discomforts pertaining to the treatments involved were explained and the participant’s safety was ensured (prevention of harm). The participant’s privacy was protected as only the patient and researcher were in the treatment room and anonymity was ensured as the patient’s information was converted into data that could not be traced back to the individual. This was adhered to at all times throughout the research dissertation. The form also stated that standard doctor/patient confidentiality was adhered to at all times when compiling the research dissertation. The participant’s file was stored in a safe and secure room in an enclosed cabinet at the University of Johannesburg Chiropractic day clinic. The participant was informed that their participation was on a voluntary basis and that they were free to withdraw from the study at any stage. Any further questions the participants had were explained by the researcher; whose contact details were made available. The participant was requested to sign the information and consent
form, signifying that they understand all that was required of them for this particular study. Results of the study were made available on request.

With regards to this particular study, the risks and discomforts that could have occurred were slight pain or stiffness following sacroiliac and/or hip joint adjustments. This was a normal response and should dissipate within a day or two. The potential benefits of the study was an increase in athletic performance, improved hip range of motion and an effect on acceleration and sprint speed times.

Participants were referred to the appropriate practitioner when necessary.
CHAPTER FOUR - RESULTS

4.1 Introduction

This chapter and findings arose from the study presented.

This study consisted of one group of 20 male participants. All participants received spinal manipulative therapy to the sacroiliac and/or hip joints.

The objective data used in this study included: either a positive or negative score for the Modified Thomas Test, measurements of hip range of motion, acceleration over 10 metres and sprint speed over 30 metres of rugby players that presented with tight hip flexors. The acceleration and sprint speeds were measured in seconds (s) and hip range of motion in degrees.

The statistical analysis of the participants represents a small portion of the population therefore no assumptions could be made with regards to the population as a whole.

The p-value represents the level of significance of the results of the tests and was set at 0.05. A p-value that was less than or equal to 0.05 ($p \leq 0.05$) indicates that there was a statistically significant finding. If the p-value was greater than 0.05 ($p > 0.05$) this indicated that no statistical difference was noted. Statistical significance indicated that the results were not likely to have occurred due to random chance.

The analyses included:

- Demographic analysis of the age of the participants
- The objective measurements for the intra-group analysis included:
  - A Wilcoxon Signed Ranks Test was used for the 10 and 30 metre acceleration and sprint test
  - The Friedman Test was used to analyse the hip range of motion, specifically for flexion and extension
• The Cochran and Wilcoxon Signed Ranks Test were used to assess the Modified Thomas Test

4.2 Demographic Analysis

The population group consisted of 20 male participants (n=20). The participants performance was measured against their own performance in a pre and post test analysis of the data obtained.

4.2.1 Age

The participants that were eligible for the research were between the ages of 18 and 35 years. Participants that were older than 35 years old are rarely seen playing rugby and participants that are younger than 18 years old are skeletally immature so were also ruled out of the study.

Figure 4.1 A Bar Graph Representing the Number of Participants and their Ages

Mean = 25.35
Std Dev = 3.9
N = 20
With reference to Figure 4.1 above, the average age of the participants was 25.35 years. The minimum age was 18 years and the maximum age was 34 years. An age difference of 16 years was found between the minimum and maximum ages. The most common age found was 25.50 years and a standard deviation of 3.9 was noted. There was one participant for each of the following ages: 18, 21, 25, 27, 33 and 34 years old, two were 22 years old, five were 23 years old, three were 26 years old and four were 28 years old.

4.3 Intra-Group Analysis

The Cochran, Wilcoxon Signed Ranks and Friedman test were used in the intra-group analysis.

4.3.1 Modified Thomas Test

The Cochran test was used to analyse the data at the consultations 1, 4 and 7. Then a post hoc test called the Wilcoxon Signed Ranks test was used to determine where the difference occurred at the different consultations 1 and 4, 4 and 7 and 1 and 7.
With reference to Figure 4.2 above, it indicated the results of the Modified Thomas Test at the varying consultations. At the first consultation all the participants had a positive score. At the fourth consultation nine participants obtained a positive score and eleven participants received a negative score for the Modified Thomas Test. At the final, seventh consultation three participants were positive and seventeen tested negative for the Modified Thomas Test.

### A. Cochran test

Table 4.1 below shows the results obtained by the Cochran Test. The p-value obtained is 0.00 this was less than 0.05 which indicates a statistically significant difference was found.
Table 4.1 Showing the P-Value for the Modified Thomas Test as determined by the Cochran Test

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cochran's Q</td>
<td>21.37</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>2</td>
</tr>
<tr>
<td>P-Value</td>
<td>0.00</td>
</tr>
</tbody>
</table>

B. Wilcoxon Signed Ranks test

The Wilcoxon Signed Ranks test is a non-parametric post hoc test used once a statistically significant difference has been found to determine where the difference occurred when comparing the different consultations.

Table 4.2 Showing the P-Value for the Modified Thomas Test as determined by the Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th></th>
<th>Comparing the Results of the Modified Thomas Test 1 to Test 4</th>
<th>Comparing the Results of the Modified Thomas Test 4 to Test 7</th>
<th>Comparing the Results of the Modified Thomas Test 1 to Test 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Value</td>
<td>0.00</td>
<td>0.03</td>
<td>0.00</td>
</tr>
</tbody>
</table>

With reference to Table 4.2 above, the p-value level of significance was set at a p-value of less than or equal to 0.05 (p≤0.05). When comparing the Modified Thomas Test a significant difference was noted when comparing the different consultation periods to each other. This was seen by achieving a p-value of 0.00 when comparing consultation 1 to 4 and a p-value of 0.03 when comparing consultation 4 to 7 and a p-value of 0.00 when comparing
consultation 1 to 7. This means a statistically significant difference was found between all the groups.

4.3.2 Hip Range of Motion

The Friedman Test was the statistical test used to analyse the data for hip range of motion.

A. Hip range of motion - flexion

Table 4.3 Hip Flexion Range of Motion (in degrees) for Left and Right Hand Sides

<table>
<thead>
<tr>
<th>Flexion</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHS 1</td>
<td>99.49</td>
<td>104.53</td>
<td>60.50</td>
<td>15.35</td>
<td>60.50</td>
<td>122.60</td>
</tr>
<tr>
<td>RHS 4</td>
<td>95.01</td>
<td>95.48</td>
<td>72.80</td>
<td>11.88</td>
<td>72.80</td>
<td>114.20</td>
</tr>
<tr>
<td>RHS 7</td>
<td>99.46</td>
<td>101.10</td>
<td>77.25</td>
<td>9.60</td>
<td>77.25</td>
<td>118.40</td>
</tr>
<tr>
<td>LHS 1</td>
<td>97.71</td>
<td>97.83</td>
<td>83</td>
<td>7.74</td>
<td>83</td>
<td>110</td>
</tr>
<tr>
<td>LHS 4</td>
<td>103.43</td>
<td>100.80</td>
<td>98.55</td>
<td>13.38</td>
<td>80.05</td>
<td>138.95</td>
</tr>
<tr>
<td>LHS 7</td>
<td>101.76</td>
<td>101.53</td>
<td>82.40</td>
<td>9.31</td>
<td>82.40</td>
<td>124.45</td>
</tr>
</tbody>
</table>
In Table 4.3 above we see that the mean for hip flexion before spinal manipulative therapy on the right hand side was 99.49° and on the left hand side was 95.01°. The mean for hip flexion measured during the treatment period at consultation 4 on the right hand side was 99.46° and on the left hand side was 97.71°. The mean scores measured after the spinal manipulative therapy on the right hand side was 103.43° and on the left hand side was 101.76°. The standard deviation before the treatment period on the right hand side was 15.35° and on the left hand side was 11.88°, during the treatment period on the right hand side was 9.60° and on the left hand side was 7.74° and after the treatment period a standard deviation on the right hand side of 13.38° and on the left hand side of 9.31° was noted.

A minimum and maximum score for hip flexion before the treatment period on the right hand side of 60.50° and 122.60° and on the left hand side of 72.80° and 114.20° was recorded. In the treatment period a minimum and maximum score on right hand side of 77.25° and 118.40° and on the left hand side of 83° and 110° was noted. The post treatment scores for the minimum and maximum hip flexion scores measured on the right hand side was 80.05° and 138.95° and on the left hand side was 82.40° and 124.45°.

B. Friedman test

The Friedman Test is a non-parametric test used to test for differences between groups.
Table 4.4 Showing the P-Value for Hip Flexion on the Right Hand Side as determined by the Friedman Test

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi – Square</td>
<td>4.90</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>2</td>
</tr>
<tr>
<td>P – Value</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Table 4.4 above shows the p-value of 0.09 for hip flexion on the right hand side. It is greater than the p-value meaning that no statistically significant difference was noted.

Table 4.5 Showing the P-Value for Hip Flexion on the Left Hand Side as determined by the Friedman Test

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi – Square</td>
<td>9.70</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>2</td>
</tr>
<tr>
<td>P – Value</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 4.5 above shows the p-value of 0.01 for the Friedman test for hip flexion on the left hand side. It is less than the p-value set level of significance (p≤0.05) meaning that a significant statistical difference was noted.
C. Hip range of motion - extension

Table 4.6 Hip Range of Motion in Extension (in degrees) for Left and Right Hand side

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHS1</td>
<td>24.33</td>
<td>24.25</td>
<td>26.30</td>
<td>5.85</td>
<td>14.60</td>
<td>35.90</td>
</tr>
<tr>
<td>LHS1</td>
<td>22.66</td>
<td>24.08</td>
<td>17.70</td>
<td>5.98</td>
<td>4.80</td>
<td>31.55</td>
</tr>
<tr>
<td>RHS4</td>
<td>24.12</td>
<td>23.30</td>
<td>23.30</td>
<td>5.29</td>
<td>14.60</td>
<td>33.85</td>
</tr>
<tr>
<td>LHS4</td>
<td>23.50</td>
<td>24.10</td>
<td>5.95</td>
<td>6.32</td>
<td>5.95</td>
<td>33.60</td>
</tr>
<tr>
<td>RHS7</td>
<td>26.07</td>
<td>26.05</td>
<td>15.70</td>
<td>5.24</td>
<td>15.70</td>
<td>34.95</td>
</tr>
<tr>
<td>LHS7</td>
<td>25.02</td>
<td>25.75</td>
<td>9.40</td>
<td>5.14</td>
<td>9.40</td>
<td>35.00</td>
</tr>
</tbody>
</table>

In Table 4.6 above, the values for the hip extension are seen. The mean for hip extension prior to the treatment period on the right hand side was 24.33° and on the left hand side was 22.66°. The mean measured during the treatment period on the right hand side was 24.12° and on the left hand side was 23.50°. After the treatment period a mean of 26.07° was noted on the right hand side and was 25.02° on the left hand side. A standard deviation prior to treatment on the right hand side of 5.85° and on the left hand side of 5.98° was noted. In the treatment period the standard deviation on the right was 5.29° and on the left was 6.32° and after the treatment period on
the right hand side it was 5.24° and on the left hand side it was 5.14°. A minimum and maximum score is seen in the table. A minimum score of 14.60° and a maximum score of 35.90° was seen on the right hand side and on the left hand side a score of 4.80° and 31.55° was noted prior to the treatment period. In the treatment period a minimum and maximum of hip extension was seen on the right of 14.60° and 33.85° and on the left of 5.95° and 33.60°. After the treatment period the minimum and maximum found on the right hand side was 15.70° and 34.95° and on the left hand side was 9.40° and 35.00°.

**D. Friedman test**

The Friedman Test is a non-parametric test used to test for differences between groups.

**Table 4.7 Showing the P-Value for Hip Extension on the Right Hand Side as determined by the Friedman Test**

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi – Square</td>
<td>1.9</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>2</td>
</tr>
<tr>
<td>P – Value</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Table 4.7 above shows a p-value of 0.39 which is greater than the set p-value level of significance (p≤0.05). This means that no statistically significant difference was found.
Table 4.8 Showing the P-Value for Hip Extension on the Left Hand Side as determined by the Friedman Test

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi – Square</td>
<td>3.10</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>2</td>
</tr>
<tr>
<td>P – Value</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Table 4.8 above has a p-value of 0.21 for hip extension on the left hand side. This is greater than the set level of significance ($p \leq 0.05$) thus no statistically significant difference was found.

4.3.3 Acceleration

The Figure 4.3 below shows the varying scores for the pre treatment acceleration over 10 metres. The most common score was 1.8 seconds which occurred seven times, and then 1.6 and 2.6 seconds occurred four times. The next acceleration score was 2.2 seconds and 3 seconds which appeared twice each and 2.4 seconds which occurred once. The mean score was 2.14 seconds with a standard deviation of 0.42 seconds.
Figure 4.3 A Bar Graph illustrating the Frequency of the Scores obtained for the Acceleration Test Pre Treatment

The Figure 4.4 below shows the frequency of scores recorded post treatment period. The time 1.8 seconds was the most commonly occurring time and this was achieved nine times, 1.6 seconds was achieved five times and 2.6 seconds was seen four times and 2.2 seconds and 3 seconds occurred once each. The mean score was 2.03 and the standard deviation of 0.42 seconds was noted.

Figure 4.4 A Bar Graph illustrating the Frequency of the Scores obtained for the Acceleration Test Post Treatment
A. Wilcoxon Signed Ranks test

Table 4.9 Showing the P-Value for Acceleration as determined by the Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th>comparing the pre and post treatment acceleration scores</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>p-value</td>
<td>0.29</td>
</tr>
</tbody>
</table>

In Table 4.9 above a p-value of 0.29 is seen which is greater than the set p-value level of significance which means no statistically significant difference was found.

4.3.4 Sprint Speed

The Figure 4.5 below, shows the vary sprint speeds achieved by the participants pre chiropractic intervention, the mean was 4.55 seconds and the standard deviation noted was 0.29 seconds. The most repeated score was 4.5 seconds occurring eight times, then 4.25 seconds and 4.75 seconds occurring three times each. The rest occurred two times each at 4 seconds, 5 seconds and 5.25 seconds.
Figure 4.5 A Bar Graph illustrating the Frequency of Scores obtained for the Sprint Speed Test Pre Treatment

The Figure 4.6 below shows the varying scores obtained by the participants following the treatment period with a mean of 4.66 seconds and a standard deviation of 0.45 seconds. The scores obtained were 4.75 seconds which occurred eight times, 4.5 seconds which occurred seven times, then 4 seconds occurred twice and the rest occurred once each at 5, 5.5 and 6 seconds.

Figure 4.6 A Bar Graph illustrating the Frequency of Scores obtained for the Sprint Speed Test Post Treatment
A. Wilcoxon Signed Ranks test

Table 4.10 Showing the P-Value for Sprint Speed as determined by the Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th>P – Value</th>
<th>Comparing the Pre and Post Treatment Sprint Speed Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.26</td>
<td></td>
</tr>
</tbody>
</table>

The table 4.10 above shows the p-value of 0.26 using the Wilcoxon Signed Ranks Test. This p-value is higher than the set level of significance of \( p \leq 0.05 \) which means no statistically significant difference was noted between the pre and post treatment periods.
CHAPTER 5 - DISCUSSION

5.1 Introduction

This chapter uses the figures and tables from chapter four to discuss the results obtained. The priority is to focus on any statistically significant results.

Possible explanations of the results will be explored along with the aim in chapter one and the literature review in chapter two.

5.2 Demographic Data Analysis

This data included age and showed that the participants were comparable to each other.

5.3 Intra-Group Analysis

5.3.1 Modified Thomas Test

The results obtained when performing the Modified Thomas Test showed a statistically significant difference. The Cochran test had a p-value of 0.00, whilst the Wilcoxon Signed Ranks test showed differences over time when comparing the different consultations. The comparisons showed a p-value of 0.00 when comparing consultation 1 to 4 (p=0.00) and at 4 and 7 a p-value of 0.03 (p=0.03) was found and when comparing consultation 1 and 7 a p-value of 0.00 (p=0.00) was noted. This indicated that a change over time was noted. Initially at the pre treatment period 100% of the participants
achieved a positive score for the Modified Thomas Test. Post treatment the participants changed to 15% scoring positively and 85% scored negative. The improvement seen is unlikely to have occurred by chance and could show chiropractic manipulation as the cause of the improvement. Chiropractic spinal manipulative therapy is proven to correct biomechanical deficiencies such as leg length inequalities and/or anterior pelvic tilts which both commonly occur when a positive score is obtained with the Modified Thomas Test (Sandell, Palmgren and Bjorndahl, 2008; Haldeman, 2005). A single spinal manipulative therapy can decrease paraspinal muscle electromyography activity (Smith and Cox, 2000). Thus, spinal manipulative therapy may have had an influence on the surrounding soft tissue, decreasing muscular activity. This could possibly be a cause for improvement. The reason for the increased differences noted from consultations 1 to 7 is possibly due to the participant receiving three more chiropractic spinal manipulative interventions compared to consultations 1 and 4 where each participant received only three spinal manipulative interventions.

5.3.2 Hip Range of Motion

In this group a p-value of 0.09 (p=0.09) was found for hip flexion on the right hand side indicating that no statistically significant difference was found. In hip flexion on the left hand side a p-value of 0.01 (p=0.01) was obtained and this was less than the set level of statistical significance (p≤0.05). This indicates that a statistically significant difference was found when comparing the data between consultations 1, 4 and 7. The mean for left hand side hip flexion pre treatment was 95° and post treatment of 101.8° thus an improvement of 6.8° was found. A possible explanation for the improvement of hip flexion on the left hand side is the spinal manipulative therapy and/or possibly due to a learned response from repeating the procedure three times. As mentioned above spinal manipulative therapy may correct
biomechanical deficiencies and decrease muscular activity (Sandell, Palmgren and Bjorndahl, 2008; Haldeman, 2005). This could allow for optimal or better functioning of the joints and decrease the restrictions from muscles, ligaments and capsules and allow greater range of motion to be achieved. Spinal manipulative therapy has also been proven to improve range of motion of the hip joint (Pollard, 2000). Another factor is that the majority of the world is right hand side dominant so it can be assumed that the majority in the group are right handed. As a result the left hand side could have improved because the less dominant side is used less and therefore less likely to suffer from overuse injuries and is more likely to show positive improvements (Ajmal and Masud, 2012).

Hip extension on the right hand side had a p-value of 0.39 (p=0.39) and on the left hand side of 0.21 (p=0.21). This indicated that no statistically significant difference was noted with the results.

5.3.3 Acceleration and Sprint Speed

The groups p-value for the acceleration was 0.29 (p=0.29), thus indicating no statistically significant difference was found. Although no significant improvement was noted for acceleration the scores overall were more consistent post treatment and an insignificant improvement in the means was seen. The mean pre treatment was 2.14 seconds and post treatment was 2.03 seconds thus improving overall by 0.11 seconds. A possible reason for this may be as a result of chiropractic manipulation performed.

The sprint speed analysis achieved a p-value of 0.26 (p=0.26) also showing no statistical significant difference. If one looks at the means as above for the pre treatment it was 4.55 seconds and post treatment of 4.64 thus showing an overall decrease in performance in sprint speed of 0.09 seconds. This could be due to changes in the surrounding musculature and biomechanics of the sacroiliac and hip joint causing changes in their natural
running style (Sandell, Palmgren and Bjorndahl, 2008; Haldeman, 2005). This change in their natural running style can increase the effort required to perform thus possibly affecting optimal performance. Other factors that could have decreased sprint speed performance is fatigue, technique and excessive body fat. The participants could have been more fatigued at the second testing and if the participant had poor sprinting techniques fluctuations in sprint speed are common (Coulson and Archer, 2009).
CHAPTER SIX - CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The aim of this study was to determine whether chiropractic manipulation improved the performance of rugby players. After completion of the study it was concluded that improvements were noted in the Modified Thomas Test and in hip flexion on the left hand side. It could be proposed that chiropractic manipulation performed over a treatment period of six sessions could have caused the changes seen in the specified performance indicators. Thus it could be concluded that chiropractic manipulation caused the improvements that were noted. In this study chiropractic manipulation is shown to have had no impact on performance and/or caused significant differences to be seen in acceleration, sprint speed and in the performance of hip extension. It can be concluded from this study that chiropractic manipulation has an effect on hip flexion and could induce change and/or improve repeated testing of the Modified Thomas Test but due to the small size of the sample group used in this study the objective data collected has limited statistical significance. Thus further chiropractic research is required in this field.

6.2 Recommendations

The following is a list of recommendations that is aimed at helping future researchers in improving and providing statistical significance for future studies in this field:

- The study should consist of a larger sample group as this would represent the population more accurately and therefore provide an
adequate clinical study so that sufficient statistical significance could be achieved

- Female rugby players should be included to test the difference of the study on female participants compared to male participants

- The measures of acceleration and sprint speed should be performed at every testing session so that if a difference is noted it can be determined where it occurred in the treatment period

- A second group should be added utilising asymptomatic participants to determine if a difference will be noted between the asymptomatic and symptomatic groups in terms of the effect of the chiropractic spinal manipulative therapy

- A smaller age group should be utilised to increase the comparability of the participants

- The sprint tests should be performed in the exact same location on the fields and at the same time for each participant

- The research should take the participants through a standard warm-up to increase group comparability

- This study could be performed on a longer basis, by the medical staff for a specific rugby club over an entire season

- Comparing the different chiropractic treatment protocols (stretching, dry needling, sport massage, active release and taping) for tight hip flexors to chiropractic manipulation to determine which has a greater effect on the performance indicators
REFERENCES


Sher, G. (2002). *The Effect of Sacroiliac Joint Manipulation on Quadriceps Muscle Strength*. Faculty of Health Sciences, University of Johannesburg; pp 34-43.


APPENDICES

APPENDIX A: Advertisement

ARE YOU A RUGBY PLAYER?

Interested in sprinting?

If you are between the ages of 18 and 35, come take part in a research study aimed at determining the effect of chiropractic spinal manipulative therapy on acceleration and sprinting times.

Come and visit me in the University of Johannesburg Chiropractic Day Clinic on Doornfontein Campus: Gate 7, Sherwall Road, Doornfontein

Please contact Tony Bleekers at 0829333462 if you are interested
APPENDIX B: Information Form

DEPARTMENT OF CHIROPRACTIC
FACULTY OF HEALTH SCIENCES
Telephone: (011) 559 6218

Date: ____________________

INFORMATION FORM

Dear Participant,

My name is Tony Bleekers and I am doing my Master’s Degree at the University of Johannesburg. I would like to invite you to consider participating in my research study entitled:

THE EFFECT OF CHIROPRACTIC MANIPULATION OF THE HIP AND SACROILIAC JOINT ON ACCELERATION AND SPRINTING TIME OF MALE RUGBY PLAYERS THAT PRESENT WITH A POSITIVE MODIFIED THOMAS TEST

Before agreeing to participate, it is important that you read and understand the following explanation of the purpose of the study, the study procedures, benefits, risks, discomforts, and precautions as well as the
alternative procedures that are available to you, and your right to withdraw from the study at any time.

This information leaflet is to help you to decide if you would like to participate. You need to understand what is involved before you agree to take part in this study. You may find that this form may contain words that you do not understand. If you have any questions, do not hesitate to ask me. You may also take home a copy of this form before signing the consent form to think about or discuss with family or friends before making your decision.

Purpose of the study

The purpose of this study is to determine the effect of chiropractic spinal manipulative therapy of the sacroiliac and hip joints of rugby players that present with limited hip extension.

Procedure

Should you decide to partake in this study you will first be screened for what we call “inclusion and exclusion criteria”. The inclusion criteria for this study are:

- Participants need to be in the 18-35 age category
- The participant has to have played or play rugby or touch at school, varsity, social or club level for a minimum of one season
- The participant has to present with a positive score for the modified Thomas test, (Sandell, Palmgren and Bjorndahl, 2008). That means that the rugby player presents with tight ilipsoas and quadriceps muscles which can cause limited hip range of motion
- The participant has to be male as rugby is a male dominant sport and participants are more readily available
- Participant have to present with at least one restriction in the hip and sacroiliac joint which will be confirmed by motion palpation (Sandell, Palmgren and Bjorndahl, 2008)
The exclusion criteria for this study are:

- Participants that demonstrate any contra indications to chiropractic spinal manipulative therapy (Gatterman, 2004) (Appendix D)
- Present with a history of lumbar spine surgery or neuromuscular disease
- Any current musculoskeletal condition that is likely to affect the outcome of the study or alter the performance of the participants such as a muscular strain or ligament sprain and or ankle or knee injury
- Participants may not receive any other form of treatment that may interfere with the outcome of the study

I would especially like you to note that you may not participate in another research study, nor take any medications that may influence the outcomes of this study. Not all medications may be a problem, so please be open with me regarding any medication or supplements you are using. Also, please be open with me regarding your health history, since you may otherwise harm yourself by participating in this study.

After screening, a 3 week treatment period will commence where the participant will receive 2 treatments a week for 3 weeks. All the objective data (modified Thomas test, range of motion, acceleration and sprinting) will be measured at the 1st and 7th consultations before treatment and at the 4th consultation only the range of motion and modified Thomas test will be measured. No treatment will be performed in the 7th consultation but all objective data will be measured and recorded (Appendix E).

20 participants will participate in this study and it will be performed in South Africa. The entire study, including all treatments will take place at the University of Johannesburg’s Chiropractic day clinic and the sprints will be timed at the University fields near the campus. The total amount of time required for your participation in this study will be 7 consultations over a 3 week period. All consultations will take on average 30 minutes except the first consultation which will take approximately 1 hour. Spinal manipulation
is a standard procedure that is performed as part of a routine chiropractic
treatment and may present a slight risk of discomfort. You may or may not
hear a popping sound associated to the treatment. If you do hear this
sound it is completely normal and is as a result of a normal physiological
response. It is possible that you may feel some discomfort, although this is
uncommon.

As this study is investigational there may be other risks or side effects
which are unforeseen or unknown. You should immediately contact me if
any side effects occur throughout your participation in this study.

As your participation in this study is entirely voluntary you can decline to
participate, or stop at any time, without stating any reason. Your
withdrawal will not affect your access to other medical care. Alternate
treatment in the form of stretches or soft tissue therapy is often used to
treat tight hip flexors. If you decide not to take part in this study you may
still receive the best current care from your usual practitioner. This may or
may not include this studies’ treatment.

If it is deemed to be in your best interest, I retain the right to withdraw you
from the study. Injuries that result in damage to bone, ligaments or other
soft tissue would be contraindicated to this type of treatment. If you get
diagnosed by another medical practitioner during this trial for any medical
condition that was not stated in your original history, please, notify me.
Some conditions may be contraindicated to this treatment.

If at any time between your visits, you feel that any of your symptoms are
causing you any problems, or you have any questions during the study,
please, do not hesitate to contact me. The 24 hour telephone number
through which you can reach me is 0829333462.

If you want any information regarding your rights as a research participant,
or complaints regarding this research study, you may contact the
University of Johannesburg’s Academic Ethics committee which is an
independent committee established to help protect the rights of research participants.

This study protocol has been submitted to the University of Johannesburg’s Academic Ethics Committee and written approval has been granted by that committee. The study has been structured in accordance with the Declaration of Helsinki if 2008, which deals with the recommendations guiding doctors in biomedical research involving human participants.

Should any injuries occur as a result of this study the University of Johannesburg has medical insurance that will cover the expenses related to the injury.

**Confidentiality**

All information obtained during the course of this study will be kept strictly confidential. Recorded data used for the statistical analysis by STATKON will not include any information that identifies you as a participant in this study. Data that may be reported in scientific journals will not include any information that identifies you as a participant in this study.

Any information uncovered regarding your test results or state of health as a result of your participation in this study will be held in strict confidence. You will be informed of any finding of importance to your health or continued participation in this study but this information will not be disclosed to any third party without your written consent. The only exception to this rule will be cases of communicable diseases were a legal duty of notification of the Department of Health exists. In this case, you will be informed of my intent to disclose such information.

Thank you for taking the time to read this form and consider participation in this study.
Should you have any concerns or queries regarding the current study, the following persons may be contacted.

Researcher: Tony Bleekers  tbleekers@gmail.com

Supervisor: Dr I Landman  011 559 6820

UJ Ethic's clearance number: ____________________________
DEPARTMENT OF CHIROPRACTIC

CONSENT FORM

Dear participant

Before signing this consent form please take your time and read the information form.

Personal doctor/specialist notification option

Please indicate below, whether you want me to notify your personal doctor or your specialist of your participation in this study:

- YES, I want you to inform my personal doctor/specialist of my participation in this study
- NO, I do not want you to inform my personal doctor/specialist of my participation in this study
- I do not have a personal doctor/specialist

Do you have any questions related to this study?

INFORMED CONSENT

- I hereby confirm that I have been informed by the researcher Tony Bleekers about the nature, conduct, benefits and risks of this study with the title:

THE EFFECT OF CHIROPRACTIC MANIPULATION OF THE HIP AND SACROILIAC JOINT ON ACCELERATION AND SPRINTING
TIME OF MALE RUGBY PLAYERS THAT PRESENT WITH A
POSITIVE MODIFIED THOMAS TEST

- I have also received, read and understood the above written
  information (participant information leaflet) regarding this study
- I am aware that the results of this study, including personal details
  regarding my gender, age, date of birth, initials and diagnosis will
  be anonymously processed into a study report
- In view of the requirements of research, I agree that the data
  collected during this study can be processed
- I may, at any stage, without prejudice, withdraw my consent an
  participation in this study
- I have had sufficient opportunity to ask questions and (of my own
  free will) I declare myself prepared to participate in this study.

Signed Participant

Printed name       Signature       Date and time

Signed Researcher

Printed name       Signature       Date and time
APPENDIX D: Contra-Indications to Spinal Manipulative Therapy

Contra-Indications to Spinal Manipulative Therapy (Gatterman, 2004)

1. Vascular complications
   - Vertebral-basilar insufficiency
   - Atherosclerosis of major blood vessels
   - Aneurysms

2. Tumours
   - Lung
   - Thyroid
   - Prostate
   - Breast
   - Bone

3. Bone infections
   - Tuberculosis
   - Bacterial infection (osteomyelitis)

4. Traumatic injuries
   - Fractures
   - Joint instability or hypermobility
   - Severe sprains or strains
   - Unstable spondylolisthesis

5. Arthritis
   - Ankylosing spondylitis
   - Rheumatoid arthritis
- Psoriatic arthritis
- Reiter’s syndrome
- Osteoarthritis (unstable or late stage)
- Uncoarthrosis

6. Psychological considerations

- Malingering
- Hysteria
- Hypochondriasis
- Pain intolerance

7. Metabolic disorders

- Clotting disorders
- Osteopenia (osteoporosis, osteomalacia)

8. Neurological complications

- Sacral nerve root involvement from medial or massive disc protrusion
- Disc lesions (advancing neurological deficits)
- Space-occupying lesions
APPENDIX E: Case History

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

CASE HISTORY

Date:______________

Patient:____________________________ File No:______________
Age:_______  Sex:_______  Occupation:__________________
Student:___________________  Signature:_________________

Complies with Inclusion criteria of the research:

Clinician:____________________________
Signature:___________________________

Examination:

Previous: UJ  Current: UJ
Other  Other

X-ray Studies:

Previous: UJ  Current: UJ
**Clinical Path. Lab:**

Previous: UJ  
Current: UJ  
Other  

**Case status:**

PTT: Conditional  
Signed off:  
Final sign out:  

**Recommendations:**

---

**Students case history**

1. Source of history: 
2. Chief complaint: (patient's own words)

___________________________________________________________
___________________________________________________________
___________________________________________________________
___________________________________________________________

3. Present illness: 
   Location:  
   Onset:  
   Duration:  
   Frequency:  
   Pain (character):  
   Progression:  
   Aggravating factors:  
   Relieving factors:  

---
Associated Sx’s and Sg’s

Previous occurrences

Past treatment and outcome

Other complaints:

4. Past history

General health status

Childhood illnesses

Adult illnesses

Psychiatric illnesses

Surgery

Hospitalisation

5. 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

6. 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

7. Psychosocial history:
   Home situation
   Daily life
   Important experiences
   Religious beliefs

8. 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
PHYSICAL EXAMINATION

Underline abnormal findings in RED. Date: _________________

Patient: ___________________ File No: ___________________

Clinician: ___________________ Signature: ________________

Height: __________ Weight: _________ Temp: __________

Rates: _______ Heart: _______ Pulse: _______ Respiration: ________

<table>
<thead>
<tr>
<th>Blood pressure:</th>
<th>Arms:</th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Legs:</td>
<td>L</td>
<td>R</td>
</tr>
</tbody>
</table>

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: 35°
   Rot. to L: 35°

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
      - Scapula-thoracic
- acromioclavicular
- elbow
- wrist

14. Chest measurement:

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

- inspiration
- expiration

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 gland
   - nasolacrimal duct
   - position and alignment
   - corneas and lenses

   - corneal reflex

   - ocular movement
- visual fields
- accommodation
- Opthalmascopic

**Examination**

- iris
- pupils
- red reflex
- optic disc
- vessels
- general background
- macula
- vitreous
- lens

4. Ears:

- auricle

**Inspection**

- 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
     - CN X
     - inspection

9. Neck
   - Posture
   - Size
   - Swelling
   - Scars
   - discolouration
   - Hair line

Ranges of motion (cervical spine)

The following are normal ranges of motion

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

L. lat Flex

Flex.

R. Rot

L. lat Flex

Ext.

R. Lat Flex

- Lymph nodes
- Trachea
- Thyroid
- Carotid arteries (thrills, bruit)
- Cranial Nerves
  - CN V
  - CN VII
  - CN VIII (nystagmus)
  - CN IX
  - CN XI
  - CN XII

9. NEUROLOGICAL EXAMINATION (CERVICAL SPINE)

<table>
<thead>
<tr>
<th>DERMATONES</th>
<th>Left</th>
<th>Right</th>
<th>MYOTOMES</th>
<th>Left</th>
<th>Right</th>
<th>REFLEXES</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td></td>
<td></td>
<td>Neck Flexion C1/2</td>
<td>Biceps C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td></td>
<td></td>
<td>Lat. Neck Flexion C3</td>
<td>Brachio-radialis C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td></td>
<td></td>
<td>Shoulder Elevation C4</td>
<td>Triceps C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td></td>
<td></td>
<td>Shoulder Abduction C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td></td>
<td></td>
<td>Elbow Flexion C5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td></td>
<td></td>
<td>Elbow Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Forearm Pronation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forearm Supination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrist Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrist Flexion</td>
<td></td>
<td>C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finger Flexion</td>
<td></td>
<td>C8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finger Abduction</td>
<td></td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finger Adduction</td>
<td></td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Peripheral vasculature
   - Inspection
     - skin
     - nail beds
     - pigmentation
     - hair loss
   - Palpation
     - pulses: femoral, dorsalis pedis, popliteal, radial, post. Tibial, brachial
     - lymph nodes: epitrochlear, femoral (horizontal & vertical)
     - temperature (feet and legs)
   - Manual compression test
   - Retrograde filling (Trendelenburg) test
• Arterial insufficiency test

10. Musculoskeletal:

(i) 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></td>
</tr>
<tr>
<td>ext rot</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

|       | L       | R       |
| flex. |         | 130     |
| ext.  | 0/15    |         |

|      | L       | R       |
| plantar Flex | 45    |         |
| dorsiflex   | 20     |         |
| inversion   | 30     |         |
| eversion    | 20     |         |

|       | L       | R       |
| Apparent |       |         |
| Actual   |         |         |

• knee
• ankle

(ii) leg length

• Co-ordination - point to point
  - dysdiachokinesia

10. TMJ

• Inspection - ROM
  - deviation

• Palpation - crepitus
  - tenderness

11. Thorax

• Inspection - skin
- shape
- respiratory distress
- rhythm (respiratory)
- depth (respiratory)
- effort (respiratory)
- intercostals/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 (ronchi)
  - 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
MENTAL STATUS

(i) Appearance and behaviour
- level of consciousness
- posture and motor behaviour
- dress, grooming, personal hygiene
- facial expression
- affect

(ii) Speed and language
- quantity
- rate
- volume
- fluency
- aphasia (pm)

(iii) Mood

(iv) Memory and attention
- orientation (time, place, person)
- remote memory
- recent memory
- new learning ability

(v) Higher cognitive functions
- information and vocabulary
- (general and specialised knowledge)
- abstract thinking

NEUROLOGICAL EXAMINATION (LUMBAR SPINE)

<table>
<thead>
<tr>
<th>Dermatomes</th>
<th>Left</th>
<th>Right</th>
<th>Myotomes</th>
<th>Left</th>
<th>Right</th>
<th>Reflexes</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>T12</td>
<td></td>
<td></td>
<td>Hip Flexion (L1/L2)</td>
<td></td>
<td></td>
<td>Patellar (L3, 4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td></td>
<td></td>
<td>Knee Extension (L2, 3, 4)</td>
<td></td>
<td></td>
<td>Medial Hamstring (L5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td></td>
<td>Knee Flexion (L5/S1)</td>
<td></td>
<td></td>
<td>Lateral Hamstring (S1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td></td>
<td>Hip Int. Rot (L4/L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td></td>
<td></td>
<td>Hip Ext. Rot (L5/S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td></td>
<td>Hip</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adduction (L2, 3, 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>Hip Abduction (L4/5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>Ankle Dorsiflexion (L4/L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>Hallux Extension (L5)</td>
<td>Ankle Plantar Flexion (S1/S2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eversion (S1)</td>
<td>Inversion (L4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hip Extension (L5/S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX G: Lumbar Spine Regional Examination

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

REGIONAL EXAMINATION
LUMBAR SPINE AND PELVIS

Date: ________________
Patient: ____________________ File No: ____________________
Clinician: ____________________ Signature: ____________________
Student: ____________________ 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
5. RANGE OF MOTION

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

// = Painful limitation
/ = Pain free limitation

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

7. MOTION PALPATION – sacroiliac joints

B. SITTING

01. SPECIAL TESTS
- Tripod Test
- Kemp’s Test
- Valsalva Manoeuvre
2. MOTION PALPATION

<table>
<thead>
<tr>
<th>Jt. Play</th>
<th>Left</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Right</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P/A</td>
<td>Lat</td>
<td>Fle</td>
<td>Ext</td>
<td>LF</td>
<td>AR</td>
<td>PR</td>
<td>Fle</td>
<td>Ext</td>
<td>LF</td>
</tr>
<tr>
<td>Jt. Play</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P/A</td>
<td>Lat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U</td>
<td>L</td>
<td>S1</td>
<td>U</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. SUPINE

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

4. LEG LENGTH

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th></th>
<th>RIGHT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTUAL</td>
<td>cm</td>
<td></td>
<td>cm</td>
<td></td>
</tr>
<tr>
<td>APPARENT</td>
<td>cm</td>
<td></td>
<td>cm</td>
<td></td>
</tr>
</tbody>
</table>

5. ABDOMINAL EXAMINATION

- Observation
- Abdominal Reflexes
- Auscultation Abdomen and Groin
- Palpation Abdomen and Groin
# NEUROLOGICAL EXAMINATION

<table>
<thead>
<tr>
<th>DERMATOMES</th>
<th>Left</th>
<th>Right</th>
<th>MYOTOMES</th>
<th>Left</th>
<th>Right</th>
<th>REFLEXES</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>T12</td>
<td></td>
<td></td>
<td>Hip Flexion (L1/L2)</td>
<td></td>
<td></td>
<td>Patellar (L3, 4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td></td>
<td></td>
<td>Knee Extension (L2, 3, 4)</td>
<td></td>
<td></td>
<td>Medial Hamstring (L5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td></td>
<td>Knee Flexion (L5/S1)</td>
<td></td>
<td></td>
<td>Lateral Hamstring (S1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td></td>
<td>Hip Int. Rot (L4/L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td></td>
<td></td>
<td>Hip Ext. Rot (L5/S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td></td>
<td>Hip Adduction (L2, 3, 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td></td>
<td></td>
<td>Hip Abduction (L4/5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td></td>
<td></td>
<td>Ankle Dorsiflexion (L4/L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td>Hallux Extension (L5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ankle Plantar Flexion (S1/S2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eversion (S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inversion (L4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hip Extension (L5/S1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 8. SPECIAL TESTS
- SLR
- WLR
- Braggard's
- Bowstring
- Sciatic Notch Pressure
- Sign of the Buttock
- Bilateral SLR
- Patrick Faber
- Gaenslen's Test
- Gapping Test
- “Squish” Test
- Gluteus Maximus Stretch
- Thomas’ Test
- Rectus Femoris Contracture Test
- Hip Medial Rotation
- Psoas Test

**LATERAL RECUMBENT**

- Sacroiliac Compression
- Ober’s Test
- Femoral Nerve Stretch Test
- Myotomes: - Quadratus Lumborum Strength
  - Gluteus Medius Strength

**PRONE**

- Facet joint challenge
- Myofascial Trigger points:
  * Quadratus Lumborum
  * Gluteus Medius
  * Gluteus Maximus
  * Piriformis
  * Tensor Fascia Lata
  * Hamstrings
- Skin Rolling
- Erichsen’s Test
- Sacroiliac Tenderness
- Pheasant’s Test
- Gluteal Skyline
- Myotomes:
  - Gluteus Maximus strength

**NON-ORGANIC SIGNS**

- Pin-point pain
- Axial Compression
- Trunk Rotation
- Burn’s Bench Test
- Flip Test
- Hoover’s Test
- Ankle Dorsiflexion Test
- Pin-point pain
APPENDIX H: Hip Regional

UNIVERSITY OF JOHANNESBURG
CHIROPRACTIC DAY CLINIC

REGIONAL EXAMINATION
THE HIP

Date: ___________________
Patient: ___________________ File No: ___________________
Clinician: ___________________ Signature: ___________________
Student: ___________________ Signature: ___________________

OBSERVATION

- Gait
- Posture
- Weight bearing
- Use of support
- Balance
- Proprioception (stork standing test)
- Skin

ANTERIOR VIEW

- Bony Contours
- Soft tissue contours
- Swellings
LATERAL VIEW

- Buttock contour
- Hip flexion deformity
- Lumbar spine lordosis

POSTERIOR VIEW

- Lumbar spine scoliosis
- Body contours
- Soft tissue contours

ACTIVE MOVEMENTS

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion (110 – 120)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension (10 – 15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abduction (30 – 50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adduction (30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral rotation (40 – 60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial rotation (30 – 40)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS:
___________________________________________________________
___________________________________________________________
___________________________________________________________

PASSIVE MOVEMENTS (noted end feel and range of motion)

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral rotation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial rotation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RESISTED ISOMETRIC MOVEMENTS

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip flexion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip abduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip adduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip medial rotation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip lateral rotation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee flexion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee extension</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS:
___________________________________________________________
___________________________________________________________
___________________________________________________________

(Note specific muscle involvement if applicable).

JOINT PLAY

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caudal glide (Long leg traction)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral distraction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS:
___________________________________________________________
___________________________________________________________
___________________________________________________________

SPECIAL TESTS

- Patrick – FABER test
- Trendelenberg’s test (assess hip instability)
- Craig’s test (femoral anteversion)
- Sign of the buttock (assess site of lesion)
- Thomas test (rectus femoris hypertonicity)
- Ober’s test (ITB contracture)
- Noble compression test (ITB friction syndrome)
- Piriformis test
- Hamstring contracture test

**DERMATONES**

<table>
<thead>
<tr>
<th></th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PALPATION**

**ANTERIOR ASPECT**
- Iliac crest
- Greater trochanter
- ASIS
- Inguinal ligament
- Femoral triangle
- Hip Joint
- Symphysis pubis

**POSTERIOR ASPECT**
- Iliac crest
- PSIS
- Ischial tuberosity
- Greater trochanter
- Sacroiliac joints
- Sacrococcygeal joints
APPENDIX I: SOAP Note

CHIROPRACTIC DAY CLINIC

SOAP NOTE:

<table>
<thead>
<tr>
<th>Patient:</th>
<th>Visit No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>File No:</td>
<td>Student:</td>
</tr>
<tr>
<td>Date:</td>
<td>Clinician:</td>
</tr>
</tbody>
</table>

| S:                 | O:            |

| A:                 | P:            |

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Patient:</th>
<th>Visit No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>File No:</td>
<td>Student:</td>
</tr>
<tr>
<td>Date:</td>
<td>Clinician:</td>
</tr>
</tbody>
</table>

| S:                 | O:            |

| A:                 | P:            |
Comments:

<table>
<thead>
<tr>
<th>Patient:</th>
<th>Visit No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>File No:</td>
<td>Student:</td>
</tr>
<tr>
<td>Date:</td>
<td>Clinician:</td>
</tr>
</tbody>
</table>

S:            O:

A:            P:

Comments:
APPENDIX J: Score Sheet

<table>
<thead>
<tr>
<th>File Number</th>
</tr>
</thead>
</table>

1<sup>st</sup> Consultation

Acceleration and sprinting times

<table>
<thead>
<tr>
<th></th>
<th>Sprint 1</th>
<th>Sprint 2</th>
<th>Time (Average of two sprints)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration (10m)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximal speed (30m)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modified Thomas test</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Hip Flexion</th>
<th>Hip Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>Right</td>
</tr>
</tbody>
</table>

Range of motion 1

<table>
<thead>
<tr>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

4<sup>th</sup> Consultation

<table>
<thead>
<tr>
<th>Modified Thomas test</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Hip Flexion</th>
<th>Hip Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>Right</td>
</tr>
</tbody>
</table>

Range of motion 1

<table>
<thead>
<tr>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
7th Consultation

Acceleration and sprinting times

<table>
<thead>
<tr>
<th></th>
<th>Sprint 1</th>
<th>Sprint 2</th>
<th>Time (Average of two sprints)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration (10m)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximal speed (30m)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified Thomas test</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Hip Flexion</th>
<th>Hip Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Range of motion 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX K: Timing Lights/Error Correction

Smartspeed system, demonstrating the error correction process. (Earp and Newton, 2010)
APPENDIX L: Chiropractic Techniques (Kirk, Lawrence and Valvo, 1985)

Thigh Ilio-Deltoid:

**THIGH ILIO—DELTOID**

L: RPIN—LPIN

PP: Side-lying with listing up; lower shoulder is anterior with hand under head; upper shoulder is posterior with forearm resting on lateral thoracic wall; lower thigh and leg are straight; upper thigh and leg are flexed with the dorsum of the foot in the popliteal space of the lower limb. Pelvis is brought towards edge of table. Pelvis is positioned so that the upper ASIS is anterior to lower ASIS or pelvis is vertical.

DP: Anterior to patient; fencer's stance facing cephalad; lateral thigh to thigh contact; caudal foot off floor.

CH: Caudal hand; pisiform contact medial and inferior to PSIS; fingers point obliquely cephalad and medial across the spine. Elbow flexed. Forearm at right angles to CH.

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

T: IH stabilizes. CH drives PSIS anterior with slight torque (ulnar deviation) and simultaneous body drop.
Ischial Popliteal Deltoid:

L: RAIN-LAIN.
PP: Side-lying with anterior innominate up. Hand of lower arm is underneath head. Upper arm is flexed at elbow and resting on upper lateral chest wall. Lower thigh and leg are straight. Upper thigh is flexed and brought off the table anteriorly.
DP: 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. Caudal thigh against table bracing patient’s lower thigh (Fig. 117A).
CH: Caudal hand; pisiform-calcaneal contact on posterior aspect of ischial tuberosity; forearm and fingers pointing down line of femur.
IH: Cephalad hand; palmar contact on anterior surface of deltoid of upper arm.
T: IH stabilizes by tractioning cephalad on shoulder. CH drives in line of femur as doctor’s cephalad leg tractions patient’s upper thigh into further flexion.
Sacral – Ilio Cross:

**SACRAL—ILI<sup>1</sup> CROSS**

L: AS; RAIS—LAIS.
PP: Prone in extreme antigravity.
DP: Toggle stance at right angles to patient. AS: either side of table. RAIS—LAIS: contralateral to listing.
CH: Cephalad hand; pisiform and hypothenar contact on apex of sacrum. Fingers point caudally. AS: midline contact. RAIS—LAIS: contact sacral apex contralateral to listing (homolateral to doctor).
IH: Caudal hand; pisiform contact medial and inferior to PSIS homolateral to listing. Fingers point obliquely cephalad and lateral.
T: Multiple thrusts from shoulders with torque of ulnar deviation both hands.
Hip Techniques (Bergmann and Peterson, 2011)

Long Axis Distraction:
Internal and External Rotation of the Hip:

Internal Rotation:
External Rotation:
Inferior Glide in Flexion:
Anterior to Posterior Glide:
Posterior to Anterior Glide:
APPENDIX M: Ethics Clearance Letter

FACULTY OF HEALTH SCIENCES
HIGHER DEGREES COMMITTEE

HDC-01-79-2014
31 October-2014

TO WHOM IT MAY CONCERN:

STUDENT: BLEEKERS, T
STUDENT NUMBER: 200596389

TITLE OF RESEARCH PROJECT: The Effect of Chiropractic Manipulation of the Hip and Sacroiliac Joint on Acceleration and Sprinting Time of Male Rugby Players that Present with Positive Modified Thomas Test

DEPARTMENT OR PROGRAMME: M Tech
SUPERVISOR: Dr I Landman
CO-SUPERVISOR:

The Faculty Higher Degrees Committee has scrutinised your research proposal and concluded that it complies with the approved research standards of the Faculty of Health Sciences, University of Johannesburg.

The HDC would like to extend their best wishes to you with your postgraduate studies.

Yours sincerely,

Prof Y Coopoo
Chair: Faculty of Health Sciences HDC
APPENDIX N: Turnitin Originality Report

The Effect of Chiropractic Manipulation of the Hip and Sacroiliac Joint on Acceleration and Sprinting Time of male Rugby Players that present with a Positive Modified Thomas Test

by TK BLEEKERS

From 2015 Proposals, theses, dissertations, assignments for all postgraduates (2015 - POSTGRADUATE CENTRE RESEARCH DEVELOPMENT FORUM)

- Processed on 22-Jul-2015 15:53 SAST
- ID: 556447013
- Word Count: 13342

Similarity Index 16%

Similarity by Source

Internet Sources: 11%
Publications: 4%
Student Papers: 10%

Sources:

1

2% match (student papers from 14-Sep-2011)

Submitted to University of Johannesburg on 2011-09-14

2

1% match (Internet from 15-Mar-2014)

http://dermatologic.com.ar/5.htm

3


Submitted to Clemson University on 2014-11-12

http://buwiki.net/lib/exe/fetch.php/anat1_li_lower-limb-composite_v2.pdf?id=anatomy&cache=cache

Submitted to Queen Mary and Westfield College on 2015-04-23


http://ujdigispace.uj.ac.za/bitstream/handle/10210/3133/Legg.pdf?sequence=1/

Submitted to University of Bradford on 2012-02-12

Submitted to Beirut Arab University on 2014-11-26


Submitted to Chester College of Higher Education on 2010-04-20


Submitted to Pennsylvania State System of Higher Education on 2012-07-24


Submitted to University of Johannesburg on 2013-05-08

< 1% match (student papers from 17-Feb-2014)
Submitted to University of Johannesburg on 2015-02-05

< 1% match (student papers from 26-Jan-2012)

Submitted to West Nottinghamshire College, Nottinghamshire on 2012-01-26

< 1% match (student papers from 22-Oct-2013)

Submitted to Durban University of Technology on 2013-10-22

< 1% match (student papers from 23-Nov-2014)

Submitted to University of Johannesburg on 2014-11-23

< 1% match (student papers from 14-Feb-2009)

Submitted to United States Sports Academy on 2009-02-14

< 1% match (student papers from 09-Nov-2012)

Submitted to Lincoln College, Lincolnshire on 2012-11-09

< 1% match (Internet from 22-Oct-2010)


< 1% match (Internet from 03-Nov-2014)


< 1% match (student papers from 05-Apr-2011)

Submitted to Queen Mary and Westfield College on 2011-04-05

< 1% match (student papers from 22-Aug-2012)

Submitted to La Trobe University on 2012-08-22

< 1% match (student papers from 23-Apr-2015)

Submitted to University of Bradford on 2015-04-23
< 1% match (Internet from 24-Jun-2015)

http://www.cram.com/flashcards/anatomy-exam-4-lower-limb-611099

< 1% match (Internet from 22-Apr-2013)


< 1% match (publications)


< 1% match (publications)


< 1% match (publications)


< 1% match (student papers from 19-Jul-2011)

Submitted to EDMC on 2011-07-19

< 1% match (Internet from 31-Mar-2012)

http://download.videohelp.com/vitualis/med/mmhipthg.htm

< 1% match (Internet from 15-Jun-2015)

http://archive.org/stream/IntroductionToBody/introduction_to_body_djvu.txt

< 1% match (Internet from 07-May-2015)


< 1% match (Internet from 15-May-2015)
http://etheses.whiterose.ac.uk/1531/2/THOM_GOBBITT_THESIS.pdf

< 1% match (Internet from 12-Jan-2014)

http://www.itu.dk/people/rkva/docs/Vatrapu-Dissertation.pdf

< 1% match (Internet from 19-Mar-2010)

http://epublications.bond.edu.au/cgi/viewcontent.cgi?article=1189&context=rlj

< 1% match (Internet from 07-May-2013)


< 1% match (publications)


< 1% match (publications)


< 1% match (publications)

"FREE PAPERS", Developmental Medicine & Child Neurology, 11/12/2008

< 1% match (student papers from 12-Jun-2015)

Submitted to 97324 on 2015-06-12