An analysis of injury profiles and management strategies utilised by chiropractic students at the 2014 Durban 'Rugby Rush Tournament'

By

Caryn McAlery

Dissertation submitted in partial compliance with the requirements for the

Master's Degree in Technology: Chiropractic

Durban University of Technology

I, Caryn McAlery, do declare that this dissertation is representative of my own work in both conception and execution

_____ _____

Caryn McAlery Date

Approved for Final Submission

_____ _____

Supervisor Date

Dr G. Haswell

B.Com (UND), M.Tech: Chiropractic (Natal), M.C.A.S.A.

DEDICATION

To my parents for their unconditional love and support.

AKCNOWLEDGEMENTS

1. To my parents, I can never quite show the immense admiration and appreciation I have for you. Thank you for always supporting me in every life decision and for your patience and understanding throughout this course.

2. To my siblings Katie and John for being so understanding and supportive of my studies and for always being there for me during the stressful periods. I am so grateful for everything you do for me.

3. To Dr Charmaine Korporaal for her ongoing support throughout the research process. Your hard work and dedication to chiropractic is truly admirable.

4. To my supervisor Dr G. Haswell of the Department of Chiropractic, Faculty of Health Sciences, Durban University of Technology, for his guidance and support.

5. Mrs Tonya Esterhuizen for her assistance with the statistical analyses of results used in this study.

6. Mrs Wendy Drake and Dr Laura O'Connor for their administrative assistance throughout the research process.

7. To Chantal Da Silva for all her support, criticism and guidance throughout the research process.

8. To Kai Petty for always believing in me.

ABSTRACT

Background:

Rugby union is one of South Africa's most popular sports; it requires high levels of skill and fitness and is played at a high intensity and speed which allows for a greater risk of injury. The high risk of injury is said to be due to the nature of the physicality of rugby. It is because of this high risk of injury that several adaptations of rugby have since developed which rely more on speed and agility than physicality. These adaptations include tens or ten-a-side rugby, sevens or seven-a-side rugby and finally touch rugby, which is played with six players a-side. Each adaptation has its own set of rules and is played differently to the traditional rugby union or fifteen-a-side rugby. Hence, in these adaptations the physicality is said to decrease with a resultant increase in demand for speed and agility. The reduction of physicality and increase in the need for speed and agility would imply that the nature of injuries sustained will be different to those sustained in traditional rugby union.

Objectives:

To develop a profile of injuries that describe the type, anatomical location and mechanism of injuries sustained in tens, sevens and touch rugby; to compare the injuries sustained between the three groups; and, to analyse management strategies utilised by chiropractic students at the 2014 Durban 'Rugby Rush Tournament'. Additionally this study aimed to provide recommendations to the injury reporting form utilised.

Methods:

This study was a retrospective, quantitative, descriptive study based on the Chiropractic Student Sports Association's report form in order to produce a retrospective cohort analysis of injury and treatment profiles.

Participants who made use of the chiropractic treatment facility were required to complete the informed consent section of the injury reporting form. The chiropractic intern was required to complete the remainder of the form pertaining to the participant, complaint and treatment information. This study was limited to event participants to allow for subgroup analysis. The forms were then captured and analysed.

Results:

The data collected consisted of a total of 345 individual patient forms which indicated 626 visits for a total of 733 complaints. The average participant age was 24 ± 5.58. The study found muscle strains (41.5%), SI Syndrome (17.6%) and Joint sprains (15.0%) to be the most frequent diagnoses. A history or previous injury or trauma was reported in 18.7% and 7.40% respectively. Acute injuries accounted for 64.3% and 35.7% were recorded as chronic in nature. The most frequent mechanism of injury was that of overuse (81.9%) and trauma accounted for 17.2% of injuries. The lumbar region (26.1%), thigh (20.7%) and shin/calf (15.6%) were the most commonly reported regions of complaint. Manipulation (58.8%), massage (32.0%) and stretch PNF (27.9%) were the most frequently used treatment protocols. Strapping was utilised in 21.1% of injuries of which 5.20% was applied to the muscle and 13.6% was applied to the joint. No comparison was made using the sevens subgroup as there were insufficient records, thus only tens and touch players were compared. A borderline non-significant difference *(p* = 0.057*)* was noted between the type of player and the history of previous trauma. Tens players were more likely to have a history of trauma compared to touch players. A significant difference (*p* = 0.001) was found between the type of athlete and mechanism of injury. Overuse was more common in touch players whereas trauma was more common in tens players. Due to statistical inconsistencies no significance tests were applicable to compare the type of player and region of complaint. Recommendations were proposed in order to avoid this in future research.

Conclusion:

This study provides a base of knowledge regarding the injuries that were presented to the chiropractic treatment facility at the 2014 Durban 'Rugby Rush Tournament' and the management strategies utilised by the chiropractic interns at the event. This research provides insight into injury profiling of tens, sevens and touch rugby players. There were several recommendations proposed for future researchers in order to expand on this field of knowledge.

Keywords: Rugby union, tens, sevens, touch rugby, injuries, chiropractic, musculoskeletal injuries, injury profile, and treatment profile.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

ABBREVIATION AND DEFINITIONS

Acute injury

For the purposes of this research an acute injury is defined as an injury which occurred suddenly as a result of macro-trauma or aggravation of a chronic complaint.

Biomechanics

The study of the mechanical laws relating to the movement or structure of living organisms.

Breakdown

The breakdown is a colloquial term for the short period of open play immediately after a tackle and before and during the ensuing ruck. During this time teams compete for possession of the ball, initially with their hands and then using feet in the ruck.

Chiropractic

Is a health profession specialising in the diagnosis, treatment and prevention of mechanical disorders of the musculoskeletal system and the effects of these disorders on the function of the nervous system and general health.

Chiropractic Intern

A senior chiropractic student registered in fifth or sixth year.

Chronic injury

For the purposes of this research a chronic injury is defined as an injury as a result of repetitive micro-trauma, stress or trauma to soft tissue structures and improper healing of these structures resulting in pain for a pro-longed period.

Complaint

A complaint refers to the reason of visitation to the chiropractic treatment facility at the 2014 Durban 'Rugby Rush Tournament', whether due to an injury, prophylactic reasons or for management.

Conversion

If a team scores a try, they have an opportunity to 'convert' it for two further points by kicking the ball between the posts and above the crossbar – that is, through the goal. The kick is taken at any point on the field of play in line with the point that the ball was grounded for the try parallel to the touch-lines.

CSSA

Chiropractic Student Sports Association.

Delayed onset muscle soreness (DOMS)

Generalised muscle pain after unaccustomed physical activity that results in pain at rest hours after the activity (Mueller-Wohlfahrt *et al.,* 2012).

Facet Syndrome

Inflammation in the joint capsule or increased joint fluid due to repetitive micro-trauma and is often diagnosed by anamnesis in addition to physical examination. It is clinically characterized by back pain, pseudo-radicular pain, sensitivity on palpation of the facet joints and decreased painful range of motion (Karkucak *et al.,* 2014).

Free Kick

This is a lesser form of the penalty, usually awarded to a team for a technical offence committed by the opposing side such as numbers at the line-out or time wasting at a scrum.

Full-Contact Sport

Is a sport whereby athletes purposely make physical contact with each other and inanimate objects with great force.

Injury

For the purposes of this research an injury is defined as “Any physical complaint, which was caused by a transfer of energy that exceeded the body’s ability to maintain its structural and/or functional integrity, that was sustained by a player during a rugby match or rugby training, irrespective of the need for medical attention or time-loss from rugby activities” (Fuller *et al.,* 2007).

Manipulation

The application of a force to specific body tissues with therapeutic intent (Ernst and Canter, 2006)

Maul

When a ball carrier is held up (without being tackled) by both an opposing player and a player from his own team, a maul is then considered formed.

Minimal Contact Sport

Is a sport whereby athletes purposely make physical contact with each other and inanimate objects with less force than in full contact sports.

Overuse injuries

Defined as an injury that results from repetitive micro-trauma to a muscle, tendon, bone and/or joint.

Participants

All athletes who attended the chiropractic treatment facility at the 2014 Durban 'Rugby Rush Tournament'.

Penalty

Penalties are awarded for serious infringements like dangerous play, offside and handling the ball on the ground in a ruck.

Penalty Kick

If a side commits a penalty infringement the opposition can take the option of a place kick at goal from where the infringement occurred (or, if the offence occurred when a player was in the process of kicking the ball, the non-offending team can opt to take the kick from where the ball landed which may be more advantageous). This is called a penalty kick. If successful, it is worth three points.

Perception

The Oxford Learner's Dictionary (2010), defines perception as "...the way in which things are seen, understood to be like, and interpreted as".

Preventative

A term used in this study as a mechanism of injury to code for participants who presented to the chiropractic treatment facility at the 2014 Durban 'Rugby Rush Tournament' for prophylactic reasons. The participant could either have a pre-existing complaint or was asymptomatic and wished to prevent a complaint from occurring.

Red flags

These are indicators of possible underlying conditions which may be serious and require further medical attention.

Ruck

A ruck is formed when the ball is on the ground and two opposing players meet over the ball.

Rugby Union

Is a full-contact team sport played between two teams of fifteen players.

Scrum

The eight forwards from each team bind together and push against each other. The scrum-half from the team that has been awarded possession feeds the ball into the centre of the scrum from the side most advantageous to them.

Stretch/PNF

Proprioceptive neuromuscular facilitation stretching is a set of stretching techniques commonly used in clinical environments to enhance both active and passive range of motion with the ultimate goal being to optimise motor performance and rehabilitation.

Tackle

A tackle takes place when one or more opposition players [tackler(s)] grasp onto the ball carrier and succeed in bringing/pulling him/her to ground and holding them there.

Touchdown

To place the touch rugby ball by hand on the ground on or over an opponent's goal line in scoring a try and if successful is worth one point.

CHAPTER 1 : INTRODUCTION

1.1 Introduction

The purpose of this chapter is to introduce the topic of injuries in rugby sevens, tens and touch, to create a background to the study and to briefly discuss the aims and objectives, hypothesis and lastly the limitations of the study.

1.2 Background

Rugby union is a sport that is played in over 120 countries throughout the world (Australian Rugby Union, 2014; Schneiders *et al*., 2009) and is one of South Africa's most popular sports (Brooks and Kemp, 2008). Rugby union requires high levels of skill and fitness and is played at a high intensity and speed which allows for a greater risk of injury due to the greater velocity exerted during impact (Noakes and du Plessis, 1996). The overwhelming contribution of the tackle to injury episodes could reflect recent law changes that encourage open play conducted at higher speeds to enhance the game as a flowing spectator sport (Austin *et al.,* 2011). It is because of this high risk of injury, most commonly sustained in high-velocity impacts (i.e. tackling), that several adaptations or codes of 15-a-side rugby union have since developed which involve fewer high-velocity impacts. These adaptations include ten-a-side rugby also known as tens, sevens or seven-a-side rugby and finally touch rugby, originally referred to as touch football which is played with six players a-side. Each rugby code has its own set of rules and is played differently to the traditional rugby union or fifteen-a-side rugby.

Rugby union is known to account for several acute injuries that are often reported and recorded at secondary health clinics and hospitals but seldom are the less acute injuries reported (Finch and Mitchell, 2002).The high risk of injury is said to be due to the nature of the physicality of rugby (Tuck, 2010), hence in these adaptations the physicality is said to decrease with a resultant increase in demand for speed and agility (Rugby Rush, 2014). This would imply that the nature of injuries sustained may be different to those sustained in traditional rugby union (Tuck, 2010).

Injury reporting is the collection of information on injuries in an effort to reduce similar injuries in the future (Finch, 2006). Injury reporting is the first step in operating a sports injury surveillance system. It involves the collection and analysis of data on injury and interpreting

the findings to guide policy development and implementation, including the development and evaluation of preventive measures and programmes (Finch, 2006). Injury profiling assists in the understanding of the mechanism of injury related to a particular sport, anatomical location of specific injuries and the nature of the treatment protocols executed in order to better prevent and manage injuries sustained while participating in specific sporting activities (Finch *et al.,* 1999; Finch, 2006; Junge *et al.,* 2008).

Sports injury profiling studies have been conducted for fifteen-a-side rugby or rugby union (Wekesa *et al*, 1996; Jakoet and Noakes, 1998; McManus and Cross, 2004; Best *et al,* 2005; Tuck, 2010); however, there is currently a paucity of literature regarding injury profiles on tens, sevens and touch rugby players. These three adaptations of rugby union have become very popular as they require less physicality but an increased demand for speed, agility and fitness (Gabbett, 2002). It is because of these adaptations that fewer serious medical injuries are sustained but there may be an increase in repetitive strain and/or sprain injuries (Garraway and Macleod, 1995).

McIntosh (2005) described when profiling injuries of junior rugby players it was noted that the majority of injuries sustained were acute severe injuries and that very few were described as overuse injuries. Gabbe and Finch (2001) found that there is very little information about injuries sustained by rugby players in the lower level of participation and a paucity of information on injuries that are not considered severe enough to warrant hospital care. Therefore further research is required to identify the nature and aetiology of injury at all levels of competition and to use these findings to develop effective injury prevention strategies in the sport (McManus and Cross, 2004).

Chiropractic is becoming a more popular choice of treatment by amateur and professional athletes (Cloete, 2008). Sports teams and individual athletes are turning to chiropractic as a form of management because as trained professionals in the field of biomechanics and neuromuscular physiology, they are well prepared to design tailored conditioning and injury prevention programmes (Dagenais and Haldeman, 2011). One of the main objectives of conducting research on injury profiling is to provide data that can be used to inform these injury prevention programmes (Arscott-Mills *et al.,* 2002).

The purpose of this research was to provide an injury profile of tens, sevens and touch rugby participants that presented to the chiropractic treatment facility at the 2014 Durban ‘Rugby Rush Tournament’. This profile aimed to provide information that described the type, anatomical location and mechanism of injury which allowed for sub-analysis of injury profiles between the different types of rugby adaptations played as well as the treatment or management protocol provided.

This quantitative descriptive study provided an analysis of the clinical patient records obtained at the chiropractic treatment facilities at the 2014 Durban 'Rugby Rush Tournament'. Each patient that presented to the Durban University of Technology (DUT) chiropractic treatment facility was examined by a chiropractic intern, under the supervision of a chiropractic clinician. The findings were recorded on the validated Chiropractic Student Sports Association's (CSSA) questionnaire (Korporaal, 2002) (Appendix A) after signed agreement from the patient to participate in the study and receive treatment. There were 695 CSSA records collected from this event.

The latest version of SPSS was used for data analysis, with a p value of < 0.05 considered as statistically significant. Descriptive statistics outlined categorical variables. Associations between the demographic variables and region of complaint, clinical impressions and treatment were assessed using Pearson chi-square (Esterhuizen, 2014).

1.3 Research Aim and Objectives

1.3.1 Research Aim

To develop a profile of injuries that described the type, anatomical location and mechanism of injuries sustained in the tens, sevens and touch rugby divisions and to analyse management strategies utilised at the 2014 Durban 'Rugby Rush Tournament'.

1.3.2 Objectives

The first objective was to determine a demographical profile of the participants presenting to the DUT chiropractic treatment facility.

The second objective was to determine and describe an injury profile in terms of injury type, mechanism of injury and anatomical location.

The third objective was to determine and describe the treatment protocols used in the management of participants who presented to the chiropractic treatment facility.

The fourth objective was to describe and compare injury profiles between tens, sevens and touch rugby participants that presented to the DUT chiropractic facility at the Durban 'Rugby Rush Tournament 2014', in order to determine if there were any differences in the injuries sustained between the three groups.

1.4 Null Hypothesis

There is no difference between the injury profiles of the tens, sevens and touch rugby participants.

1.5 Rationale and Benefits of the Study

Rugby Union is an international sport ranking second in participation only to soccer as a football code (Bathgate *et al,* 2002). Due to the nature and physicality of rugby union, acute injuries are sustained and thus several different rugby codes have developed to limit the physicality. Ten-a-side and sevens rugby and touch football are individual sports that have their own rules and regulations but have the same basic principles of rugby union. These principals include running, catching and passing; touch rugby is the only adaptation or code that does not include full contact (Rugby Rush, 2014). As a result of the decrease in physicality there has been an increase in speed and agility in the afore mentioned adaptations and thus fewer impact injuries are sustained but there is a subsequent increase in the number of sprain and strain injuries due to muscle overload and overuse (Garraway and Macleod, 1995). However these types of injuries often go unreported (Finch and Mitchell, 2002) and thus without an injury profile it is difficult to prevent these injuries in the future (Finch *et al*, 1999).

Injuries are inevitable in contact sports (Hoskins *et al.,* 2006; Fuller *et al.,* 2009), rugby being no exception. In fact rugby union is shown to present with the most injuries per 1000 hours of play when compared to soccer and cricket (Posthumus and Viljoen, 2008). Specific situations of the game that require taking the ball into contact such as the set scrum, the ruck, or the maul lead to substantial bodily contact and thus increase the risks of injury (Posthumus and Viljoen, 2008). Injury surveillance and injury profiling enable health care professionals such as chiropractors to diagnose and treat chronic, repetitive strain type injuries more effectively (Cloete, 2008; Labuschagne, 2009).

1.6 Limitations

- A study of this nature required the participants to willingly give their consent to allow their recorded data to be used for research purposes. In order for this to occur, the participant had to understand that their data was being recorded and that any information they submitted could be used for potential research, current or future. The limitation is that four injury report forms were not included where the participant had not signed to consent to their data being used in future research.

- This study was retrospective in design and relied on the knowledge and training of chiropractic interns, who, under the supervision of a chiropractic clinician, were required to accurately record participant information. Capturing a participant's symptoms and making a diagnosis and electing a particular treatment protocol can be regarded as subjective. Thus the accuracy of information should be taken into account when considering the subjectivity of such a design (Mouton, 1996).

- It must be considered that the data captured by these interns was based on subjective and objective clinical impressions and hence diagnoses may have been limited in terms of their scope but still relevant in terms of the signs and symptoms presented as it is unethical to treat a patient without a condition being present (Allied Health Professions Act 63 of 1982 (as amended)).

- In addition the misconception of the scope of chiropractic (Kazemi and Shearer, 2008) and the fact that there were other medical services (e.g. emergency medical care) offered at the event may have reduced the number of injuries reported to the chiropractic facility thus reducing the sample size.

- By contrast, the ability of participants to seek chiropractic treatment free of charge at the event may have resulted in over reporting of injuries. This is particularly true as participants are more likely to seek treatment if the services are offered free of charge than if a fee is attached (Konczak, 2010).

1.7 Conclusion and Outline

Chapter One provided an introduction to the study, discussing the context and background to the research including the aim, objectives and hypothesis and the presenting benefits and limitations of the study. **Chapter Two** provides information regarding the current literature on the different rugby codes and why there is a need for research on injury profiles of this nature to allow for the reader to better understand the rationale behind the research. **Chapter Three** discusses the methodology which includes the study design, procedure and data analysis. **Chapter Four** presents the results and **Chapter Five** comprises the discussion of these results in the context of the current literature. **Chapter Six** concludes the study, describes the limitations and offers recommendations for future studies.

CHAPTER 2 : LITERATURE REVIEW

2.1 Introduction

This chapter provides the reader with a definition of rugby union, tens, sevens and touch rugby. It describes the variations in the aforementioned rugby adaptations and discusses the aetiology, incidence and prevalence, anatomical locations and mechanisms of injury in each adaptation. It also discusses the management protocols that have been utilised by the on-site chiropractic interns to treat and manage these injuries.

2.2 Classification of Injury

There are several variations in the definitions and methods utilised in the studies conducted on rugby union injuries which has resulted in inconsistent data collection and therefore inconsistent results (Fuller *et al.,* 2007). According to Fuller *et al.* (2007) the classification of a sports injury should be according to the anatomical area and mechanism of injury and an injury should be defined according to the context of the study being performed. In the case of this study as it is retrospective in nature the definition of injury is determined by the standardized injury reporting CSSA form (Appendix A) (Korporaal, 2002). This requires the research to adhere to the classification of injury provided on the form, which is defined according to anatomical area, mechanism of injury and type of injury. For the purpose of this research injuries were classified according to type of injury being either extrinsic (acute) or intrinsic (chronic) and mechanism of injury was defined as being due to trauma, overuse or idiopathic.

2.2.1 Extrinsic (Acute) Injuries

An extrinsic or acute injury may manifest into further injury and has an impact on the athlete when competing in sport (Caine *et al.,* 2008). An extrinsic injury occurs as a result of an external force that has been applied to the body by another person or object (Caine *et al.,* 2008). In rugby the more serious injuries usually occur as a result of an extrinsic injury often as a result of a collision with another player or object (Noakes and du Plessis, 1996).

2.2.2 Intrinsic (Chronic) Injuries

Woolmer, Noakes and Moffat (2008) defined an intrinsic injury as an internal problem or failure of the body. Intrinsic injuries incur as a result of repetitive use and are often termed

overuse injuries (Noakes and du Plessis, 1996). Intrinsic factors that are specific to the athlete result in overuse injuries; these are psychological and or biological factors that predispose the athletes to incur a particular injury (Caine *et al.,* 2008). Overuse injuries were termed as 'wear-and-tear' injuries by Noakes and du Plessis (1996) which result from a steady onset of discomfort and/or loss of mobility. Clarsen *et al.* (2012) indicated that chronic overuse injuries were the most commonly noted cause of complaints in athletes across five different sports. Injuries can be further classified according to the mechanism of injury, anatomical location and risk factors involved.

2.3 Background

Rugby union is a contact team sport played throughout the world by people of all ages (McIntosh, 2005; Fuller *et al.,* 2009). At the professional level, there are several major tournaments across the world including the Six Nations in Europe, the Tri-Nations between New Zealand, Australia and South Africa, and the Rugby World Cup (McIntosh, 2005). The physicality of the sport and its ability to allow athletes of all shapes and sizes to participate makes it a very popular sport (International Rugby Board [IRB], 2008; Fuller *et al.,* 2009). The number of players, coaches and officials involved in rugby are increasing each year and contributes greatly to the growth of the sport from a spectator and professional point of view (Best, 2003; Butt, 2008). This is evident in South Africa, with rugby being one of the three biggest sports along with Cricket and Soccer (Morgan, 2014).

The high intensity, speed, skill and physicality required to play rugby results in an increased risk for injury (Noakes and du Plessis, 1996). Rugby is a sport that accounts for an increasingly large percentage of sporting injuries (King *et al.,* 2006; King and Gabbett, 2007) spread across all age groups (Gabbett, 2008).The popularity of the game and nature of the injuries sustained in fifteen-a-side rugby has led to the development of several adaptations of different codes of rugby union (Dainoff, 2014). These include tens, sevens and touch rugby.

There have been many known studies reporting the nature of rugby injuries (Garraway and Macleod, 1995; Jakoet and Noakes, 1998; Alsop *et al.,* 2000; McManus and Cross, 2004; McIntosh, 2005; Hoskins *et al.,* 2006; Gianotti *et al.,* 2009; Posthumus and Viljoen, 2008; Schneiders *et al*., 2009; Tuck, 2010; Bleakly *et al.,* 2011; Brown *et al.,* 2012). Most of the injuries reported that are of serious medical concern occur in fifteen-a-side rugby (Rourke *et al.,* 2006). The less severe injuries (e.g. sprain and strain injuries) are often not recorded. There have been a number of injury profiles completed on traditional rugby union (Wekesa, 1996; Jakoet and Noakes, 1998; McIntosh 2005; Schneiders *et al.,* 2009; Tuck, 2010).

However; there is a paucity of literature on injury profiles of tens, sevens and touch rugby players. Due to the fact that these adaptations are relatively new very little research has been conducted (Higham *et al.,* 2012). Thus it is important to contribute to this gap in the current literature and provide information regarding the injuries sustained in these sporting codes in order to better prepare athletes, coaches and healthcare professionals in terms of injury prevention and better management of sustained injuries (Finch, 2006; Verhagen *et al.,* 2010)

2.4 Rugby Union

2.4.1 Basics of the Game

Traditional rugby union or fifteen-a-side rugby is one of the most popular sports played today, with more than three million people in a hundred different countries across the world playing the game (Brooks and Kemp, 2008). The sport's governing body is the International Rugby Board (IRB), and there are currently ninety-two member unions. Each member union generally represents one country (Bathgate *et al,* 2002). Rugby union is a full-contact, territorial game played by two teams of fifteen players and seven substitutes, officiated by a referee and two touch judges (Rugby Sidestep Central, 2014). The game is played with an oval shaped ball on a grass field measuring one hundred meters by seventy meters and two in goal areas on either ends of the field measuring ten metres by seventy metres, where there are two sets of rugby poles shaped like an 'H' through which the kicker must kick the ball through in order to score points (Robinson, 1998). The game is played in two forty minute halves whereby players carry, pass or kick the ball in order to ground it over the goal line to score as many points as possible (Rugby Sidestep Central, 2014). The ball can be kicked in any direction on the field, however the ball may only be passed backwards (E.g. the ball must be passed to a player either behind or in line with the player passing the ball) (Robinson, 1998). The on-field referee with the assistance of two side-line referees ensures the players play fairly according to the rules governed by the international rugby board (Robinson, 1998).

The game consists of two types of play. There is the set play, which as the definition suggests involves specific or 'set' manoeuvres which occur at the start or restart of play. This type of play consists of the line-outs, scrums, penalties or free kicks (Tuck, 2010). Open play occurs after the set play has commenced which enables any player on the field to handle the ball. Open play is defined by the International Rugby Board as a phase of play where the ball is being passed or kicked between team mates and both teams are able to contest for the ball (IRB, 2008). There are different elements which commence randomly throughout open

play, these include running and kicking into an open space if you are the attacking side and there is defensive tackling for the opposing side (Robinson, 1998; Tuck, 2010). A ruck and/or maul requires both sides to engage in a physical impaction in order to contest the ball (Robinson, 1998; Tuck, 2010).

2.4.2 Biomechanics

I. Positions

Position in rugby plays a significant role in the outcome of the game (Tuck, 2010). It is a sport that is characterized by the varying shapes and sizes of the players and how their physical characteristics often determine their selected position (IRB, 2008). A team consists of fifteen players, eight forwards and seven backs (Tuck, 2010). The forwards consist of two props whose primary role is to anchor the scrum, lift the forwards in the lineouts and provide an aggressive force in the rucks and mauls. The next of the forward players is the hooker whose main role is to win possession of the ball in the scrum. The goal of the two locks is to win the ball in the lineouts and when play restarts from the centre. The key objective of the two flankers is to cause reversal of possession through tackling and speed particularly at the breakdown. The number eight or eighth-man is the link between the forwards and the back line players. This player must secure possession at the back of the scrum and carry the ball forward in open play and thus has a dual role in defence and attack (IRB, 2008).

The backline players consist of a scrum half and a fly half whose role is to kick and pass the ball to allow for forward progression (Tuck, 2010). The two centres have a defensive and attacking role; they are required to tackle opposing attacking players and use their speed and agility to run the ball in open play to break through the opposing team's defence (IRB, 2008). The remaining backline players consist of two wings and a fullback. These players are responsible for general open play which includes running, passing and tackling when necessary (Tuck, 2010).

II. Training and Fitness

The main action of the forward players in rugby is to secure the ball through fair contest of possession which means they require strength and power fitness as well as a high degree of endurance fitness to move around the field while continuing to recover physically from forcefully competing for the ball (Tuck 2010). The back line players' main action is to run and tackle when faced with a defensive situation (Tuck, 2010). They therefore require more reaction speed to evade getting tackled, coupled with power to enable them to stay on their feet while being tackled.

Endurance fitness is determined to be the most necessary form of fitness in rugby to allow players to recover from sprinting but maintain an average speed for the remainder of the game followed by the need for quick acceleration and finally strength to endure the force of tackling (Noakes and du Plessis, 1996; Tuck, 2010).

It is well known that rugby is a high intensity, interval type activity. The actions involved in the game of rugby are that of an explosive nature, powered by oxygen dependent energy systems, therefore proper fitness and training techniques are required in order to cope with the high paced nature of the game (Noakes and du Plessis, 1996; Tuck, 2010).

III. Skills Training

Field work and gym training should be the two main elements to focus on when training for rugby (Tuck, 2010). Field work involves the repetition of the basic skills involved in the game and basic fitness drills which include stretching and agility drills for a period of three to four hours a week, usually in two practice sessions (Noakes and du Plessis, 1996; Tuck, 2010). Gym work targets particular body areas and involves strength training but should also include flexibility and strength endurance for a period of four to six hours a week (Noakes and du Plessis, 1996; Tuck, 2010).

2.4.4 Set Play

I. Lineout

The lineout is a set piece which occurs when the ball has been kicked or passed outside of the field lines often referred to as ‘into touch’. The lineout focuses the forwards from both sides in two opposing parallel lines. The hooker throws the ball straight down the middle of the two competing teams. The aim is for the forwards to contest the ball as it is thrown in order to win possession and distribute the ball to their backline players. The backline players are allowed the rest of the field in which to manoeuvre the ball (IRB, 2008).

II. Scrum

A scrum or scrummage is defined as a set piece that allows for the restarting of play after a minor infringement has occurred (IRB, 2008). The scrum consists of three rows of eight players, with the first row having two props and a hooker, the second row having two locks, and the third row having two flanks and an eighth man. All eight players must stay bound to the scrum until it ends (Robinson, 1998). The team who has possession of the ball is permitted to place the ball into the centre tunnel of the scrum, allowing for equal contest from both sides. The team who throws the ball into the scrum usually retains possession, because

the hooker and scrum half can synchronise their actions. Once possession has been secured the attacking team can both keep the ball grounded and force the defending team down field or they can bring the ball backwards and pass it to the backline to initiate open play (IRB, 2008)

III. Penalty Kick

Infringements of the laws by any player which have a material and significant impact on the opposition are disciplined with the award of a penalty kick (IRB, 2008), as a result the team awarded the penalty can elect to take a scrum, kick for touch to allow for a lineout, or take a quick foot tap to initiate open play (Robinson, 1998). If they are within range of the goal posts they can elect to kick for a goal from a place kick. The ball is placed on a grounded kicking tee and the elected kicker attempts to kick it between the posts and over the crossbar. Three points are awarded for a successful kick (IRB, 2008).

2.4.5 Open Play

I. Tackling

Open play is defined as any phase of play where the ball is being handled or kicked between teams allowing for equal contention of the ball. The aim of open play is to permit the team with possession to get their players into space to allow them to progress toward their opposition's goal line in an attempt to score (IRB, 2008). Rugby is a full-contact sport and it is often through this contact that teams allow for forward progression; the three most common contact situations are tackling, a maul and/or ruck formation (IRB, 2008).

II. Ruck and Maul Formation

The ball carrier is the only player on the field that is permitted to be tackled by one or more of the opposing player(s) (IRB, 2008). If the ball carrier is brought to ground by the offensive team, a ruck is formed (Tuck, 2010); as soon as the attacking player is tackled he/she must immediately release the ball to allow for equal contest from both teams. Players can contest the ball in the ruck with their feet but no hands can be involved (IRB, 2008). If the ball carrier is tackled but does not go to ground a maul is formed (Robinson, 1998); the ball must remain above the ground which allows for the attacking team to gain ground through forcing their opponents backwards or through backward placement of the ball to the backline to allow for open play to resume (IRB, 2008).

2.5 Rugby Rush Tournament

The ‘Rugby Rush Tournament’ previously known as the ‘East Coast Tens Tournament’ is a three day event consisting of over fifteen hundred male and female participants participating in several adapted forms of traditional rugby union. There are three distinct divisions comprising tens, sevens and one-touch touch rugby with the addition of provincial six-touch touch rugby in 2014. The main aim of the ‘Rugby Rush Tournament’ is to promote and contribute to the growth of rugby and its various forms (Rugby Rush, 2014). The following section elaborates on these adaptations.

2.6 Rugby Tens

2.6.1 Background

Rugby tens, also known as ten-a-side and X’s, is a variant of rugby union in which teams consist of ten players, typically five forwards, one scrum-half and four backline players (Rugby Rush, 2014). The ten-a-side game is often used in pre-season training, and late-summer tens festivals provide an excellent and gentle introduction to the season ahead (Kerikeri Rugby Football Club, 2014). This code of rugby is typically faster and more intense but with a lower physicality level than traditional fifteen-a-side rugby.

Major rugby tens tournaments include the COBRA Rugby Tens in Malaysia (since 1967) and the Hong Kong Football Club Tens (since 1986). Other regular tournaments include the Cape Town Tens, first held in 2009 (Kerikeri Rugby Football Club, 2014). Rugby tens started in Durban, South Africa, in 2012 and has since become an addition to the annual Rugby Rush Festival (Rugby Rush, 2014).

2.6.2 Rule Variations in Rugby Tens

There are several variations in rugby union laws which apply to tens rugby, primarily to speed up the game and to account for the reduced number of players. These law amendments are listed below according to the International Rugby Board Laws (IRB, 2008):

I. A game lasts no longer than twenty minutes plus lost time and extra time. A match is divided into two halves of not more than ten minutes playing time however match organisers may vary the duration of the match.

II. When a try is scored the kicker must take the kick within forty seconds of a try having been scored. The kick is disallowed if the kicker does not take the kick in the time

allowed; the kick has to be a drop kick as opposed to a rugby union kick, where the ball is placed on a static kicking tee.

III. A scrum must have five players from each team at all times. All five players must stay bound to the scrum until it ends. Each front row must have three players in it, no more and no less. Two locks must form the second row by binding together so that their heads are between a prop and the hooker.

IV. Any player may take a penalty or free kick awarded for an infringement with any kind of kick: punt, drop kick but not a place kick. The ball may be kicked with any part of the leg from below the knee to the toe but not with the heel.

V. No delay. If a penalty is awarded and the kicker indicates to the referee the intention to kick at goal, the penalty kick must be taken within thirty seconds of the penalty having been awarded. If the thirty seconds is exceeded the kick is disallowed, a scrum is ordered at the place of the mark and the opponents throw in the ball.

2.7 Rugby Sevens

2.7.1 Background

The popularity of rugby sevens has spread rapidly in recent years and the sport is now played at a domestic and international level throughout the world (King *et al.*, 2006). In 2009 sevens rugby was formally introduced as an official sport to be included in the 2016 Olympic Games (Higham *et al.,* 2012).

Rugby sevens is an abbreviated variant of rugby union in which two teams, each with seven players on the field, compete for two seven minute halves with a two minute half time interval (IRB, 2009). Rugby sevens is played on a full dimension rugby union field under substantially the same laws as fifteen-player rugby union (Higham *et al.,* 2012). Traditionally a sevens tournament occurs over two days consisting of three group stage matches on the first day, each game is separated by a three hour interval and depending on the results, up to three matches on the second day of the tournament (West *et al.,* 2013). The international rugby union sevens' series requires two tournaments to be played on consecutive weekends (IRB, 2009).

Sevens is consistent with rugby union in that the players experience periods of low-intensity activity and face high-paced high-intensity and high-impact activity (King *et al.,* 2006). The overall structure of the sevens match is the same as regular rugby; there are kickoffs to re-start play, as well as scrums, lineouts, and penalties, with the only major difference being the

reduced amount of players (Rugby Rush, 2014). The fact that the size of the field does not change, the number of players is reduced to seven a side and the time on the field is reduced to a fifth of the time of a traditional union match, means the players have twice as much room to manoeuvre in a shorter amount of time, which results in the game being played at a much faster pace with less physicality but an increase in intensity (Dainoff, 2014). While the duration of the match is much shorter than rugby union the players are expected to play several matches a day over a number of days (King *et al.,* 2006).

2.7.2 Variations in Rugby Sevens

I. Game Strategy and Basic Concepts

The nature of all forms of rugby is essentially to gain territory in order to score over the opposing team's goal line; however the difference in sevens is that there are fewer players playing on the same size pitch as rugby union allowing the players twice as much room to manoeuvre and less time to do so. This requires the sevens' players to utilise as much energy as possible on open play. The majority of sevens' teams focus on keeping possession by running and passing while avoiding getting tackled and strategically reducing the amount of kicking (IRB, 2014).

One of the more distinctive features of a sevens match other than the speed of the match, is the ability of a player to score from anywhere on the field. Fewer players on the pitch translates to less assistance on defence which means that if two offensive players find themselves isolating one defender they can easily convert that advantage into a try.

II. Players involved in Sevens

Although sevens is a sport that permits players of all shapes and sizes to play, it is rare to see traditional rugby union props on the field (iSport Rugby, 2014). Due to the continuously fast pace of a sevens game players are required to have a much higher aerobic fitness, speed and more explosive muscular power than traditional rugby union players (Gabbett, 2002), thus teams tend to consist of backline and loose forward players that are relatively lean and small when compared to rugby union players (iSport Rugby, 2014).

III. Reduced Scrum Size

Each sevens side has only three scrum players which include two props and a hooker, reducing the number of players involved in the scrum from the usual sixteen in rugby union to six (Dainoff, 2014). The reduced number of players in the scrum allows for less physicality

and force resulting in a much faster contest lasting only a few seconds (iSport Rugby, 2014; Dainoff, 2014).

IV. Lineouts

Sevens' teams spend very little time preparing for lineouts as they are a rare occasion in a sevens match (iSport Rugby, 2014). However when a lineout does occur, a team will still have hoisters and a jumper, the only difference is that there will only be one option for the hooker to throw to and not two like there is in traditional rugby union. The ball is thrown in quickly and play will continue to the backline almost immediately to initiate open play (iSport Rugby, 2014).

V. Substitutions

In rugby union both sides are permitted to have seven substitute players and are allowed to make seven substitutions throughout the game. In a sevens game, each team is allowed five substitute players and are only permitted to substitute players three times (iSport Rugby, 2014).

VI. Conversion Kicks

Sevens differs from rugby union in that the kicker is not permitted to use a kicking tee (iSport Rugby, 2014). The kicker has to perform a drop-kick whereby the ball is released to the ground and is kicked immediately as it rebounds from the ground (National Rugby League [NRL], 2013).

VII. Kick-off Protocol

In sevens the team that scored kicks off from the starting line, to the conceding team which is the opposite to rugby union whereby the conceding team kicks off to the scoring team (iSport Rugby, 2014).

2.8 Touch Rugby

2.8.1 Background

Touch Rugby is known as a minimal contact sport that is played worldwide by men, women and children of all ages (In2Touch, 2014). It played extensively in New Zealand and Australia with developing roots in South Africa, Japan, Canada and several other countries

worldwide (Neumann *et al.,* 1998). In New Zealand more scholars are participating in more non-traditional sports like touch rugby (Neumann *et al.,* 1998; Thompson, 2000). The Hilary Commission in 1999 found that touch rugby ranked as the fourth most popular sport for students aged between eighteen and twenty-four. The reason behind this rapid growth in participation is said to be due to less organisation and bureaucracy, greater participant control and the active participation of both males and females in what is formally known as a mixed team (Thomson, 2000).

Touch rugby, sometimes referred to as touch football or just touch, is an adaptation from two rugby codes i.e. rugby union and rugby league and football. The roots of touch rugby can be traced back to Australia in the 1960s where it was originally used as a warm-up for playing rugby union players (England Rugby, 2014).

Touch Rugby has over 400,000 registered members and an additional 500,000 children participating in school programmemes and related activities, which places the sport among the top participant based, organised sports in Australia (Touch Football Australia, 2014). The skills required to play touch rugby are very similar to that of the aforementioned codes but the main difference is that there is no full body contact or intense physicality involved and no kicking of the ball. The sport relies solely on basic running, passing and catching skills (Touch Football Australia, 2014).

2.8.2 Touch Rugby Basics

Touch rugby is an advantage sport whereby the attacking team has the advantage and control of the ball to potentially improve its position to score relative to the defending team. There are two teams consisting of a maximum of fourteen players each with only six players allowed on the field from each team at any point; each team is allowed an unlimited amount of what are deemed rolling substitutions. Touch rugby can be played by men, women and mixed sides which involve an equal ratio of women to men. A touch rugby match lasts forty-five minutes, consisting of two twenty minute halves and a five minute halftime break. The team who at the end of play has scored the most touchdowns is declared the winner. In the event of neither team scoring, or in the event of both teams scoring the same number of touchdowns, a draw is declared. The match is controlled by one on-field referee and two sideline referees, who may interchange throughout the match (Federation International Touch [FIT], 2003).

2.8.3 Variations in Touch Rugby

I. The Field

The field of play is rectangular in shape and measures seventy metres in length from score line to score line and fifty metres in width with interchange areas on either side of the field, extending ten metres either side of the halfway line and one metre from the sideline measuring twenty metres in length by no more than five metres in width (FIT, 2003).

II. The Ball

The game is played with an oval, inflated ball of a shape, colour approved by the Federation of International Touch with a size of thirty-six centimetres long and fifty-five centimetres in circumference (FIT, 2003).

III. Mode of Play

The onside attacking team members may pass, knock or hand the ball to each other, they are able to move with the ball in an attempt to gain territorial advantage over the defending team in order to score, they are permitted six touches in order to score or the possession is given to the defending team. The defending team aim to prevent the attacking team from gaining territorial advantage by touching the ball carrier on the offensive side. Once a touch has been initiated the attacking player who was touched must stop and place or roll the ball on the ground between his or her legs while the defending team must all retreat five metres from the mark where the touch was initiated and may only advance once another attacking player has touched the grounded ball. When an attacking player (without being touched) places the ball over the defending team's goal line a touchdown is awarded and earns the attacking team one point. When the time expires, play is to continue until the next ball becomes dead, however if a penalty is awarded it must be taken.

2.9 Injury in Sport

Physical activity has been shown to improve general well-being and results in a greatly reduced mortality and morbidity however there is an activity associated risk of injury and re-injury (McBain *et al*., 2014). Sports and other physical activities are very advantageous to individuals and to society, as being active in some form contributes greatly to the overall health of an individual and at the same time provides enjoyment and relaxation (Waller *et al.,* 1994; Accident Rehabilitation and Compensation Insurance Corporation [ACC], 2002). Involvement does however carry the potential risk of injury which has shown to increase with an increased level of participation (ACC, 2002). Safety in physical activity is vital to allow for continued participation particularly when it relates to sport and maintenance of a healthy lifestyle (Verhagen *et al*., 2010).

Timpka *et al*. (2011) conducted a study to determine one conclusive definition for a sports injury but found that a three-context framework was required to adequately cross-reference sports injury-related concepts which resulted in the development of a definition based on impairment determined by the loss or abnormality of psychological, physiological or anatomical structure or function. These concepts are then further differentiated based on the duration of the process leading to the loss or abnormality which then determines the prevention and/or management strategy required. For the purpose of this research an injury was defined as "Any physical complaint which was caused by a transfer of energy that exceeded the body's ability to maintain its structural and/or functional integrity, that was sustained by a player during a rugby match or rugby training, irrespective of the need for medical attention or time-loss from rugby activities" (Fuller *et al.,* 2007).

It is due to the potential risk of injury associated with physical activity that injury prevention; reduction and control of sporting injuries are important areas to focus on for further success in the field of sport and physical activity (Verhagen *et al*., 2010). A comprehensive model for injury causation was proposed by Bahr and Krosshaug (2005) based on the four step model proposed by van Mechelen (1997) and consists of the following sequence:

- Firstly, determine the extent of the problem and describe this problem in terms of incidence and severity of sports injuries.
- Secondly, recognise the injury mechanisms and risk factors involved in the occurrence of the injury.
- Thirdly, identify the measures that are likely to reduce the risk of future injuries; such measures are based on the information provided regarding the mechanisms and aetiological factors that were identified in the second step.
- Fourthly, repeat the first step and evaluate the effect of the measures using trend analysis of injury patterns or through the use of a randomized clinical trial (Van Mechelen, 1997; Bahr and Krosshaug, 2005).

McBain *et al*. (2014) reviewed the current literature on injury prevention by reviewing published articles that evaluate specific clinical interventions designed to reduce sport injury risks and determined that injury prevention research plays an important role in the control and safety of exercise participation by identifying risk factors for injury and re-injury.

2.9.1 Rugby Injuries

Rugby union presents an above average overall risk of injury when compared to other popular team sports (Fuller and Drawer, 2004; Fuller *et al.,* 2009; Schneiders *et al.,* 2009;

Brown *et al*., 2012). Per 1000 hours of exposure, rugby was shown to have fifty percent more injuries than reported in soccer and two-thirds more than cricket (Brown *et al.,* 2012).

The inherent contact nature of the game of rugby means that injury is a common occurrence. The hard bodily contact that repeatedly occurs implies that injuries are inevitable. Players can be involved in as many as forty physical confrontations per game and often players wear minimal or no protective gear (Hoskins *et al*., 2006).

Rugby is a very popular sport in New Zealand and accounts for the highest reported incidence of injury. The incidence of rugby injuries due to the tackle was so high that it has been labelled 'Tackling Rugby Injury' and a national rugby injury prevention programme was introduced to prevent this large incidence of injuries (Chalmers *et al.,* 2004). Rugby injury costs the Accident Rehabilitation and Compensation Insurance Corporation (ACC) in excess of 19.6 million New Zealand dollars per annum (ACC, 1998).

Physicality is one of the most predominant characteristics of rugby and it is through this constant physicality that many dangerous injuries are sustained (Garraway and Macleod, 1995) with the most common injury being a head concussion (Tuck, 2010). In South Africa a national rugby safety programme called 'BokSmart' was introduced to record serious head and neck injuries sustained in the game of rugby in order to develop strategies to prevent further injuries (Viljoen and Patricios, 2012).

By adapting certain elements of the game such as decreasing or eliminating the 'contact' element, more people will feel confident to participate and thus promote the sport and general health and wellness through physical activity.

2.9.2 Tens Injuries

There is currently no literature on injuries specific to tens rugby; however, it is hypothesised that they would be similar to that of rugby union due to the small number of adaptations made to the game. Because the field is the same size as rugby union but the amount of players on the field is reduced play is faster and can be considered to be less physical as there is more space to manoeuvre and thus it can be hypothesised that more overuse injuries as compared to contact injuries are sustained compared to those sustained in rugby union.

2.9.3 Sevens Injuries

To the researcher's knowledge there have only been three studies that have documented injury rates in rugby sevens with all three studies reporting higher injury rates in rugby

sevens' players when comparing to rugby union (Gabbett, 2002; King *et al.,* 2006; Higham *et al*., 2012). These injury rates are 76.5% higher than previously reported for the same cohort of conventional amateur rugby players (160.6 per 1000 hours), using the same injury definition, during the same time period (Gabbett, 2002).

In a study of amateur rugby sevens players by Gabbett (2002), an injury was defined as any pain or disability suffered by a player who was then assessed by a head trainer during or directly after the game. This definition was similar to that of King *et al.* (2006) who conducted a similar study which involved national seven's players. For the purpose of this research an injury was defined as "Any physical complaint, which was caused by a transfer of energy that exceeded the body's ability to maintain its structural and/or functional integrity, that was sustained by a player during a rugby match or rugby training, irrespective of the need for medical attention or time-loss from rugby activities" (Fuller *et al*., 2007).

Injuries in these studies were classified according to anatomical site: head and neck, face, thorax and abdomen, shoulder, arm and hand, knee, calf, ankle and foot, and 'other' (Gabbett, 2002; King *et al.,* 2006). Gabbett (2002) described the types of injuries according to: haematomas and strains, contusions, concussions, joint sprains, fractures and dislocations, lacerations, abrasions, and 'other'. King *et al.,* (2006) classified injuries as: sprains, strains, bruises and contusions, haematomas, dislocations, lacerations, fractures, overuse, concussion and unspecified medical conditions which indicates the injuries documented were those reported to a medical facility and were typically acute in nature.

These studies included descriptions of the cause and severity of the injury (King *et al.*, 2006; Gabbett, 2002). All injuries reported to have occurred during the matches were recorded regardless of severity and classified as transient (no matches missed), minor (one match missed), moderate (two to four matched missed) and major (more than five matches missed) (King *et al.,* 2006).

Gabbett (2002) determined that fatigue contributed to injuries in rugby sevens through noting the progressive increase in injury incidence as more matches were played. It was determined by Gabbett (2002) that teams who progressed further in the tournament sustained the highest injury rates; the cause of the high injury rates was said to be either to fatigue associated with repetitive nature of the tournaments and poor aerobic fitness of amateur athletes or the increased playing time and the high intensity associated with playing in finals. Thus it was concluded that amateur seven's players generally have poor aerobic functioning when compared to professional athletes and are therefore predisposed to injury because of the requirements to play multiple games in one day resulting in increased fatigue and therefore injury (Gabbett, 2002).

King *et al*. (2006) suggested that a high playing intensity contributed to a higher incidence of injuries as the findings were the opposite of Gabbett (2002) in that more injuries were recorded on the first day of the tournament than on the second. These findings suggest that fitness, fatigue and intensity may be contributing factors to injuries sustained on the first day of tournament (King *et al*., 2006).

2.9.4 Touch Rugby Injuries

Injury risk is an important issue in Touch (Neumann *et al.,* 1998). It is perceived as a sport that has less risk than rugby union, ten and sevens rugby due to the lack of contact, particularly the tackle.

In a study conducted by Neumann *et al*. (1998) 345 touch players completed a questionnaire after reading an information sheet. The survey required them to recall information regarding activity and injuries over the year 1996. Players were asked to record the number of games and the number of hours they spent training a week. Extra personal fitness and participation in other sporting activities were also recorded in the questionnaire. The only injuries recorded were those sustained while playing the game of touch or during touch specific training. In this study an injury was defined as that which prevented a player from playing or training for at least a week. Injuries were classified according to minor, moderate and severe based on the amount of time the participant was unable to train and or play. Minor was classified as one to two weeks, moderate, three to four weeks and severe, five weeks or more (Neumann *et al.,* 1998).

Of the injuries reported, 177 injuries were reported in total and of those, 30 injuries were caused by contact with other players and 147 were due to non-contact events. Fifty four percent were classified as minor, 23% moderate and 23% severe. The average time lost per injury was 3.7 weeks. Sprains were reported as the most common injury sustained, followed by strains and then fractures, it was reported that males sustained more injuries than females. There was no significance noted between representative and non-representative players and between those who trained and those who did not train (Neumann *et al.,* 1998).

In order to determine comparative injury rates it is useful to compare sports with similar modes of play such as rugby union, football and Australian Rules Rugby which are all played on grass turf or field. All these sports are termed continuous and involve intermittent sprinting and changing direction with the use of an inflatable ball (Neumann *et al.,* 1998). The result was that touch rugby participants sustained fewer injuries than the above mentioned sporting codes and thus was deemed a safer sport that could be a useful training

technique for other rugby codes since avoiding injury is a top priority in any sport (Neumann *et al*., 1998).

2.10 Mechanism of Injury

The mechanism of injury is how an injury occurs. Seering *et al*. (1980) and the Committee on Trauma Research (1985) both proposed different classifications systems for mechanisms of injury as cited by Bahr and Krosshaug (2005) but these were proposed from a mechanical perspective and it was argued that these systems do not set out to identify a modifiable cause with the aim of preventing further sporting injuries. Bahr and Krosshaug (2005) concluded that a detailed biomechanical description of all the factors involved in injury could provide the most information on the cause of injury and how to modify these factors in order to prevent future injury. An injury mechanism can be used to define the vital features of the sport or activity, the athletes and opponents participating which can be defined as a qualitative description of the interaction between the athlete and opponent, the biomechanics of the body as a whole and finally localised biomechanics which in the case of activity would be the joint and/or tissue biomechanics (Bahr and Krosshaug, 2005).

The New Zealand Rugby Injury and Performance Project (1993) found that 33% of all rugby union injuries occurred in tackles (Gerrard *et al.,* 1994). Hence the tackle has been identified as an aspect of rugby union carrying a substantial risk of injury and a high cost (Gerrard *et al.,* 1994; Garraway and Macleod, 1995; Wilson *et al.,* 1999, Schneiders *et al.,* 2009; Tuck, 2010). According to Wilson *et al.* (1999) the majority of tackle injuries were associated with players being tackled from the front (63%) rather than the side or from the back. In a five year rugby union injury surveillance study by Dutfield *et al*. (2007) which measured the injuries in Australian rugby from schoolboy level to national rugby players, it was found that the tackle was the most common injury event, associated with 31% of injuries. A player was twice as likely to be injured being tackled than making a tackle. This is further supported by Garraway and Macleod (1995) who found that tackling in games was associated with 22% of injury episodes and accounted for 18% of absence days from employment or school; being tackled was associated with a further 27% of injury episodes and resulted in 43% of all time lost from employment or education.

An injury survey study conducted by Neumann *et al.* (1998) on touch rugby players revealed that 117 subjects out of 365 reported some type of injury while participating in touch rugby training or match play during the course of the year, of these injuries reported, 30 were due to contact with other players and 147 were due to non-contact reasons. Of the injuries

reported 37% were diagnosed as sprains, 35% as strains, 7% as fractures, 6% as overuse injuries, 5% as bruises, 5% as wounds and 5% as other.

This research was retrospective in nature and therefore the definitions of mechanism of injury are limited to those included on the CSSA form (Appendix A) (Korporaal, 2002). A traumatic injury is classified as an acute impact injury whereby an injury has been incurred as a result of contact with another player or object such as the ground. An overuse injury is classified as an injury that was either pre-existing and would have been defined as a chronic overuse injury or an acute overuse injury which would technically be termed acute-on-chronic but this is latter option is not available on the CSSA injury reporting form (Appendix A) (Korporaal, 2002).

2.11 Anatomical Location of Injuries

In several studies conducted on rugby union injuries the most common anatomical location of injury was the lower limb (Bird *et al.,* 1998; Gabbett, 2003; Schneiders *et al*., 2009; Tuck, 2010). This was reiterated by Hoskins (2006) in that the most common rugby injuries reported were musculotendinous in nature and affected the lower limb more frequently than elsewhere. However in a descriptive retrospective study on injuries done of South African rugby players the results demonstrated that the vast majority of injuries occurred to the upper extremity (Donson, 2003, Brooks and Kemp 2008). A study conducted by Wilson *et al*. (1999) on New Zealand rugby players revealed the most frequently injured body sites were the head and neck followed by the knee.

Junge *et al*. (2004) compared the injuries of rugby union and soccer players and found that in rugby players most injuries affected the lower limb, followed by the upper limbs, head and/or neck in varying order. Brooks and Kemp (2008) reported that in rugby the most common injury location was the lower limb, accounting for 41% - 45% of all injuries reported. The three most common areas were the knee, thigh and ankle. The most common injuries to occur to the knee were medial collateral ligament injuries followed by meniscal injuries, hamstring injuries were the most common thigh injuries and in the ankle the lateral ligaments and Achilles' tendon pathologies were the most common injuries reported. Head and neck injuries made up 12-33% of all injuries the most common type of injury being a laceration followed by facial fractures. Injuries to the upper limb comprised 15-24% of injuries reported, with the shoulder being the most common location with rotator cuff, instability and acromioclavicular joint injury being the most common types of injuries reported.

Schneiders *et al*. (2009) reported on injuries sustained by New Zealand premier club rugby union players and found that the face was the most commonly injured anatomical location (15.8%) followed by the shoulder (13.9%) and knee (13.9%). The largest percentage of injuries diagnosed were lacerations (22.6%) followed by haematoma or bruising (21.3%) and ligament tear or sprain (20.7%). It can be concluded that overall the lower limb is the most commonly affected anatomical location for rugby injuries, particularly the knee. The most common injuries diagnosed were lacerations followed by haematomas and joint sprains with or without ligamentous damage.

In an injury survey study conducted on 345 touch rugby players conducted by Neumann et *al*. (1998) 71% of injuries reported affected the lower limb, 23% of which involved the ankle. Less than 3% of injuries affected the head or neck.

2.12 Risk Factors for Injury

Risk factors in sport are any factors that may increase the risk for injury (Caine *et al.,* 2008). A sports injury results from a complex, multifactorial interaction that involves a combination of risk factors and composite physical events (Verhagen *et al.,* 2010). Bahr and Holme, (2003) described the sports injury model which involves the dynamic interaction between a multitude of risk factors and an events sequence which will ultimately result in a sporting injury. The model described by Bahr and Holme (2003) assesses the intrinsic and extrinsic risk factors which impact the individual that ultimately contribute to injury. The presence of risk factors does not necessarily result in injury but result in the athlete being increasingly susceptible to the probability of injury (Bahr and Holme, 2003). Risk factor identification is a vital step in sports injury prevention (Finch *et al.,* 1999). Risk factors have been described in the literature as intrinsic/internal, extrinsic/external or modifiable, non-modifiable (Bahr and Holme, 2003).

2.12.1 Intrinsic

Intrinsic risk factors or internal factors are specific to the individual athlete that contributes to his or her injury (Quarrie *et al,* 2001; Bahr and Holme, 2003;). They can be viewed as factors that predispose the athlete to respond in a particular way to an injury circumstance (Caine *et al*., 2008). They include age, gender, anthropometric characteristics, fitness, health status, and injury history (Quarrie *et al*, 2001).

2.12.1.1 Age

Specific age groups can sustain age related injuries. Fukuchi *et al.* (2013) sought to investigate differences in flexibility, muscle strength and running biomechanical factors between younger and older runners. The study reiterated that biological aging results in alterations in running biomechanics, reduced muscle force output and reduced joint flexibility. The underlying mechanisms at play in age-related biomechanical and clinical changes are obscure and multifactorial in nature (Fukuchi *et al.,* 2013).

Studies of schoolboy rugby union have shown that the frequency of injury rises with an increase in age (Nathan *et al.,* 1983 as cited by Noakes and du Plessis, 1996). This is further supported by Caine *et al.* (2008) and Bleakly *et al.* (2011) who proposed that the risk of injury is greater in older boys because they are heavier, stronger, faster and able to generate more force when engaging in contact further substantiated by Clark *et al.* (1990) who found that senior rugby players were injured more frequently than school boy players particularly in open play. However these findings were contradicted by a study involving all the senior rugby clubs in the Scottish borders showing that players in the age group 20 - 24 years showed a higher incidence of injury than other groups and that those players in the category of thirty-five years or older sustained the lowest injury rates (Garraway and Macleod, 1995).

Neumann *et al,* (1998) found in a retrospective survey of 345 touch players the average age was 26.6, however a statistically significant relationship between age and injury was not found.

2.12.1.2 Anthropometric Characteristics

A study by Quarrie *et al*. (2001) showed few associations between anthropometric and physical performance variables. Players with a body mass of greater than 81kg sustained more injuries than those players whose body mass was lower than 74kg. Similarly, players with a BMI higher than 26.5 sustained more injuries than players with a BMI of 23 or less. Players whose height was in the middle quintile (179cm - 181cm) sustained more injuries and missed more game time than those shorter players in the bottom quintile (< 174cm) (Quarrie *et al.,* 2001)

2.12.1.3 Gender

A study performed by Bird *et al.* (1998) showed than male rugby players had higher injury rates than female players in matches and in practice – injury in training was rare for female

players. There were no significant differences between positional groups for the males in games or practices however in females this was in direct contrast to the men. The female inside backline players had the highest incidence rates in both games and practices compared with other positions (Bird *et al.,* 1998). This was in contrast to the findings of Collins *et al.* (2008) who performed a study on male and female high school rugby players in the United States of America, who found that injuries patterns did not differ between male and female players.

Taunton *et al.* (2002) conducted a study on runners to determine any difference in the injuries sustained by men and women. No significant difference was found in the amount of injuries sustained between the two but did determine that certain injuries were found more prevalent in the two groups, an example being that men sustained more meniscal injuries than women.

In an injury survey on touch rugby players, gender difference was a significant finding in that there was a much higher injury rate amongst male players. Male touch rugby players had an injury rate of 5.95/1000 hours of play compared to women who had an injury rate of 3.47/1000 hours of play (Neumann *et al.,* 1998).

2.12.1.4 Previous Injury

Competitive and recreational athletes, of every age, are at risk of a wide variety of soft tissue, bone, ligament, tendon and nerve injuries, caused either by direct trauma or repetitive stress (Maffulli *et al.,* 2011). Injury results in an alteration in the mechanical characteristics of the muscle. These alterations, often from a prior minor injury, may precede a major injury (Croisier, 2004). According to Caine *et al*. (2008) a previous injury can lead to fibrosis, adhesions and limited joint function predisposing the injured site to further injury.

A preseason injury was defined by Quarrie *et al,* (2001) as an injury that was affecting a player's ability to train or play at the time of preseason assessment. Those players that reported an injury in the preseason assessment had a higher injury rate than those who did not. It was therefore decided that a player who had an existing injury may not perform to their optimum function on the field compared to a player that is not injured, thus it is crucial to identify those players with existing injuries before playing to ensure no further injury ensues (Van Noordwyk, 2007 as cited by Tuck, 2010).

2.12.2 Extrinsic

Extrinsic factors are those external to the individual (Quarrie *et al,* 2001). They are external factors that influence the already predisposed athlete and create a situation in which the athlete is susceptible to an inciting event, ultimately resulting in injury. During a given situation, a pre-disposed athlete is exposed to the interaction of multiple risk factors and the inciting event is usually directly associated with the onset of injury (Bahr and Holme, 2003). These include the nature of the sport, environmental conditions, and equipment used (Quarrie *et al*, 2001).

2.12.2.1 Nature of the Sport

Different sporting activities and player positioning within these sports are associated with different patterns and types of injuries. Sports specific injuries are well documented (e.g. volley ball shoulder [Notarnicola *et al*., 2012], tennis elbow [Orchard and Kountouris, 2011]), and emphasises the effects of biomechanics and repetitive stress on the prevalence of injuries. The manipulation of time, intensity and load in these sports results in the activities involved being a risk factor for injury (e.g. constant wrist extension and gripping is a risk factor for lateral epicondolitis) (Orchard and Kountouris, 2011).

I. Position

According to the New Zealand Rugby Injury and Performance Project VI (1993) in terms of positional groups, the midfield backline players missed a greater proportion of their season than the frontline players (Quarrie *et al*, 2001). However in a study performed by Garraway and Macleod (1995) there were no significant differences in the proportion of injury episodes according to playing position, but injuries to the trunk (mainly back strain and sprain) were three times more frequent in forwards than in backs. According to Brooks and Kemp, (2008) the difference in the incidence of injury between forwards and backs is insignificant.

II. Grade of play

Grade of play was identified as a significant risk factor for a high injury incidence rate. It was suggested by Noakes and du Plessis (1996) that the higher the level of play and the higher the intensity of the game, the higher the probability of injury. Players from higher grades reported higher incidence rates than players from lower grades (Garraway and Macleod, 1995; Quarrie *et al.,* 2001; Gabbett, 2003; Caine *et al.,* 2008). Those who had played less rugby leading up to the season missed the greatest proportion of their season due to injury which demonstrates that the more experience a player has the less likely that he or she will miss out on playing due to injury (Quarrie *et al,* 2001).

No significant difference was found between representative and non-representative touch rugby players in an injury survey conducted by Neumann *et al*. (1998).

2.12.2.2 Time of Play

Injuries were more frequent at the beginning of the season, with a period prevalence of injury occurring in September to October season and in the March to April season (Garraway and Macleod, 1995). Naokes and du Plessis (1996) demonstrated through the review of several injury profiles conducted by Nathan *et al*. (1983), Clark *et al*. (1990) and Roux (1992) that most injuries occur either in pre-season training or in the first two months of the season which is further supported by a study conducted by Quarrie *et al.* (2001). The incidence of injury was higher in matches than in training sessions (Bird *et al.,* 1998; Quarrie *et al.,* 2001; Gabbett *et al.,* 2007). According to Gabbett *et al*. (2007) there were approximately ten times more injuries in matches than in training sessions.

2.12.2.3 Environmental Conditions

Hodgson Phillips *et al*. (1998) as cited by Gabbett (2002) showed that injury incidence doubled when the professional European season moved from winter to summer which was supported by Hoskins *et al*. (2006). Hoskins *et al.* (2006) found that the warmer months had a greater prevalence of injuries, which was said to be due to the impact of the harder ground or the increase in the speed of the game allowing more player collisions. There was a significant correlation of increased number and rate of injuries when playing on hard ground. There was a significant interface between the ground condition and session type which showed there were more injuries sustained when playing a match on hard ground than when training on hard ground (Gabbett *et al.,* 2007)

Humidity and temperature were shown to be the only significant predictors of the number of injuries and the rate of injury according to a study performed by Gabbett *et al.* (2007). Higher levels of humidity and higher temperatures were associated with fewer injuries. Long term rainfall measure did not show to correlate with repetitive ground-contact injuries, non-contact injuries, minor injuries, strains, and calf injuries (Gabbett *et al*., 2007)

2.12.2.4 Equipment

I. Facilities

Tuck (2010) described how correct training technique in both the gym for strength training and on the field for skills training has been shown to be an integral part of developing a rugby player.

II. Personal Protective Equipment

According to Caine *et al.* (2008) there are mixed results with regards to protective equipment protecting against injury in various sports. According to Noakes and du Plessis (1996) protective equipment must be utilised and include the use of mouth guards and ear protection for forwards; soft helmets or scrum caps are optional but have been shown to reduce the risk of concussion. According to Tuck (2010) risk factors for injury increase immensely for those players that do not wear sport specific boots (McManus, *et al.,* 2004) and incorrect and/or ineffective protective gear, such as helmets (Braham *et al*., 2004).

2.13 Treatment Available to Rugby Players

2.13.1 Medical Treatment at Sports Events

The various extrinsic and intrinsic factors that contribute to injury imply that the treatment required must be varied and thus a diverse group of medical personnel are essential to provide the necessary treatment. The minimum requirements as defined by the Safety at Sports and Recreation Events Act (2009) states that a fully prepared and correctly staffed paramedic vehicle must be present. The presence of any other medical staff or support personnel to provide other forms of treatment may be provided according to the discretion of the players, teams and/or event organisers.

2.13.2 First Aid

The Kwazulu-Natal Rugby Union (KWAZULU-NATAL RUGBY UNION Fixtures booklet, 2008) stated that no rugby game may commence unless there is a first aid team and an ambulance present to attend to any injuries that may occur (Tuck, 2010). A study conducted by Glaun *et al*. (1984) as cited by Tuck (2010), surveyed 29 schools in the Western Cape to determine the standard of first aid care provided. It was found that the care provided was sub-standard and adequate equipment was not provided (e.g. lack of splints, correct stretchers and neck braces) (Glaun *et al.,* 1984 as cited by Tuck, 2010). The principal issue was the coaches' lack of knowledge in the management of injuries (Tuck, 2010).

The most likely reason for the lack of adequate medical care and equipment is funding (Tuck, 2010). One possible reason suggested for the insufficient medical facilities is the lack of finance to support it. The cost of equipment and medical care is often secondary to the benefit of playing the sport and success on the field is worth more than providing adequate treatment to those that are injured in the process (Tuck, 2010).

First aid equipment should be readily available in the event of an injury in rugby matches and in practise and there should be fully trained staff available to attend to these injuries as well as the coaches, managers and officials having adequate first aid knowledge.

2.13.3 Medical Staff

If a player is injured during a rugby match or at a practice, he/she needs to be adequately accessed and managed (Tuck, 2010). The severity of the injury will determine the extent of the management required. In order to fully determine whether an athlete is fit to return to play he/she must return to practice without putting the other players or themselves at risk of further injury (Beardmore *et al*., 2004). The team's healthcare provider should determine when the player is fit to return to practise and should monitor the player to prevent re-injury (Tuck, 2010).

It was recommended by Tuck (2010) that every high school rugby first team should have a healthcare practitioner with experience in first aid present to assess and manage any injuries that occur. However certain teams lack the funding to have first aid equipment or a healthcare practitioner present (Tuck, 2010).

2.14 Sports Medicine and Chiropractic

Sports medicine is a form of healthcare that is practiced in a variety of amateur and professional sport settings and chiropractic has become synonymous with sports medicine as a result of athletes requesting chiropractic management (Theberge, 2008). Athletes across various sporting disciplines are relying on chiropractic as a form of injury prevention and conditioning (Thomle and Ziegler, 1991). In order to correctly manage athletes effectively, it is vital as a practitioner to have an understanding of the nature of the injuries they will be facing (Finch, 1999); hence injury surveillance systems have been utilised to determine and describe these injury profiles.

For the purpose of this research chiropractors will be defined as: "Health professionals specializing in the diagnosis, treatment and prevention of disorders of the musculoskeletal system and the effects of these disorders on the function of the nervous system and general health" (World Federation of Chiropractic, 2015). This definition is consistent with the definition from the Chiropractic Association of South Africa (CASA, 2015).

The demand for complementary and alternative health care practitioners by athletes has increased over the past decade (Labuschagne, 2009). Chiropractic is considered to be an alternative health care option and has grown to be a synonymous addition to the medical

personnel providing treatment to athletes and sports teams in various grades of play (Labuschagne, 2009). The reason for this increase could be due to the fact that chiropractic is well-suited to the treatment of athletic injuries as it focuses on mechanical stresses that are often directly linked to the onset of symptoms (Cloete, 2008) and is known as a drug free profession which is congruent with anti-doping laws in sporting activity (Labuschagne, 2009).

Chiropractors and other manual therapist are a vital part of the treatment and management of musculoskeletal injuries and disabilities (Hoskins *et al*., 2009). Chiropractic has often been viewed by other medical professions, particularly allopathic medical practitioners as being a one dimensional vocation that is limited to only providing treatment for spinal disorders (Miners, 2010). This is primarily due to the philosophy of 'classical' chiropractors that follow a historically driven treatment method that involves a 'manipulation-only' treatment strategy (Hoskins *et al*., 2009). There has however been a surge in the incorporation of multimodal treatment strategies into the chiropractic curriculum, which has resulted in an increase in modern multimodal chiropractors that utilise components of active and passive care to treat and manage all stages of injury and/or dysfunction (Hoskins *et al*., 2009).

The role of the chiropractor is changing and more are becoming involved in sports medicine through the interaction with other sports healthcare practitioners, coaches and emergency care providers to allow for the holistic treatment of athletes (Miners, 2010). The main role of the chiropractor in this collaborated sports medical approach is to work with all the other practitioners to determine an accurate diagnosis in order to provide the most effective treatment strategy that will enable the most efficient recovery and allow for the prevention of future injury and thus allow the athlete to perform at an optimum level (Miners, 2010). In some cases chiropractors are given the responsibility of being the primary health care practitioner which implies they are responsible for the diagnosis, referral and management of all injuries within the scope of chiropractic (Julian *et al*., 2010).

Modern multimodal chiropractic involves a combined method of soft-tissue and stretching techniques, rehabilitation and therapeutic exercises with biomechanical rehabilitation while maintaining an emphasis on high-velocity low-amplitude manipulation (Hoskins *et al.,* 2009). There are several additional modalities that include taping, physical therapies, electrotherapies, acupuncture, gait analysis and retraining, nutritional advice, ergonomic correction and prescription of exercise programmes (Hoskins *et al.,* 2009). This is the preferred method of treatment amongst athletes and therefore modern multimodal chiropractic is an integral part of any sports medical team (Hoskins *et al.,* 2009).

The DUT chiropractic treatment facility usually consists of five or more portable chiropractic beds and all the basic equipment required by the chiropractic interns to treat athletes

efficiently and effectively. This equipment includes towels, ice, acupuncture needles and the oils and gels utilised in massage techniques. The treatment protocols provided are limited to those included in the scope of chiropractic and those that are able to be executed in an on-field environment. These include; manipulation, massage, static and PNF stretching, needling, ischaemic compression, cryotherapy, heat therapy, mobilization, rest and taping. These treatments can be singularly utilised or combined to treat a variety of injuries. As stated in Act 63 of the Government Gazette (1982 (as amended)) all athletes are treated under the supervision of a qualified chiropractor. If the injury reported by the athlete is not within the scope of chiropractic he or she must be referred to another heath care practitioner (Act 63 of the Government Gazette (1982 (as amended)).

In South Africa there are certain sports events where the chiropractic sports facility are present and provide free treatment to the athletes and general public attending the event. These treatment facilities are run by chiropractic interns that are part of either the University of Johannesburg (UJ) or the Durban University of Technology (DUT) chiropractic programmes. This study is based on the data collected from the chiropractic facility provided by the DUT chiropractic programme. The procedure followed by the DUT chiropractic interns at sports events will now be elaborated on. The CSSA form (Appendix A) (Korporaal, 2002) is the standardized clinical injury reporting document that is required to be completed by the patient, intern and supervising clinician in order for treatment to occur. The form was validated through the means of a focus group and pilot study (Korporaal, 2002) which represents the accuracy and reliability of such a research tool (Bernard, 2000). The Government Gazette, Act 63 (1982 (as amended)) states that it is standard clinical practice to record all clinically relevant information at each visit at any of the chiropractic treatment facilities.

The CSSA form (Appendix A) (Korporaal, 2002) includes sections on participant demographics, injury and treatment protocol(s) executed. Patients are required to complete the top portion of the form which includes basic demographic information followed by signing the consent to treatment and permission to include the use of the data in any future research. The other sections of the form include any relevant case history, the history of injury and/or trauma, clinical impression, mechanism and anatomical location of injury followed by a section on objective findings found on physical examination followed by diagnosis and treatment selection. After the intern has adequately obtained all relevant information the case is discussed with the supervising clinician who either agrees with or modifies the proposed treatment plan followed by a signature allowing treatment to commence. This is the standard clinical practice performed at the DUT chiropractic Day Clinic (Government Gazette, Act 63 of 1982 (as amended); Clinical Manual, 2007).

2.15 Injury Reporting and Surveillance

There have been many questions regarding the frequency and type of injuries sustained and the preventative methods required to reduce these injuries. Injury surveillance has come from professional, amateur and junior levels. Few studies share the same injury definition or data collection method, making comparisons and conclusions difficult (Hoskins *et al*., 2006).

Finch *et al.* (1999) investigated the practicality for improved data collection for recording sports injuries recommended for the use of sports medical practitioners. It was proposed that on-site sports medical professionals or first aiders would directly observe, treat and record information regarding the presenting injury and that this would provide the most accurate and comprehensive data to profile injuries in Australian Basketball (McKay *et al.,* 2001).

In order to accurately record and collect the most useful data surrounding an injury, appropriate methods of recording need to adopted. Junge *et al*. (2008) described the need for a standardized injury reporting form that was simple, concise but flexible, representative and timely. The form should document the date and time of the injury, the sport being played and the event participating in and the anatomical location and mechanism of injury (Junge *et al*., 2008). According to Finch *et al.* (1999), there are several steps to allow for standardized injury surveillance that will provide a concise but descriptive injury report:

- All data required for medico-legal reasons needs to be reported. This includes personal details, diagnosis and the treatment performed.
- The report should be concise but allow for further elaboration if required.
- The form should be created according to the needs of the event organizers regarding printing costs and logistics.
- Finally the form should be created in a format that can be interpreted and completed in a timely manner

According to Finch (1997), “Injury Surveillance is the ongoing collection of data describing the occurrence of, and factors associated with injury”. Injury surveillance is the organized collection of data that plays a vital role in injury prevention programmes; this data identifies injury tendencies, problems with event organizing and provides an outline for further research and investigation (Finch and Mitchell, 2002). The prevention of sports injuries can be described as a four step procedure; the first step is to identify the nature and extent of the problem, then the factors and mechanisms involved in the cause of the problem, thirdly there is the introduction of the factors that aimed to reduce the problem and/or the mechanisms involved in the occurrence of the problem and finally the assessment of the success or failure of these factors. This approach will only be successful when there is total integration

of a sports injury surveillance system that has the capability to assess the aetiological factors surrounding sports injuries (Van Mechelen *et al*., 1992 and Finch *et al.,* 1999).

Standard and reliable definitions of sports injury, mechanism of injury and sports participation will determine the success and generalized application of any sports surveillance system (Finch, 1997). Injury surveillance is an integral part of an injury prevention strategy (Braham *et al*., 2004). Knowledge of the causes of injury is crucial for the development of injury prevention strategies (van Mechelen, 1997). Sports event data collection on injury benefits the organizers, athletes and future practitioners involved in treatment by presenting valuable information concerning the types of injuries, anatomical locations and high risk methods of injury. As described by Finch and Mitchell (2002), the importance of data collection during sports events increases the knowledge base surrounding the sports injury problem, it allows for epidemiological data on athletes and documents areas of importance in the prevention of future injuries.

Research conducted by McManus and Cross (2004) on elite junior rugby players revealed that further research is needed to identify the aetiology of injury at all levels of competition and to use these findings to develop effective injury prevention strategies in the sport. This particularly applies to the above mentioned rugby union adaptations as there is little research on injury profiles relating to these sports. There are various risk factors that play a role in the high injury rate during rugby (Tuck, 2010). It is worth noting that these risk factors will change within the various adaptations of the game. It is therefore important to note the differences between the different adaptations of rugby by recording the specific injuries sustained in each group and comparing them, to determine what injuries are more common, how those injuries relate to that specific rugby adaptation and how they differ between subgroups in order to better prepare athletes through adequate injury conditioning and prevention.

This research aims to demonstrate injury profiles to provide information to the participants, coaches and tournament organisers for future event success through participant preparation which may include injury prevention and or improved injury management, improved event organising through better resource planning and finally improved treatment protocols from onsite practitioners, specifically chiropractic, through the knowledge and understanding of the anticipated injuries (Finch *et al.,* 1999).

2.16 Conclusion

To the researcher's knowledge, there are many valid and reliable studies on rugby injuries (Gerrard *et al*., 1994; Waller *et al*., 1994; Garraway and Macleod, 1995; Noakes and du Plessis 1996; Wekesa *et al*., 1996; Jakoet and Noakes, 1998; Wilson *et al*., 1999; Bathgate *et al.,* 2001; Quarrie *et al*., 2001; Braham *et al.,* 2004; Best *et al.,* 2005; McIntosh, 2005; Dutfield *et al*., 2007; Fuller *et al.,* 2007; Gabbett and King, 2007; Fuller *et al.,* 2009; Schneiders *et al*., 2009; Tuck, 2010; Bleakly *et al.,* 2011). However to the researchers' knowledge there are no studies to date on tens rugby injuries.

To the researchers knowledge there are but three studies on sevens injuries (Gabbett 2002, King *et al.,* 2006; Higham *et al*., 2012) and only one study on touch rugby injuries (Neumann *et al.,* 1998). There are to date no studies on the comparison of different rugby injuries and none that have been done at one event.

This study aims to benefit the organizers, participants and future practitioners involved in treatment by presenting valuable information concerning the types of injuries, anatomical locations and high risk methods of injury. Injury data obtained during sporting events is useful to plan for future events, in terms of resources, medico-legal purposes and it plays an important role in the duty of care to the competitors. Notably the most significant function of injury surveillance at sporting events is to help make future competitions safer (Finch *et al.,* 1999).

Therefore, the primary aim of this study was to compile an injury profile of patients attending the chiropractic treatment facility and the management strategies utilised by the chiropractic students at the 2014 Durban 'Rugby Rush Tournament'. Key objective outcomes were to determine demographic information regarding patients who presented to the chiropractic treatment facility during the 2014 'Durban Rugby Rush' tournament for treatment. Secondary objective outcomes were to determine an injury profile in terms of injury type and mechanisms involved. Corresponding outcomes included determining the treatment profile used in the management of patients who presented to the chiropractic treatment facility, investigating associations between demographic and injury profiles and making recommendations, if any, to provide recommendations to improve the clinical injury reporting form. The methodology utilised in this study will now be presented in **Chapter Three**.

CHAPTER 3 : METHODOLOGY

3.1 Introduction

This chapter deals with the study design, the methodology used, the procedure in which data was collected and statistical analysis.

3.2 Study Design

This study was a retrospective, quantitative, descriptive injury profile study (Mouton, 1996). The data collection tool was the validated Chiropractic Student Sports Association's (CSSA) questionnaire (Appendix A) (Korporaal, 2002).

Based on this design, the research was approved by the Faculty of Health Sciences Research and Ethics Committee at the Durban University of Technology (Appendix B). This approval permits that the research complies with the requirements of the Declarations of Belmont, Nuremberg and Helsinki of 1975.

3.3 Study Participants

No recruitment was required. The study population consisted of all patient records from participants that presented voluntarily to the chiropractic treatment facility at the 'Durban Rugby Rush Tournament' and by signing the patient section of the Chiropractic Student Sports Association's (CSSA) questionnaire (Appendix A) (Korporaal, 2002), they agreed to their information being used for current or future research. The Durban 'Rugby Rush Tournament' took place at College Rovers (Jacko Jackson Drive, Durban 4025) from the 21st - 23rd of March 2014.

3.4 Sampling Method

The sample size was 695 patient clinical records (Korporaal, 2014). All patient records were allocated to one group with sub-analysis occurring. A purposive sampling method was used for this study (Mouton, 1996) to include and exclude records based on the criteria listed below.

3.4.1 Inclusion Criteria

- Only the records from competing participants were included.
- Data for this study was collected from the signed CSSA forms (Appendix A) which must be signed by the patient, student and clinician.

3.4.2 Exclusion Criteria

- Non-participants e.g. referee's, spectators, sponsors and event organisers.

3.5 Measurement Tool

The measurement tool in this research study was the Chiropractic Students Sports Association (CSSA) form (Appendix A) (Korporaal, 2002). The CSSA form (Appendix A) (Korporaal, 2002) is a standardised document used to record information regarding the assessment and treatment and/or management of presenting patients at all sporting events by students from the DUT Chiropractic Department. The form included a section requesting patients to consent to their information being used for future research. They were required to sign this prior to any examination and/or treatment. The form included the following sections: patient details, region of complaint, mechanism of injury, clinical impressions, treatment and continuation of play. The CSSA form (Appendix A) (Korporaal, 2002) was signed by the patient, student and clinician.

3.6 Data Collection Procedure

Permission was granted by the event organisers to allow a Chiropractic treatment facility at the 2014 'Durban Rugby Rush Tournament'. At this Chiropractic treatment facility, participants had access to treatment that was free of charge to them and allowed them to have any general or musculoskeletal complaint assessed for referral or treatment as necessary.

In order to access the Chiropractic treatment facility all participants were required to enter the treatment area voluntarily and to complete the CSSA form. Those patients that did not agree to complete the forms were excluded from being treated at the Chiropractic treatment facility at the event and referred for treatment at another local facility if it was deemed necessary or if the participant requested a referral. By completing the CSSA form (Appendix A) (Korporaal, 2002), the participant gave consent to be treated as well as for the data that was recorded to be utilised as part of a research process.

The CSSA form (Appendix A) (Korporaal, 2002) is a validated measurement tool that enables chiropractic students to legally and ethically treat patients under the supervision of a chiropractic clinician. The data captured provides a record of the patient's demographical information, the involvement in the event e.g. spectator, management or athlete, whether the participant is a new patient or a follow-up patient requiring continuation of care or presenting with a new complaint, the type of injury, mechanism of injury, anatomical location of the injury, diagnosis, treatment protocol administered and whether continuation of play was permitted or not and if no, the reason why it was not permitted. Additionally the form allows for the recorded information to be reported back to the Rugby Rush organisers to allow for more effectiveness of care and resource management regarding sports injuries sustained at the event to inform the organisers for future event management and injury prevention.

After the CSSA form was completed by the patient, a senior chiropractic student asked the patient case history questions pertaining to the fore mentioned information and then performed a basic physical examination followed by a clinical physical and/or orthopaedic assessment of the anatomical area in question. The student would then summarised all the given information and select the most likely diagnosis or formulate a list of differential diagnoses and then present the case to the supervising clinician prior to the patient being treated (Government Gazette, Act 63 of 1982 (as amended); Clinic manual; Dept handbook, 2015). In summary, all diagnoses and treatment protocols are discussed with and approved by the supervising chiropractic clinician prior to any treatment procedure being administered (Government Gazette, Act 63 of 1982 (as amended); Clinic Manual, 2015). This procedure is repeated with every new and repeat patient.

Therefore all clinically relevant information was captured for each participant presenting to the chiropractic facility. This complies with standard recording and reporting procedures for any patient visit as would be recorded in standard clinical practice (Government Gazette, Act 63 of 1982 (as amended)). After the event was concluded, all the completed CSSA forms (Appendix A) (Korporaal, 2002) were stored in a locked storeroom to ensure confidentiality (Mouton, 1996).

3.5.1 Measurement Frequency

The CSSA form (Appendix A) (Korporaal, 2002) was utilised each time a patient presented to the chiropractic treatment facility, whether as a new patient, or repeat patient for a new complaint or continuation of treatment.

3.7 Development of the Questionnaire

The CSSA questionnaire was developed by Korporaal (2002). The questionnaire was developed and a focus group was then formulated. A focus group is used to provide a discussion and allow for interaction surrounding the research topic in order to better understand the topic to better develop the questionnaire (Tuck, 2010). A focus group aims to support the researcher in deciding the quality and relevance of the questions to be utilised in the questionnaire (Morgan, 1998). The participants present in a focus group are encouraged to provoke and debate the questionnaire and members can suggest recommendations that can allow for increased accuracy in the assessment of sporting injuries. Finally the minimum requirement for validity and reliability of a questionnaire as set out by Mouton (1996) can be established through the use of a focus group.

A pilot study follows the succession of a focus group. This is where the researcher selects two or more people to complete the questionnaire as though they were the intended research participant. These people then critically analyse the questionnaire and mention any errors regarding the questions, in relation to basic spelling, grammar or the way in which the question is asked and any other technical issues with the questions. The researcher addresses all the concerns mentioned by the focus group and pilot study and thus validation is successfully achieved and the questionnaire is permitted to be used in the research study.

3.8 Data analysis

Permission was granted by the DUT chiropractic clinic director to utilise the patient records (Appendix C) but only after permission was granted by the Institutional Repositionable Ethics Committee (Appendix B) was the data accessed by the researcher.

Data was then extracted from the patient records; each patient's name was coded, ensuring confidentiality. Records remained in the clinic during data capture. The data was then captured onto a Microsoft Excel spreadsheet as recommended by the statistician (Esterhuizen, 2014) and then converted to SPSS version 21.0 (SPSS Inc., Chicago, Illinois, USA) (Esterhuizen, 2014).

3.9 Statistical Analysis

The statistical aspect of the research encompassed the following (Esterhuizen, 2014):

- Descriptive statistics such as frequencies and proportions were used to analyse the descriptive objectives. Cross tabulation and chi square tests where appropriate, were used to compare outcomes between participant groups.

- Comparisons between tens and touch rugby players were performed at the complaint level of analysis and achieved using Pearson's chi square tests. A p value < 0.05 was considered as statistically significant. The total complaints were more than the patient visits due to multiple visits per patient.
- Due to the lack of response from sevens participants. This group was not compared to the tens and touch participants.

3.10 Conclusion

This chapter outlined the methodology that was used to accomplish this study. It described the measurement tool; the CSSA form which was used to gather data at the 2014 Durban 'Rugby Rush Tournament', as well as the sampling and statistical methods in data selection and analysis. The results of the study will now be presented in **Chapter Four**.

CHAPTER 4 : RESULTS

4.1 Introduction

Chapter Four presents the results followed by a discussion of the results in Chapter Five. Results were obtained from the participant records collected for this research study. The Chiropractic Student Sports Association form (CSSA) (Appendix A) (Korporaal, 2002) was the primary tool used to collect data and was distributed to participants that presented to the chiropractic treatment facility at the Durban 'Rugby Rush Tournament 2014'. SPSS version 21 was used to analyse the data.

4.2 Research Objectives

- The first objective was to determine a demographic profile of the participants presenting to the DUT chiropractic treatment facility.
- The second objective was to determine and describe an injury profile in terms of injury type, mechanism of injury and anatomical location.
- The third objective was to determine and describe the treatment protocols used in the management of participants who presented to the chiropractic treatment facility.
- The fourth objective was to describe and compare injury profiles between tens, sevens and touch rugby participants that presented to the DUT chiropractic facility at the Durban 'Rugby Rush Tournament 2014', in order to determine if there are any differences in the injuries sustained between the three groups

4.3 Data Objectives

The objectives will now be discussed in terms of primary and secondary data.

4.3.1 Primary Data

This research utilised primary data that was collected through a retrospective, quantitative, epidemiological procedure (Mouton, 1996), based on the information reported on the Chiropractic Student Sports Association (CSSA) questionnaire (Appendix A) (Korporaal, 2002).This validated questionnaire was handed to every participant that presented for treatment at the chiropractic treatment facility at the Durban 'Rugby Rush Tournament 2014' (Korporaal, 2002).

4.3.2 Secondary Data

Secondary data utilised for this research was collected through several sources that include: journal articles, online blogs and articles, books and personal communications with relevant people in the field of Rugby, its adaptations and in the field of sports medicine.

4.4 Abbreviations

C-facet – Cervical facet syndrome

DOMS – Delayed onset muscle soreness

ITBS – Ilio-tibial band Syndrome

L-facet – Lumbar facet syndrome

N/Count – Sample Size

P value – Probability value (if <0.05 then significant)

PFPS – Patella Femoral Pain Syndrome

SI Syndrome – Sacroiliac syndrome

Std. Deviation – Standard Deviation

Stretch/PNF – Stretch/Proprioceptive neuromuscular facilitation

T-facet – Thoracic facet syndrome

4.5 Results

4.5.1 Response Rate Methodological Flow Diagram

Figure 4.1 illustrates the methods of collection, organisation and analysis of the data utilised in this research study. There were a total of 345 individual patients, 626 visits for 733 complaints.

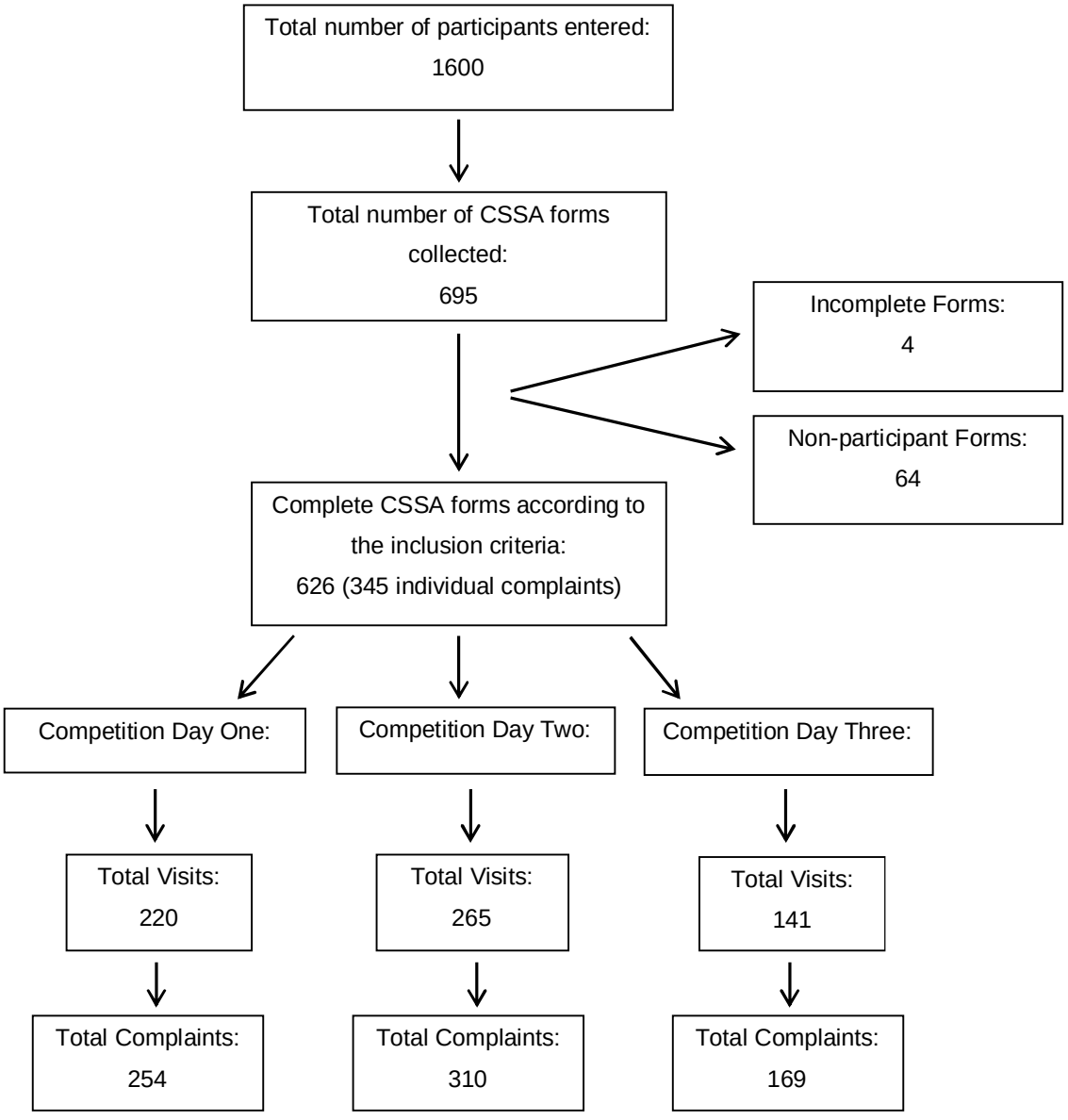


Figure 4.1: Response Rate Methodological Flow Diagram

4.5.2 Objective One

The first objective was to determine a demographical profile of the participants presenting to the DUT chiropractic treatment facility at the 2014 Durban 'Rugby Rush Tournament'.

4.5.2.1 Age

Table 4.1: Age distribution (Years)

N	Valid	341
	Missing	4
Mean		24.04
Std. Deviation		5.575
Minimum		7
Maximum		49

Table 4.1 indicates that of the 345 individual participant records collected, 341 were valid with an average participant age of 24 ± 5.58, the oldest participant being 49 and the youngest being seven years of age.

4.5.2.2 Gender

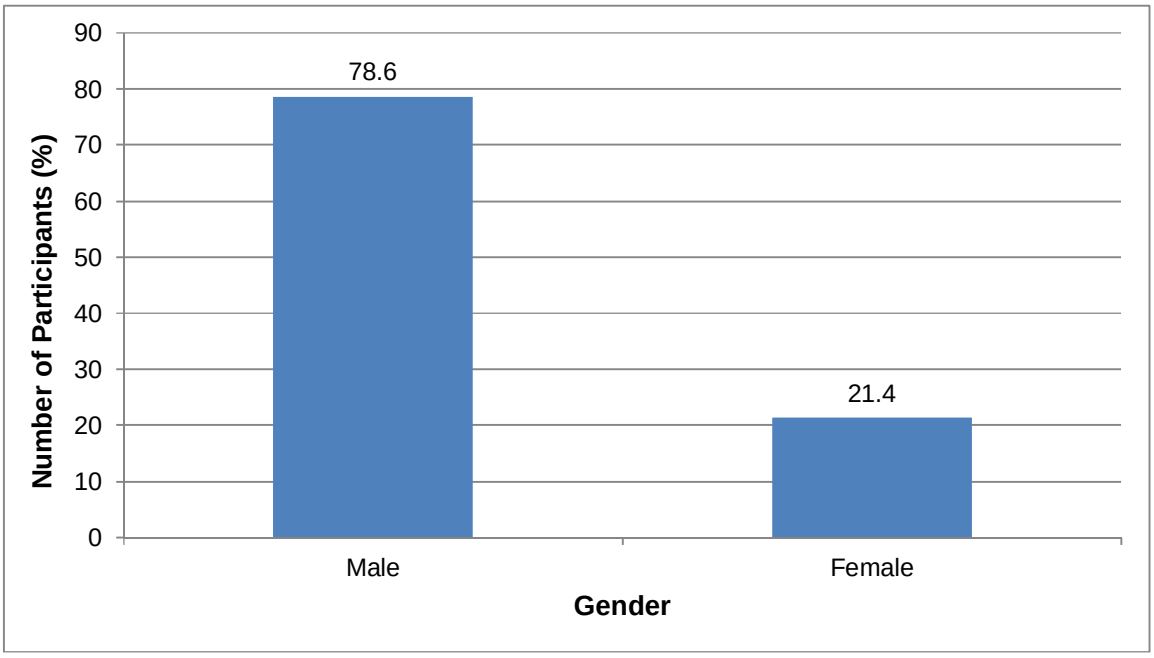


Figure 4.2: Gender distribution (%)

Figure 4.2 specifies that the majority (78.6%) of the participants that presented to the chiropractic treatment facility were men and thus, less than a third (21.4%) were female.

4.5.2.3 Ethnicity

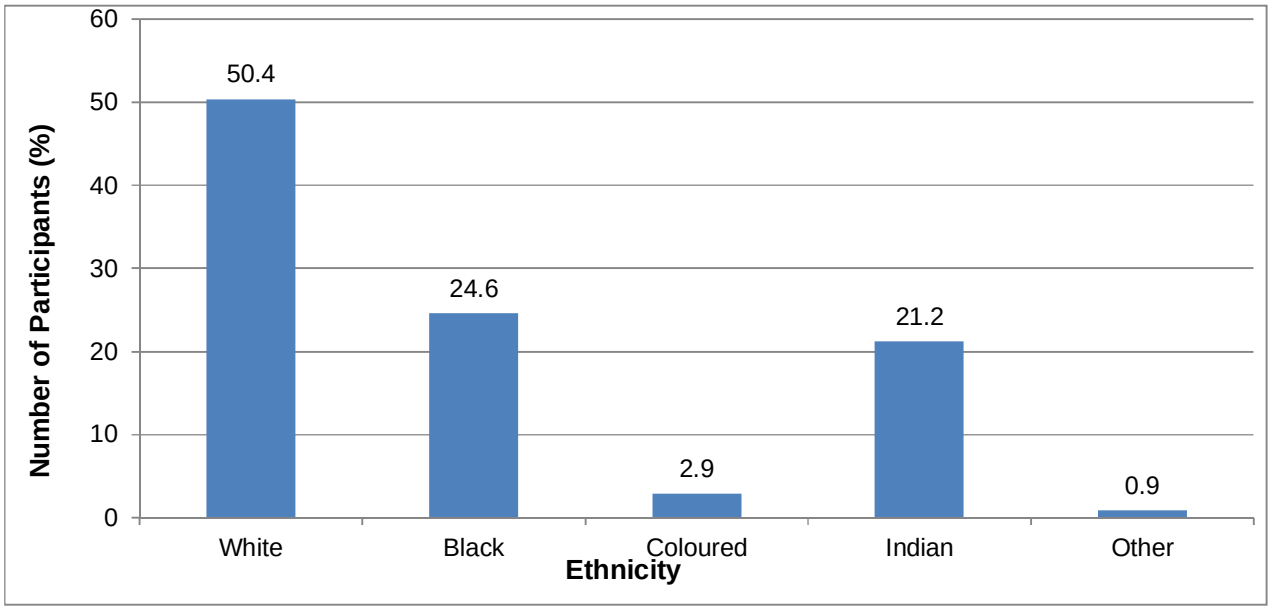


Figure 4.3: Ethnic distribution (%)

Figure 4.3 indicates that more than half (50.4%) of the presenting participants were White, followed by 24.6% being Black, 21.2% Indian, 2.90% Coloured and 0.90% were declared as Other.

4.5.2.4 Summary of Demographics

The demographical profile of the participants that reported to the chiropractic treatment facility indicated that 50.4% were White and 78.6% were men with an average age of 24 ± 5.575.

4.5.3 Objective Two

The second objective was to determine and describe an injury profile in terms of injury type, mechanism of injury and anatomical location.

4.5.3.1 Number of Complaints Reported per Visit

Table 4.2: Number of complaints reported per visit

	Visits	Percent	Total number of complaints	Percent
No of complaints seen = 1	521	83.20%	521	71.10%
No of complaints seen = 2	103	16.50%	206	28.10%
No of complaints seen = 3	2	0.300%	6	0.800%
Total	626	100.0%	733	100.0%

Table 4.2 indicates the number of complaints each participant reported when presenting to the chiropractic treatment facility. It indicates that there were a total of 626 visits to the treatment facility, with a total of 733 complaints, of this 521 (83.2%) visits reported only one complaint (71.1%) while 103 visits of the total 733, reported two complaints, thus 28.1% reported two complaints at a single visit. Two participants reported three complaints at a singular visit and thus two (0.80%) of the total complaints consisted of three reported complaints at a singular visit.

4.5.3.2 Frequency of Injury per Diagnosis

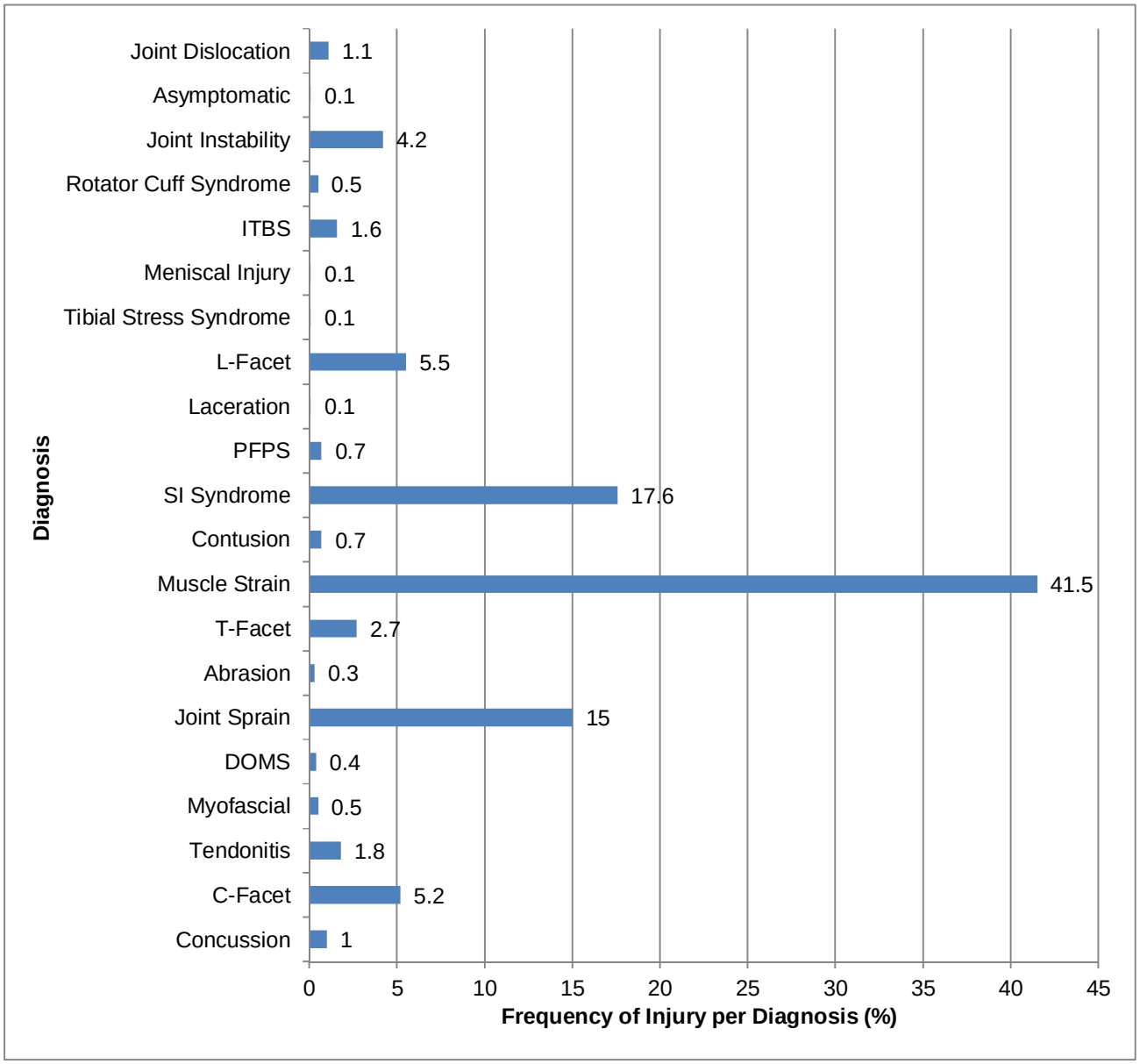


Figure 4.4: Frequency of injury per diagnosis

Figure 4.4 indicates that out of 733 primary complaints, 304 (41.5%) were diagnosed as muscle strains, 129 (17.6%) as SI syndrome, 110 (15.0%) as joint sprains, 40 (5.50%) as L-Facet, 38 (5.20%) as C-Facet, 31(4.20%) as joint instability and the remaining 11.0% as the combined percentages of other listed diagnoses.

4.5.3.3 History of Previous Injury and/or Trauma and Clinical Impression

Table 4.3: History of previous injury and/or trauma and clinical impression

		Count	Column N %
History of Previous Injury	Yes	137	18.7%
	No	596	81.3%
	Total	733	100.0%
History of Previous Trauma	Yes	54	7.4%
	No	679	92.6%
	Total	733	100.0%
Clinical Impression	Acute	471	64.3%
	Chronic	262	35.7%
	Total	733	100.0%

Table 4.3 indicates that out of 733 visits, 137 (18.7%) participants reported they had suffered from a previous injury and 54 (7.40%) had a history of previous trauma. Regarding clinical impression, of the 733 primary complaints 471 (64.3%) were considered acute injuries and 262 (35.7%) were considered chronic injuries.

4.5.3.4 Frequency of Complaints per Mechanism of Injury

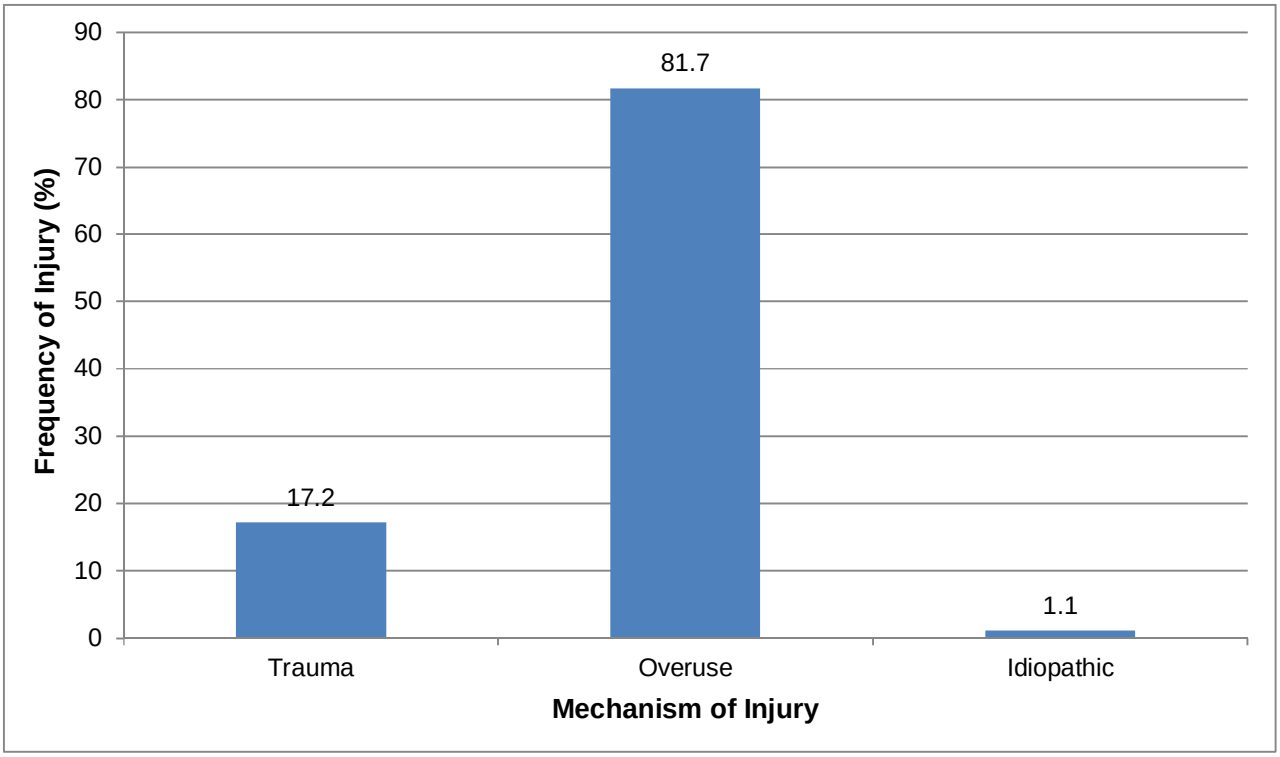


Figure 4.5: Frequency of complaints per mechanism of injury

Figure 4.5 indicates the number of complaints according to the mechanism of injury. Overuse injuries comprised 599 (81.9%) of the 733 primary complaints while trauma comprised 126 (17.2%) and 8 (1.10%) were recorded as idiopathic.

4.5.3.5 Frequency of Injury per Anatomical Region

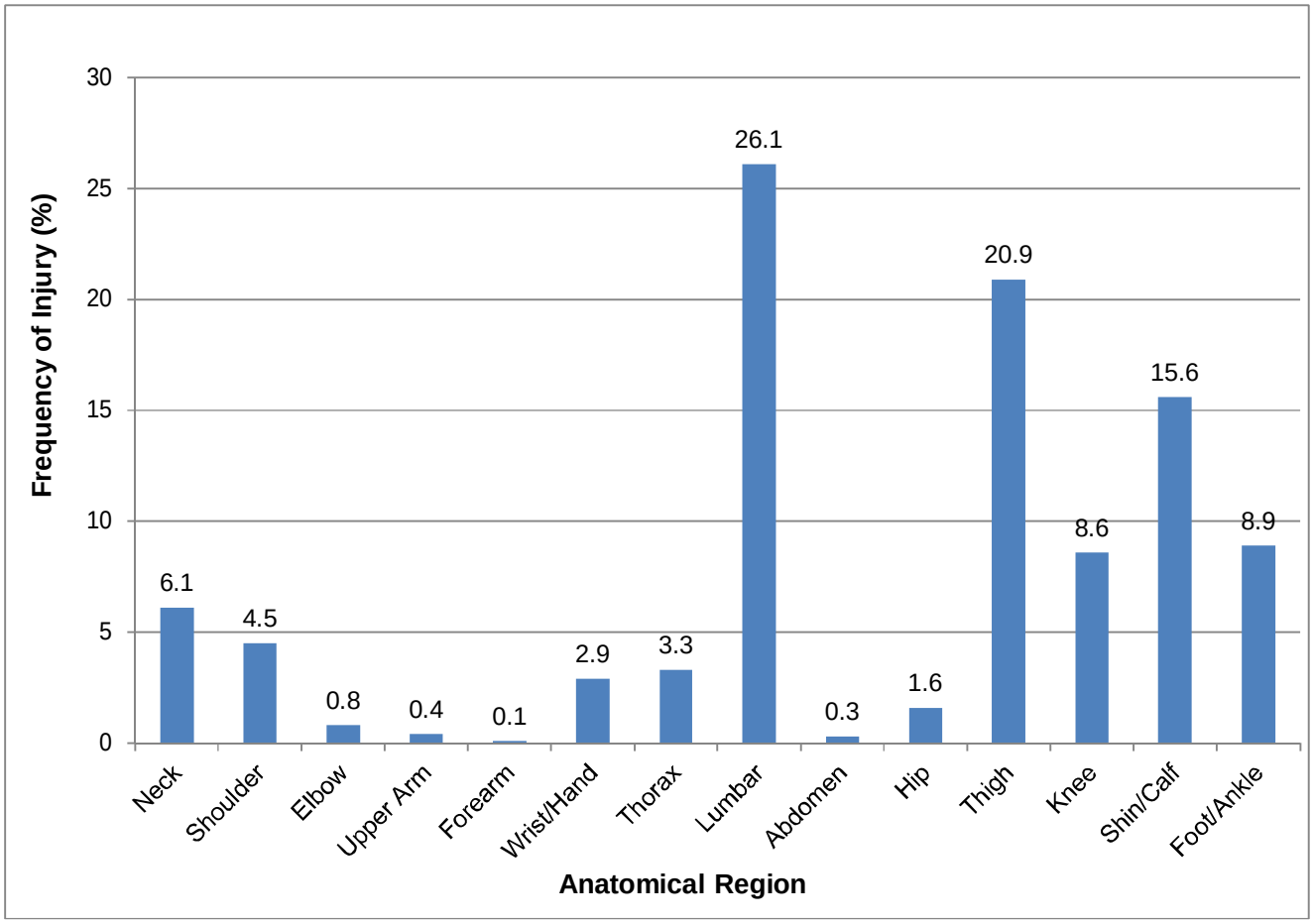


Figure 4.6: Frequency of injury per anatomical region

Figure 4.6 indicates the number of injuries per anatomical region. Figure 4.5 indicates that out of 733 primary complaints, 191 (26.1%) were recorded as affecting the lumbar region, 153 (20.9%) affecting the thigh region, 114 (15.6%) affecting the shin/calf. The remaining 37.4% of complaints were listed as affecting other anatomical regions.

4.5.3.6 Summary of Injury Profile

There were 733 visits made to the chiropractic treatment facility, of which 74.2% reported with only one primary complaint of which 41.5% were diagnosed as muscle strains. 18.7% of participants reported they had suffered from a previous injury and 7.40% had a history of previous trauma. 64.3% of injuries were recorded as acute and 35.7% as chronic injuries. 26.1% of injuries were recorded as affecting the lumbar region, 20.9% affecting the thigh region and 15.6% affecting the shin/calf. According to mechanism of injury, overuse injuries comprised 81.9%, trauma comprised 17.2% and 1.10% were recorded as idiopathic.

4.5.4 Objective Three

The third objective was to determine and describe the treatment protocols used in the management of participants who presented to the chiropractic treatment facility.

4.5.4.1 Treatment Protocols Utilised

Table 4.4: Treatment protocols utilised

	Done		Not Done	
Treatment	Count	Row N %	Count	Row N %
Rest	2	0.3%	693	99.7%
Ice	31	4.5%	665	95.5%
Manipulation	419	58.8%	293	41.2%
Mobilization	22	3.2%	674	96.8%
Massage	226	32.0%	481	68.0%
Stretch/PNF	197	27.9%	509	72.1%
Dry needle	152	21.6%	551	78.4%
Static Stretch	31	4.5%	665	95.5%
Ischaemic Compression	54	7.8%	642	92.2%

Table 4.4 indicates the treatment protocols utilised in terms of primary complaint. Manipulation was the most frequently utilised treatment (58.8%), followed by massage (32.0%), stretch/PNF (27.9%) and dry needling (21.6%). The remaining treatment protocols listed were utilised less frequently at a rate of 7.80% or less.

Table 4.5: Treatment protocols utilised: strapping, referral and continuation of play

		Count	Column N %
Strapping	Done for muscle	36	5.2%
	Done for joint	95	13.6%
	Protective	16	2.3%
	Not done	550	78.9%
Referral	Done	0	0.0%
	Not done	691	100.0%
Continuation play	Yes	713	97.1%
	No	21	2.9%

Table 4.5 indicates that in the treatment of primary complaints, strapping was utilised in 147 (21.1%) complaints of which 5.20% was done for muscle injuries, 13.6% for joint injuries and 2.30% for protective use. Referral for external treatment was not required for any primary complaints. 713 (97.1%) of participants were permitted to continue with play and thus 21 (2.90%) were not permitted to continue with play.

4.5.4.2 Frequency of Treatment per Diagnosis

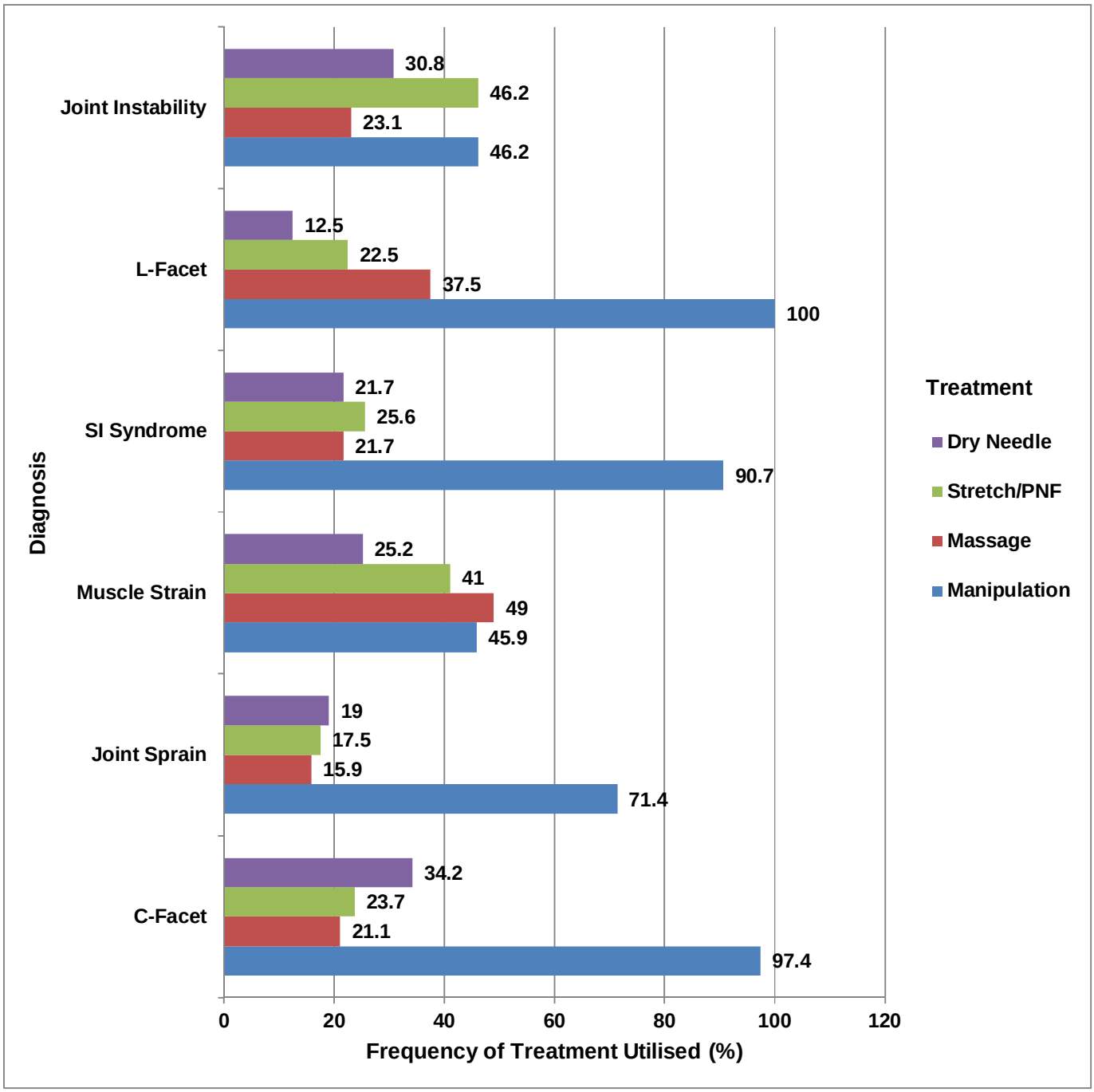


Figure 4.7: Frequency of treatment per diagnosis

Figure 4.7* illustrates the most frequently used treatments utilised in the most frequently determined diagnoses. Manipulation was the most utilised treatment used in 97.4% of C-Facet

diagnoses, 71.4% of joint sprains, 45.9% of muscle strains, 90.7% of SI Syndrome, 100% of L-Facet and 46.2% of joint instability diagnoses. Massage was used 21.1% in C-facet diagnoses, 15.9% in joint sprains, 49.0% of muscle strains, 21.7% in SI Syndrome, 37.5% in L-Facet and 23.1% in joint instability diagnoses. Stretch/PNF was utilised 23.7% in C-facet diagnoses, 17.5% in joint sprains, 41.0% of muscle strains, 25.6% in SI Syndrome diagnoses, 22.5% in L-facet and 46.2% in joint instability diagnoses. Dry needling was performed 34.2% in c-facet diagnoses, 19.0% in joint sprains, 25.2% of muscle strains, 21.7% in the treatment of SI syndromes, 12.5% of L-facet and 30.8% in joint instability diagnoses.

* This figure indicates the most frequently utilised treatments for the most frequently recorded diagnoses. For a comprehensive table of all treatment protocols utilised per each diagnosis please see Appendix D.

4.5.4.3 Frequency and Method of Strapping Utilised per Diagnosis

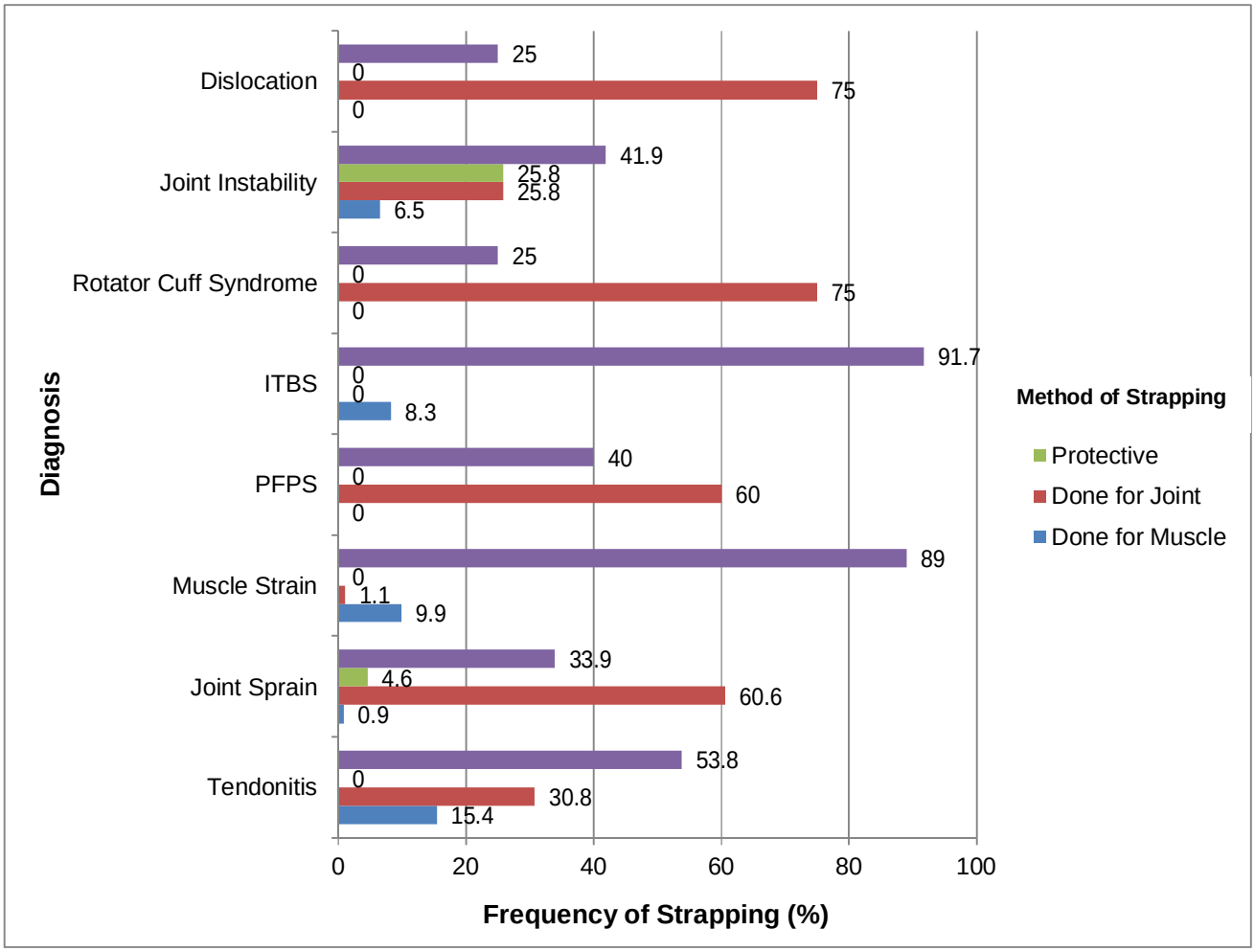


Figure 4.8: Frequency and method of strapping utilised per diagnosis

Figure 4.7* illustrates the association between the type and frequency of strapping utilised in each of the above listed diagnoses. Strapping of the joint was most frequently utilised in rotator cuff syndrome (75.0%), joint sprains (60.6%), PFPS (60.0%) and tendonosis (30.8%). Strapping of the muscle was used in tendonosis (15.4%), muscle strains (9.90%) and ITBS (8.30%). Strapping applied for protective purposes was most frequently used in diagnoses of joint instability (25.8%) and joint sprains (4.60%).

*This figure indicates the frequently of strapping utilised for the most frequently recorded diagnoses. For a comprehensive table of the frequency of strapping utilised per each diagnosis please see Appendix E.

4.5.4.4 Summary of Treatment Profile

Manipulation was used in 58.8% of treatments, strapping was utilised in 21.1% of treatments of which 13.6% involved the joint. Referral for external treatment was not required for any primary complaints. 97.1% of participants were permitted to continue with play. Manipulation was used to treat 100% of L-Facet, 97.4% of C-Facet and 90.7% in SI syndrome diagnoses. Massage was to treat 49.0% of muscle strains, 37.5% in L-Facet and 23.1% in joint instability diagnoses. Stretch/PNF was used to treat 46.2% joint instability, 41.0% of muscle strains and 25.6% in SI Syndrome diagnoses. Dry needling was used to treat 34.2% in c-facet, 30.8% in joint instability and 25.2% of muscle strain diagnoses. Strapping of the joint was utilised in 75% in rotator cuff syndrome and 60.6% of joint sprains. Strapping of the muscle was used in 15.4% of tendonosis and 9.90% of muscle strain diagnoses. Strapping applied for protective purposes was used in 25.8% of joint instability and 4.60% of joint sprain diagnoses.

4.5.4 Objective Four

The fourth objective was to describe and compare injury profiles between tens, sevens and touch rugby participants that presented to the DUT chiropractic facility at the Durban ‘Rugby Rush Tournament 2014’, in order to determine if there are any differences in the injuries sustained between the three groups.

4.5.4.1 Comparison of Tens and Touch Participants According to Type of Injury

Table 4.6: Comparison of tens and touch participants according to type of injury

			Athlete						
			Touch		Tens		Total		
			Count	Column N %	Count	Column N %	Count	Column N %	P value
History of Previous Injury		Yes	40	18.2%	29	24.4%	69	20.4%	*0.177*
		No	180	81.8%	90	75.6%	270	79.6%	
		Total	220	100.0%	119	100.0%	339	100.0%	
History of Previous Trauma		Yes	13	5.9%	14	11.8%	27	8.0%	*0.057*
		No	207	94.1%	105	88.2%	312	92.0%	
		Total	220	100.0%	119	100.0%	339	100.0%	
Clinical Impression		Acute	148	67.3%	75	63.0%	223	65.8%	*0.431*
		Chronic	72	32.7%	44	37.0%	116	34.2%	
		Total	220	100.0%	119	100.0%	339	100.0%	

Table 4.6 indicates there was a borderline non-significant difference between the touch and tens players in terms of history of previous trauma ($p = 0.057$). The tens players were more likely to have a previous trauma than the touch players. There was no statistical relevance found between the two groups when compared to history of previous injury and clinical impression.

4.5.4.2 Comparison of Tens and Touch Participants According to Mechanism of Injury

Table 4.7: Comparison of tens and touch participants according to mechanism of injury

		Athlete						
		Touch		Tens		Total		p-value
		Count	Column N %	Count	Column N %	Count	Column N %	
Mechanism	Trauma	53	10.1%	69	34.2%	122	16.8%	
	Overuse	469	89.3%	128	63.4%	597	82.1%	
	Idiopathic	3	0.6%	5	2.5%	8	1.1%	
	Total	525	100.0%	202	100.0%	727	100.0%	*p < 0.001*

Table 4.7 indicates a comparison between tens and touch players according to mechanism of injury. A P-value of *p < 0.001* which indicates there is a statistically significant association between mechanism of injury and type of player. Overuse was more common in touch players and trauma was more common in tens players.

Table 4.8: Comparison of tens and touch participants according to anatomical region

		Athlete					
		Touch		Tens		Total	
		Count	Column N %	Count	Column N %	Count	Column N %
Region of Compliant	Neck	8	3.6%	16	13.4%	24	7.1%
	Shoulder	7	3.2%	16	13.4%	23	6.8%
	Elbow	0	0.0%	4	3.4%	4	1.2%
	Upper Arm	0	0.0%	2	1.7%	2	0.6%
	Forearm	5	2.3%	10	8.4%	15	4.4%
	Thorax	4	1.8%	5	4.2%	9	2.7%
	Lumbar	67	30.5%	16	13.4%	83	24.5%
	Abdomen	1	0.5%	1	0.8%	2	0.6%
	Hip	6	2.7%	2	1.7%	8	2.4%
	Thigh	46	20.9%	19	16.0%	65	19.2%
	Knee	22	10.0%	8	6.7%	30	8.8%
	Shin/Calf	34	15.5%	6	5.0%	40	11.8%
	Foot/Ankle	20	9.1%	14	11.8%	34	10.0%
	Total	220	100.0%	119	100.0%	339	100.0%

Table 4.8 indicates that there were too many rows to make a statistical comparison in terms of anatomical location. However it can be deducted that tens players presented with more upper limb injuries with a total of 24.9% compared to touch players who presented with a total of 9.10%. It can also be deduced that touch players presented with an increased amount of lower limb injuries when compared to tens players, with a total of 58.2% and tens players presenting with a total of 41.2% but due to statistical inconsistencies no significance tests were done

4.5.4.4 Summary of Cross-tabulations

There was a borderline non-significant difference between the touch and tens players in terms of history of previous trauma ($p = 0.057$). A significant difference ($p < 0.001$) was found between the type of athlete and the mechanism of injury in that overuse was more prevalent in touch players and trauma was more common in tens players. No statistical significance tests were performed between type of player and region of complaint due to statistical inconsistencies.

4.6 Conclusion

Chapter Four presented the results obtained from the data collected. These results will now be discussed in **Chapter Five**.

CHAPTER 5 : DISCUSSION

5.1 Introduction

This chapter elaborates on the results presented in Chapter Four. The results will be discussed as per each outlined objective and substantiated by the literature discussed in Chapter Two.

5.2 Response Rate

There were a total of 1950 athletes spread across three divisions; tens, touch and sevens. A total of 695 CSSA forms were collected of which 626 were valid according to the inclusion criteria. Sixty eight forms were excluded based on the exclusion criteria of non-participant or incomplete. The 626 forms comprised 345 individual complaints; these were then organised according to the competition days. On day one, there were a total of 220 visits and 254 complaints, on competition day two there were 265 visits and 310 complaints and on the final day of competition there were 141 visits and 169 complaints. The decrease in the complaints by day three could be due to the nature of the tournament in that on the third and final day of competition the only participants are those competing in semi-final and final matches and thus there are fewer participants requiring treatment.

5.3 Objective One

The first objective was to determine a demographical profile of the participants presenting to the DUT chiropractic treatment facility.

5.3.1 Age

The results of this study indicated that the average age of the participants presenting to the chiropractic treatment facility were 24 ± 5.58. This is consistent with the findings of Garraway and Macleod (1995) who found that rugby players in the age group of 20 - 24 showed a higher incidence of injury than other groups. Tuck (2010) performed a questionnaire based study on rugby players in the greater Durban area and found the average age of the players to be 20.43 years of age, however this study was limited in that only male, club and school rugby players were included. Neumann *et al*. (1998) performed a study on touch players and found the average age to be 26.60 years ranging between 16 - 47 years; this is consistent with the results of this study. However it should be noted that in this study by Neumann *et al.* (1998) there were no statistically significant findings regarding the age of the player and the

incidence of injury. This could be due to the lack of physicality and force exhibited in the game of touch when compared to rugby and its adaptations.

In the context of South African literature, according to the Department of Sports and Recreation South Africa (2005), 50% of participants in sport were between the ages of 16 - 20 years, however it should be mentioned that there were age limitations in this study in that the sample taken of people between the ages of 21 - 25 an age group that would naturally have fewer female participants as this is an age where women are considering starting a family and would be less interested in involvement in sport.

The results of this study are similar to the findings of McIntosh *et al*. (2009) as cited by Bleakly *et al.* (2011) who described lower rates of injury in adolescent rugby players and higher rates in senior players which is supported in the a study by Caine *et al.* (2008) who found that the incidence of injury increased with age primarily due to the increase in the force the older players can generate with increased size, weight and speed, particularly in collisions like tackling. As rugby involves similar running movements and similar kicking procedures as in football it is pertinent to mention a study by Braham *et al.* (2004) on the incidence of injuries in community level football in Australia which found that injuries increased with age and that injury prevention should be aimed at players 25 years or older, as they were recorded to have suffered more injuries than other age groups.

This research study has determined that the average age of participants that presented to the chiropractic treatment facility being 24 ±5.58 is consistent with that of other findings in the aforementioned studies and therefore athletes partaking in rugby and any of its adaptations should be aware they are at a high risk for injury and should therefore partake in injury prevention programmes to reduce this risk.

5.3.2 Gender

The majority 78.6% of participants that presented to the treatment facility were men – less than a third were women. These findings are consistent with the current literature where both male and female rugby players have been included and compared in terms of injury rates. A study on touch players by Neumann *et al*. (1998) showed more male than female participants and that men suffered from more injuries per hours played than women. This is similar to a study on rugby union players by Quarrie *et al*. (2001) which indicated that out of 350 players, 258 were male and 92 were female. Bird *et al*. (1998) showed that women sustained fewer injuries than men in both training and match play.

According to Rowland *et al.* (2012), previous studies have shown that male and female athletes display biomechanical differences when performing particular manoeuvres in touch, but they found that this was not due to a gender difference but rather a difference in one of two distinct foot planting strategies, regardless of gender, to perform the same manoeuvre.

As rugby and its adaptations involves running it is appropriate to mention the study performed by Taunton *et al*. (2002) who determined that there were no significant differences in the frequency of injuries sustained between male and female runners. The only significant difference was the type of injury, in that the study showed that men sustained more meniscal injuries than women. A study conducted by Bird *et al*. (1998) showed that women sustained fewer injuries than men in both training and match play.

The above mentioned literature is consistent with the findings of this study in that more men presented to the treatment facility, this could be due the following factors:

- There were more male participants entered, as they competed across all three categories whereas females only competed in the touch category.
- Biologically men are bigger, stronger and play sport at a higher intensity with an increased physicality when compared to women and therefore are at an increased risk of injury and thus present with more injuries when competing.

In a South African context, according to Mahomed (2007), the typical patient presenting to a chiropractic private practice is a female which is different compared to the findings of this study but these findings can be accounted for in that this was a sporting event and more men participate in sport in general (Department of Sport and Recreation, 2005) and rugby in particular (Best, 2003). Butt (2008) found there to be only one female rugby team in the greater Durban area and that male rugby players are more likely to seek on-field treatment rather than receive treatment in private practice. This supports the finding that the majority of participants presenting to the treatment facility were male as there are more male participants in the sport and they are likely to seek on-field treatment compared to women. These results indicate that the environment in which a study is conducted can largely determine the gender distribution.

5.3.3 Ethnicity

Results indicated that more than half (50.4%) of the participants presenting to the treatment facility were White, followed by Black (24.6%), Indian (21.2%), Coloured (2.90%) and Other (0.90%), which is consistent within the South African sporting context according to the Department of Sport and Recreation of South Africa (2005) who stated that the general

population participating in sport comprises White (36.6%), Black (25%), Indian/other (24.4%) and Coloured (15.2%). (This is further supported by Tuck (2010) who found 64.57% of the survey respondents to be White followed by 29.14% Black, 2.29% Indian and 4.00% Coloured.

A study showing the distribution of White, Black and Coloured rugby players participating in the major rugby union tournaments in South Africa between 2007 and 2011, indicated a high percentage of White players followed by Coloured then Black players (du Toit *et al.,* 2012). Since the formation of the South African Rugby Union (SARU) in 1992 there has been continual development to make rugby fully representative at all levels of the game (du Toit *et al.,* 2012). However it still remains a White dominated sport (du Toit *et al.,* 2012) and therefore supports the results of this study which indicated the majority of participants presenting to the treatment facility were White.

Quarrie *et al*. (2001) performed a study on New Zealand rugby union players and found no difference in injuries sustained or the risk of injury to be different between different ethnic groups. Chalmers *et al*. (2012) found there to be a higher incidence of injury among Pacific Island players when compared to New Zealand Maori and New Zealand European players. To the researchers knowledge there have been no studies conducted in a South African context that compared the incidence of injury among the different ethnic groups.

The findings of this research study are consistent within the South African context in that as mentioned above, the highest percentage of participants in sport and in South African rugby were recorded as White and thus the finding of more than half the participants presenting for treatment at the Durban Rugby Rush Tournament as being White is accurate.

There are several reasons that can account for this finding:

- Rugby was originally a White colonial sport in South Africa and although there has been an increase in participation by other races it is still considered a White dominated sport in South Africa (du Toit *et al.,* 2012).
- The racial distribution may have been more favourable to White participants due to the treatment facility offering only treatment within the scope of chiropractic. The typical patient that presents to a chiropractor in private practice is White as shown in a study by Mahomed (2007). Therefore the utilisation of the treatment facility could have been based on the participants' view of chiropractic and not the nature of their injury(s).

5.3.4 Summary

Section 5.3 provided a demographic profile of the athletes presenting to the chiropractic treatment facility. The typical participant presenting to the chiropractic treatment facility was a White male with an average age of 24 ± 5.58. This is not consistent with the findings of the typical chiropractic patient; however this is a sporting event and thus the findings are consistent with the typical person participating in sporting activities in the context of South Africa. Therefore it is expected in Objective Two that the injury profile will largely be based on White males with an age of 24 ± 5.58.

5.4 Objective Two

The second objective was to determine and describe an injury profile in terms of injury type, mechanism of injury and anatomical location.

5.4.1 Injury Type

5.4.1.1 Type and Frequency of Injury According to Diagnosis

The total number of primary injuries was recorded according to diagnosis. Muscle strain was documented as the most frequent diagnosis followed by SI syndrome and joint sprain. This is consistent with the findings of Hoskins (2006) who found that the majority of rugby injuries to be musculotendinous in nature. Several studies have shown across a variety of sporting codes that the majority of injuries to be muscular in nature. For example a study performed on runners found the majority of the injuries reported to be muscular (Malisoux *et al.,* 2014).

The high percentage of muscle strain diagnoses found in this study is consistent with other research on rugby injuries (Alsop *et al*., 2000; Hoskins *et al.,* 2006; Schneiders *et al*., 2009). Rugby and its adaptations require a vast amount of running with sudden changes in direction (Noakes and du Plessis, 1996; Brooks and Kemp, 2006; Tuck, 2010). During a high intensity physical activity like rugby, muscles have to contract repetitively to allow for the aforementioned actions which results in fatigue and injury (Coetzee, 2013). Murphy *et al.* (2003) described the effects of fatigue on a muscle, in that the recruitment patterns become less effective and thus the mechanical forces applied to the joint are no longer distributed to the muscle equitably and are imposed on other soft tissue structures and often the joint itself.

It is because of the high intensity, speed and agility required to play rugby and its adaptations that a vast majority of muscle strains result. Physical trauma can also account

for several muscle strains, with touch as an exception; the intense bodily contact in rugby can result in direct physical stress to the muscle. As the game of touch has very little contact it is characteristic to receive results similar to those found in this study. When compared to the only study the researcher is aware of, by Neumann *et al*. (1998), the results are consistent in that the majority of the injuries recorded in this study were muscle strain and joint sprain injuries which together accounted for 72% of the total injuries recorded.

Spinal complaints are very common in particular sports, soccer and rugby being two of these sports (Maffulli *et al.,* 2011). This is consistent with the finding from this study of SI syndrome being the second most frequent diagnosis used by the chiropractic students at the Rugby Rush Tournament. Spinal injury has always been of huge concern in rugby and has been the reason behind the change in the rules of the game and the initiation of educational programmes to prevent such injuries from occurring as well as the eventual adaptations of the game that have emerged in order to play a version of rugby that requires less contact and thus fewer injuries while still promoting the game of rugby (Posthumus and Viljoen, 2008).

Gabbett (2002) found in a study of amateur sevens players that the second most common diagnosis of injury was joint sprain; this is further supported by Alsop *et al* (2000) and Gabbe and Finch (1999) whose studies of club rugby and soccer players respectively found the diagnosis of joint sprain to be the most frequent diagnosis. This is a consistent finding regarding this research in that sprains were the third most frequent injury diagnosis.

The physical contact involved in rugby leads to more traumatic injuries than most sporting codes and it is more common to find the most frequent diagnosis to be that of laceration and/or contusion (Gabbett, 2002) but regarding this study it would be atypical to find this for the following reasons:

- The tournament consisted of three divisions, one of which was touch, which has very little physical contact when compared to the other two rugby codes.
- There were only six sevens players that reported to the CTF for treatment and therefore the sample size is reduced to tens and touch players.
- The game of rugby tens and sevens involves a decreased amount of contact and an increased amount of running and thus the diagnoses most frequently used, correlate to the rugby adaptation.

5.4.1.2 History of Previous Injury and or Trauma

The results indicated that 18.7% of participants reported they had incurred a previous injury and 7.40% had reported history of a previous trauma. These previous injuries refer to injuries sustained in the same anatomical area being treated.

There have been no studies with similar methods to compare results. It is evident that a previous history of injury and/or trauma can be a reliable predictor for re-injury (Deroche *et al.,* 2007). Quarrie *et al.* (2001) showed that rugby union players that began the season with a pre-existing injury had a much higher risk of injury and missed a greater proportion of the season than those who did not. This emphasizes the need for correct treatment and full rehabilitation measures when managing rugby injuries because if a player has a previous history of injury or a pre-existing injury he/she is at a high risk for re-injury.

Therefore it can be deduced that a standardised method for reporting history of injury is necessary in order to compare the rate and risk of injury (Finch, 2006), and that the inclusion of such information is vital in injury profiling as knowing an athlete's injury history can aid in the prevention of future injuries (Gabbe and Finch, 2001).

5.4.1.3 Clinical Impression

Two thirds (64.3%) the injuries recorded were diagnosed as acute with only 35.7% diagnosed as chronic. The Durban 'Rugby Rush Weekend' is a competition which implies there will be more acute injuries sustained than chronic as the athletes are performing at a much high level when compared to practise (Kellmann, 2010; Maffulli *et al*., 2011). The majority of injuries occur in the match environment, with rates typically increasing as the playing level increases (King *et al*, 2010). This is further substantiated by several other studies that have shown that there is an increased risk of acute injuries in a state of competition compared to practice and/or training (Murphy *et al.,* 2003; Lund and Myklebust, 2011; Winwood*,* 2011).

The findings in this study are consistent with the findings of Noakes and du Plessis (1996) in that due to the nature of rugby union there are many physical collisions that often result in acute injuries. The game of touch is an adaptation of rugby and football (Neumann, 1998). It is relevant to mention a study by Gabbe and Finch (1999) who found that 78.0% of injuries to football players occurred during formal competitions and only 13.0% occurred during organised training.

5.4.2 Mechanism of Injury

The results of this study indicated overuse as being the most common mechanism of injury. An overuse injury can be defined as an injury that occurs as a result of a repetitive action or exercise that gradually results in repetitive microtrauma; it is an injury that occurs without a single identifiable event responsible (Bahr, 2009). These events or actions can be repetitive long-distance running or a specific movement pattern like those involved in cricket (Clarsen *et al*., 2012).

The results of this study suggest that an overuse mechanism may be the cause of injury. There are certain factors that could have contributed to this finding:

- Poor recall by the participants presenting to the treatment facility when questioned by the senior chiropractic students on duty. The participants have been competing in a three day event that requires repetitive motions and multiple weeks, in some cases months of training which can result in injuries that only seem to have required treatment at the event and therefore due to the nature of the sport, participants often cannot determine the exact motion or mechanism that resulted in the injury. Participants could have determined the cause as being 'playing touch' or 'running' which is non-specific and therefore often assumed as being an overuse injury.
- The study utilised the CSSA form (Appendix A) (Korporaal, 2002) which is non-specific when determining the mechanism of injury and therefore there were one of three options for the senior students to select. This limits the choice of mechanism of injury to that of trauma, overuse or idiopathic. Therefore participants presenting to the treatment facility may have told the student how the injury occurred and if it did not occur as a result of trauma it was recorded as being an overuse injury.

Due to the physical nature of rugby, particularly the tackle, trauma is a very common mechanism of injury and thus the findings in this study are dissimilar to those found in the most of the recent literature on rugby injuries. A traumatic injury is defined as an injury that occurs as a result from a specific event that is identifiable by the athlete (Bahr, 2009). There are several reasons for the dissimilarities found in this study:

- Poor recall from participants (Mouton, 1996) (e.g. an athlete with a stress fracture in the foot will often report that the symptoms originated during a specific run, perhaps even from a specific step). This means that the injury could be classified as an acute injury however it due to overuse over a period of time and therefore should be classified as overuse.
- There was a large response from touch players and very little response from sevens players which would may have resulted in a decreased amount of traumatic injuries

being reported; as was shown in the study by King *et al.* (2006) and Gabbett (2002) sevens players experience greater fatigue and thus suffer from more injuries than reported in rugby union.

- The majority of traumatic injuries that occurred on the fields would have been attended to by the emergency medical team as it is their responsibility at all rugby events to attend to on field injuries.
- Teams may have had their own medical teams that could have seen to the players injuries, limiting the amount of injuries reported to the chiropractic treatment facility.

This study is not consistent with the findings of Clarsen *et al*. (2012) who found the majority of complaints reported by athletes in five different sports to be chronic overuse in nature. The reason for this is there were no contact sports included in the study conducted by Clarsen *et al*. (2012) and the indistinct terms used to classify the type and mechanism of injury suggest that several of the complaints reported in this study were actually acute-on-chronic in nature whereby the condition was chronic in nature due to an overuse mechanism but was not causing a problem until the event and therefore explains classification of overuse injury as having an acute nature. The nature of the event can account for the large number of overuse injuries in that the players are playing more games than usual over three days and thus exposes them to a greater risk of overuse injuries.

5.4.3 Anatomical Location

The most common finding in this study per region of complaint was that of the lumbar spine. However as is the case in most of the other literature it is typical to group individual body divisions into broad anatomical regions. In this study the lumbar spine was the most frequently diagnosed region of complaint followed by the thigh, shin/calf and then foot and ankle. If these regions are combined into the category of lower limb then it would indicate that the lower limb was the most frequently diagnosed region of complaint.

The finding of the lumbar region being the most frequent region of complaint is inconsistent with the current literature on rugby injuries.

The reasons for this finding could be due to:

- The specific categories used to describe region of complaint.
- The perception that chiropractic is predominantly for the treatment of spinal issues. Participants may have felt they could only request treatment for a spinal injury as it may have been perceived as out of their scope to treat other regions.

If the categories of the lower limb are combined, the general region of the lower limb was the most frequently diagnosed region of complaint which is consistent with the current literature on rugby injuries (Garraway and Macleod, 1995; Gabbett, 2003; Junge *et al*., 2004; Brooks and Kemp, 2008; Tuck, 2010). The total percentage of lower limb injuries for this study would be 55.7% which would indicate that over half the recorded injuries affected the lower limb region. Schneiders *et al.* (2009) found the face and head to be the most frequent regions of complaint which is dissimilar to the results of this study. However Schneiders *et al*. (2009) utilised a similar method of recording the site of injury; if the regions of the lower limb were combined into one region then it would be the most commonly reported area of complaint, which is similar to the findings of this study.

The use of the category of lower limb is broad and does not allow for specific analysis. In certain studies on rugby injuries there have been references to specific anatomical regions and the most frequently affected region is the knee followed by the ankle. This was not consistent in this study where the thigh was the most frequently affected region followed by the shin/calf region. Brooks and Kemp (2008) found the most common anatomical location of injury to be the knee, followed by the thigh and ankle. This is not consistent when compared to the results of this study in that the thigh was the most common region of complaint. This could be due to:

- This is a study conducted on three different rugby adaptations: tens, sevens and touch; therefore the injuries sustained are different when compared to rugby union (Neumann *et al*, 1999; Gabbett, 2002; King *et al.,* 2006).
- There was a high proportion of touch participants which may have affected the results. If the groups had been separated and results configured for each individual group the results may have indicated a different region of complaint for each participant group.
- The perception of chiropractic may have determined the injuries reported. If the scope of treatment was not fully understood by participants they may have reported different injuries.

A study by Neumann *et al*. (1999) on touch players indicated that the majority of injuries reported affected the lower limb. This is consistent with the findings in this study. This finding is accurate in that there is little physical contact in touch which limits the scope of injury. It is a sport that involves continuous running with intermittent sprinting and changes in direction (Neumann *et al.,* 1999) which implies that majority of the injuries would affect the lower limb. This is substantiated by Taunton (2002) who reported on injuries sustained in running, which

is an important element of touch and all other forms of rugby. The vast majority of injuries reported were lower limb injuries.

Wilson *et al*. (1999) and Donson (2003) both reported on rugby union injuries and found the most common anatomical area of complaint to be the head, neck and face. This is dissimilar to the results of this study which could be due to the following factors:

- This study was conducted at an event where touch rugby was included as a rugby adaptation. Touch rugby does not involve the intense physical manoeuvres (e.g. tackling) that sevens and tens rugby demands (Neumann *et al.,* 1998). Therefore the injuries reported are not going to involve the type of injuries that affect the head, neck and face. There would be fewer lacerations, concussions and neck injuries.
- The head, neck and facial injuries that did occur in the sevens and tens games would have been treated by the on-site emergency medical care team and thus would not have been reported to the chiropractic treatment facility.
- The different recording methods utilised in injury reporting implies that there are going to be discrepancies in the comparison between different studies.

Thus, it is necessary for future research to gain a consensus on region of complaint and the broad or narrow definitions of anatomical region used to describe injuries in the sport of tens, sevens and touch in order to more accurately determine the most frequently affected anatomical region to allow for the design of more detailed injury profiles to prevent future injuries.

5.4.4 Summary

Section 5.4 provided a review of the results obtained in Chapter Four regarding Objective Two in determining an injury profile. In review of these results it is pertinent to conduct further research to determine the incidence of injury in these rugby adaptations, specifically between training and competition. This will aid in determining the effect of competition on athletes competing at events such as the ‘Durban Rugby Rush Weekend’. It is also vital to assess the CSSA form (Appendix A) (Korporaal, 2002) in order to expand the definition of the mechanism of injury to allow for a specific description for the cause of injury and determine a consensus in the description of anatomical area in order to more adequately determine injury and treatment profiles to prevent future injuries.

5.5 Objective Three

The third objective was to determine and describe the treatment protocols used in the management of participants who presented to the chiropractic treatment facility.

5.5.1 Frequency of Treatment Protocols Utilised

The treatments utilised in this study reflect the nature of the injuries that occur as a result of the different rugby adaptations. Julian *et al*. (2010) stated that in order for chiropractors to provide treatment at sports events they must have a vast knowledge of the nature of injuries specific to that sport, including the risk factors, mechanism and particular treatment procedures involved in the diagnosis and management of those injuries. This research shows the most common treatment protocols used to treat the variety of injuries presented at the 'Durban Rugby Rush Tournament'. The results indicated that the most frequently utilised treatment at the 'Durban Rugby Rush Tournament' was manipulation followed by massage, PNF stretch and finally dry needling.

Manipulation is the most frequent treatment utilised by chiropractors and is the unique quality that a chiropractor can provide as a form of treatment when compared to physiotherapists, who are traditionally the therapists of choice for the treatment of athletes (Julian *et al*., 2010). The chiropractic manipulation or adjustment is a valid treatment protocol for a variety of conditions; it has been shown to improve spinal stability and results in optimal muscle function through improved muscle contraction and relaxation (Conradie, 2013). Massage is a favourable management protocol for the treatment of many soft tissue injuries (Travell and Simons, 1983). Therefore it is consistent with the current literature that massage would be a favourable choice of treatment protocol. It is a validated choice of treatment for soft tissue dysfunction (Travell and Simons, 1983; Chaitow and Delany, 2002). The findings in this research are similar to those of Julian *et al.* (2010). The results indicated that manipulation (119/337) was the most frequently utilised treatment, followed by soft tissue massage techniques (107/337) which mirrors the results of this study (Julian *et al.,* 2010).

PNF stretching has been used for many years as a choice of treatment protocol and has been adapted to be used specifically to treat athletes, with great success, hence its popularity as a treatment protocol amongst sports practitioners and supports the findings of this research in that it was the third most frequently utilised treatment protocol at the event (Berry, 2006). PNF stretching is a procedure that involves a contract-relax-antagonist-contract stretch technique based on a neurophysiological concept involving the stretch reflex (Berry, 2006). The use of the PNF stretch over the static stretch technique could have been

due to the fact that it has shown to be a more effective treatment in athletes (Berry, 2006) and that it was noted in a study by MacDougall (1999) that it is clinically more effective when compared to static stretching when treating myofascial trigger points.

Dry needling is a popular choice of treatment in the management of muscular injuries and therefore it is a consistent finding in this research that it was the fourth most frequently utilised treatment. However when compared to that of clinical practice it is utilised with a higher frequency when compared to the usage at this event. The reason for this discrepancy is possibly due the fact that dry needling is an invasive procedure and is not recommended in the treatment of competing athletes as there are often post-needling effects such as post-needling muscle soreness that can last up to three days (Travell and Simons, 1983), bruising and inflammation (Maruggie, 2014). It is recommended that recipients of dry needling modify or eliminate the perpetuating activity for up to a week post-needling as the muscle has undergone mechanical disruption to allow for increased blood flow and eventual pain relief (Travell and Simons, 1983).

It should be noted that rest, ice, mobilisation and ischaemic compression were available as treatment protocols but not utilised as frequently as the aforementioned protocols. The reason for this could be, in the case of rest, the majority of the injuries were reported as being overuse in nature and athletes who are competing in an event perceive these injuries as minor and feel they need continuous treatment to allow them to continue to play. It is also possible that in the situations where traumatic injuries occurred, the injuries were not reported to the treatment facility and instead were dealt with by the emergency medical unit on site. The less frequent use of ice as a treatment protocol could be due to the lack of availability of ice at the event and due to the fact that the majority of teams were supplied with ice and ice baths so this protocol would have been used by each team and not required by the students at the treatment facility.

Mobilisation has been shown to decrease pain through decreasing muscle guarding by lengthening the muscle tissue surrounding the joint and allowing for an increase in joint proprioception through the stimulation of neuromuscular impulses (Palmer, 2009). Palmer (2009) found ischaemic compression to be a more effective treatment for myofascial trigger points than many other treatment protocols. It is evident that both these treatment protocols are highly effective but were not utilised with great frequency at this event. The reason for this could be due to the fact that these treatments require more time to complete than the most frequently utilised treatment protocols at the event and the more time consuming the treatment, the longer the athlete is unable to compete. The students at the event may also

have just preferred the other treatment protocols as they are less time consuming and require less physical effort to perform.

5.5.2 Frequency of Strapping, Referral and Continuation of Play

Strapping is used to provide mechanical support, proprioceptive feedback, control pain and inflammation and prevent future injury (Elphinstone, 2005). The frequency of strapping found in this study was similar to the results in a study on New Zealand rugby players, where 24% of the players required strapping in order to play (Gerrard *et al.,* 1994). The majority of strapping that was utilised was for the joint which is a consistent finding as according to McLean (1989) the purpose of strapping is to reduce joint range of motion in order to protect the joint from over stretch or impingement of non-contractile structures.

Referral for external treatment was not required for any primary complaints. This is probably due to the fact that the majority of the injuries reported to the treatment facility were determined as being minor. Even though the severity of injury was not noted; it can be assumed that majority were minor as only 2.9% of participants were not permitted to continue play. The reason for the lack of referral of this 2.9% would have been due to the clinician and student determining that the injury was not severe enough to require outside referral. The other reason for the low referral rate is as mentioned before – the traumatic injuries that occurred would have been seen to by the onsite emergency medical team who would have made the outside referral if required.

Hoskins *et al*. (2009) identified the most important factors in the care provided by chiropractors at sports event for the management of sporting injuries. They found that the care given by chiropractors at sports events was defined as multimodal, characterised by a variety of treatment protocols and not focused solely on adjustment as the only form of treatment. This research is consistent with Hoskins *et al*.'s assessment.

5.5.3 Treatment According to Diagnosis

The use of manipulation as a treatment protocol was utilised across a variety of diagnoses. It was not only utilised in the treatment of spinal diagnoses but was also the primary protocol utilised to treat joint sprains, contusions, PFPS, tibial stress syndrome and ITBS. The only diagnosis made that did not utilise manipulation as a treatment protocol was head concussion. This reiterates the effectiveness of the chiropractic adjustment but also demonstrates that the chiropractic students may be isolating their choice of treatment to the adjustment instead of adopting a multimodal approach as noted in the assessment by Hoskins *et al*. (2009).

Massage was utilised as the second most frequent treatment protocol. It was not the choice of treatment for all but 5 out of 17 diagnoses. Majority of diagnoses of tendonosis were treated with massage and/or manipulation, followed by ice and ischaemic compression. Tendonosis is a non-specific diagnosis as the location of the injury can vary. Some common tendinopathies include rotator cuff, Achilles, lateral or medial epicondylopathy, patellar and wrist tendinopathies (Pfefer *et al*., 2009) which is why the treatments were so varied. In order to accurately determine the best treatment protocol for tendonosis it is pertinent to describe the location of the injury.

Myofascial is another broadly defined diagnosis in which a variety of treatment protocols were utilised. The majority were treated with PNF stretching followed by a varied percentage of manipulation, massage, static stretch and dry needling. In order to determine the effectiveness of the treatment protocol, myofascial injuries need to be categorised into more definite diagnoses.

Muscle strains accounted for a large percentage of diagnoses and were treated mainly with manipulation and/or massage and/or PNF stretch. Each treatment had a percentage of 45.9%, 49.0% and 41.0% respectively which indicates that muscle strains were mainly treated with a multimodal approach. This is consistent and confirms that the criteria suggested by Hoskins *et al*. (2009) were adopted by the chiropractic students when treating muscle strains.

In order to develop a more accurate treatment profile a bigger sample size would be required as there are 17 categories of diagnosis with only 733 primary complaints; therefore the numbers per each diagnosis are low in terms of statistical significance of treatment per diagnosis.

5.5.4 Frequency of Strapping per Diagnosis

Strapping was mainly utilised to strap the joint which is consistent with McLean (1989) as it is important to strap the joint to decrease the range of motion. Strapping was mostly used in relation to rotator cuff syndrome diagnoses which is consistent with McLean (1989) who stated that it is important to strap the joint in order to prevent impingement of non-contractile structures which is a main feature of rotator cuff syndrome whereby the supraspinatus tendon is often impinged between two surfaces resulting in pain (Hamid *et al.,* 2012).

The use of strapping was frequent in joint sprains and PFPS which is consistent with current literature, in that PFPS is the most common complaint affecting the knee (Song *et al.,* 2014) and that in order to provide effective intervention there needs to be a change in kinematics.

This was demonstrated in a study by Song *et al.* (2014) through the use of femoral rotational taping. However, even though taping has shown to be an effective treatment there is no evidence in this research as to the technique used to strap the participants who were diagnosed with PFPS, thus it is important for future research to include the type or technique of strapping used to establish the effectiveness of the treatment protocol. Regarding joint sprains, the most common location is the ankle joint and the best method of treating an ankle sprain is still controversial (Mickel *et al.,* 2006). Mickel *et al.* (2006) reported that strapping of the ankle joint reduced the incidence and severity of repeat ankle sprains hence the high percentage of strapping for joint sprains is consistent with the findings of the current study.

5.5.5 Summary

Section 5.5 presents a description of the treatment protocols provided by the chiropractic students at the 2014 'Durban Rugby Rush Tournament'. There were a variety of treatments offered which allowed for a multimodal approach to the variety of sports injuries that occurred. Manipulation, massage and PNF stretching were the most frequently utilised treatments used either as isolated treatments or in conjunction with other treatment protocols. Strapping was used in less than a third of treatments and was primarily used in rotator cuff syndrome diagnoses.

5.6 Objective Four

The fourth objective was to describe and compare injury profiles between tens, sevens and touch rugby participants that presented to the DUT chiropractic facility at the Durban 'Rugby Rush Tournament 2014', in order to determine if there are any differences in the injuries sustained between the three groups.

It must be noted that this section involves cross-tabulation between the types of athlete and the type of injury, anatomical location of injury and mechanism of injury respectively. However due to the lack of response rate of sevens player the comparisons were done between tens and touch players only. There were a total of 345 patients and only six were sevens players, thus the analysis was conducted on n = 339 patients on their first condition treated.

5.6.1 Comparison According to History of Injury and Type of Injury

There was a non-significant difference *(p = 0.057)* between touch and tens players regarding history of previous trauma. Tens players were more likely to have experienced a previous trauma compared to touch players. This finding is consistent with current literature. As mentioned the game of tens is similar to rugby and no previous injury profiles have been conducted on tens players thus the comparison to rugby injury profiles is pertinent. The reason for this finding is primarily due to the nature of the game. Tens involves full physical contact including tackling and touch does not thus the incidence of previous injury is more likely to occur in the tens group in that these players experience more physicality and according to previous research would experience more injuries in playing. Touch has shown to be a sport that incurs fewer injuries than other rugby codes (Neumann *et al*., 1998). The borderline finding could be due to sample size and/or poor participant recall.

The fact that there was no statistical significance noted when comparing history of previous injury could have been due to poor recall from participants and possibly the interpretation by the students when completing the CSSA form (Appendix A) (Korporaal, 2002). The fact that there was a borderline non-significant finding between the two groups regarding history of previous trauma suggests the same should have been found between the groups regarding history of previous injury. It suggests further research should be done in the interpretation of data and possibility of a change in the format of the CSSA form (Appendix A) (Korporaal, 2002) in order to more efficiently record information.

Regarding clinical impression, the lack of significance found between the two groups is most likely due to the small sample size and/or the understanding of acute vs chronic injuries. For example, as mentioned previously, injuries that were reported as acute could have been chronic but were reported as acute due to the timing of the injury and due to poor patient recall thus the clinical impression of injuries may not have been accurate in this study. Due to the nature of the game of tens compared to touch it would be more likely that touch players experiencing very little contact and more continuous running would experience more chronic injuries than tens players who experience intense physical contact so would experience a much greater percentage of acute injuries than reflected in the results. This issue of description of clinical impression needs to be addressed and defined accordingly so that recall is interpreted and recorded correctly by chiropractic students.

5.6.2 Comparison According to Mechanism of Injury

The significant finding (*p < 0.001)* of the association between the type of player and mechanism of injury highlights the importance of injury profiling in that the physicality of a sport can determine the type of injury experienced. Neumann *et al*. (1998) indicated in a

study on touch players that only a small percentage of injuries occurred as a result of contact with other players and that the vast majority of injuries were chronic overuse in nature.

As there have been no injury profiles on tens players, it was assumed because of the physicality of the game that they would suffer from more traumatic injuries when compared to touch players. When compared to rugby union this finding is consistent as the tackle has been the main mechanism of injury in the majority of injuries reported (Gabbett, 2002; Junge *et al.,* 2004; Brooks and Kemp, 2008; Tuck, 2010). In this research there was no specific definition for mechanism of injury and therefore it was limited to trauma, overuse or idiopathic. In future research it would be useful to determine and record the exact mechanism of injury to allow for more specific profiling.

5.6.3 Comparison According to Anatomical Region

In this section statistical significance tests were not possible due to the nature of the table having too many rows, thus this section is purely descriptive showing patterns which might highlight areas for further study.

There is evidence that tens players reported more upper limb injuries compared to touch players and touch player reported more lower limb injuries, which is consistent with the current literature in that the study performed by Neumann *et al.* (1998) which showed that the majority of injuries experienced by touch players affected the lower limb. Most of the studies performed on rugby injuries also showed that the majority of injuries affected the lower limb (Bird *et al*., 1998; Gabbett, 2002; Junge *et al.,* 2004; Brooks and Kemp, 2008; Tuck, 2010).

This finding could have been due to the relatively small sample size and/or the fact that this table is comparing only primary complaints. The tens players could have reported two injuries one of which was a lower limb injury which could have recorded and treated as a secondary complaint and thus not taken into account in this cross-tabulation.

The finding that touch players experienced twice as many lumbar complaints as the tens players is an area for further research. This finding cannot be due to the nature of the treatment centre being primarily chiropractors and the participant perception that only spinal conditions are treated as then the findings would have been equally split between tens and touch players. This finding can be due to the nature of the sport in that touch involves more bending and picking up the ball than tens does which means the touch players are actively flexing and extending their spines more frequently than tens players.

5.6.4 Summary

Section 5.6 discussed the results of the cross tabulations between tens and touch rugby participants comparing type, mechanism and anatomical location of injury. The fact that there was only a comparison noted between tens and touch players and not sevens players is unfortunate, however the findings do indicate a relationship between injury type and type of player regarding tens and touch players. Tens players are more likely to have a history of previous trauma and more likely to incur acute traumatic injuries than touch players who are more likely to not have a history of trauma and incur chronic overuse injuries. This indicates that future research should focus on prospective information in determining previous history of trauma and/or injury and defining clinical impression and mechanisms of injury specific to the sporting codes involved.

5.7 Discussion of the Null Hypothesis

5.7.1 Null Hypothesis

There are no differences between the injury profiles of tens, sevens and touch rugby participants.

5.7.2 Discussion

Rejected. Differences were noted between the tens and touch participants regarding a history of previous trauma and the relationship between player and mechanism of injury. Further research needs to be performed on sevens injuries for future group comparison as there was insufficient data collected on sevens' players in this study to determine a statistical significance.

5.8 Conclusion

Chapter Five discussed the results that were presented in Chapter Four. From this it can be concluded that the typical participant presenting to the chiropractic treatment facility was a 26 year old White male as described in Objective One (section 5.3). The most prevalent injuries were that of the lower limb and most were as a result of overuse mechanisms resulting in acute muscle strains as described in Objective Two (section 5.4). The treatment profile showed that manipulation was the most frequently used treatment to treat a variety of conditions often in conjunction with other treatment protocols such as massage and PNF stretch. Strapping was utilised in the stabilization of joints particularly in the use of rotator cuff syndrome and joint sprains as descried in Objective Three (section 5.5). Associations

between the type of athlete and injury type, anatomical location and mechanism of injury indicated that tens players had a greater history of previous trauma and suffered from more traumatic injuries to the upper limb whereas touch players suffered from more overuse injuries affecting predominantly the lower limb as shown in objective four (Section 5.6). Chapter Six will describe the conclusions, limitations regarding this research and discuss recommendations for future research studies.

CHAPTER 6 : CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter will describe the conclusions of this research study based on the results and the primary data collected at the 2014 'Durban Rugby Rush Tournament' chiropractic treatment facility. Limitations of the study will then be discussed followed by recommendations for future research studies.

6.2 Conclusion

Intervention research such as this study aims to contribute to the body of knowledge known as 'sports injury surveillance'. This research is a necessary step to ensure prevention methods are adopted by the sporting event and to encourage further research not only in these sporting codes but in many other sports settings. These injury profiles enable individual health care practitioners and sports medical teams to adequately manage and prevent injuries. Injury profiles have been conducted at length in the field of rugby but are lacking in tens, sevens and touch rugby. This retrospective descriptive study aimed to establish an injury and treatment profile of the players that participate in these rugby adaptations and if any associations exist between type of player and type of injury.

In conclusion, it was shown in Section 4.5.2 that the majority of participants that presented to the chiropractic treatment facility were White males with an average age of 24 ± 5.58, which is consistent with the general population participating in sport in South Africa. Tens players were shown to have an increased history of previous trauma when compared to touch players. Of the injuries sustained, the majority were muscle strains that affected the lower limb which is consistent with the current literature on rugby union and touch rugby injuries. It was found that the majority of injuries were diagnosed as being acute in nature and being due to non-contact overuse mechanisms which is consistent with the research on touch rugby injuries but inconsistent with the literature on rugby union injuries whereby trauma was the main mechanism of injury. The most frequently reported diagnosis was that of muscle strains which is supported by previous injury profiles of rugby union players. Diagnoses reported largely determine the treatment protocols utilised; in this study the most frequently utilised treatment protocols were manipulation, massage and PNF stretching. However, there was a multimodal approach to treatment which often included more than just one protocol.

Due to the lack of response from the sevens players cross-tabulation comparisons between the three groups was not possible and only tens and touch players were compared in terms of type of injury, anatomical location and mechanism of injury. There was a significant association found between the type of player and the mechanism of injury in that touch players were injured more frequently as a result of an overuse mechanism whereas tens players experienced more injuries as a result of trauma. It was shown that tens players suffered from more upper limb injuries and touch players suffered from more lower limb injuries, however, no statistical significance was found.

These findings indicate that there were several limitations in performing this study and several recommendations to improve on this and future sport injury surveillance studies. These three rugby adaptations are growing as sporting codes, particularly in South Africa and it is important to understand the nature of the potential injuries and how to prevent them. Research such as this is a small step to guide further research to develop adequate sports injury profiles in the field of rugby as well as other sporting codes. The limitations and recommendations will now be discussed.

6.3 Limitations

- Information and selection bias are two limitations that are evident in retrospective descriptive study designs. Data interpretation is based on the information recorded by outside personnel and thus the researcher has to trust it has been recorded accurately and completely. Missing data and inaccurate recording could have an influence on the results.
- The use of the chiropractic treatment facility at the 2014 ‘Durban Rugby Rush Tournament’ could have been attributed to participant perception of chiropractic and therefore could have determined the injuries that were reported.
- The injuries reported on in this study were from one treatment facility at an event where there were several other medical teams providing treatment to injured participants and some providing private care to specific teams which implies that not all injuries may have been reported to the chiropractic treatment facility which affects the data collection and therefore the results of this research.
- The injuries reported in this study were only those that occurred during the event and thus were injuries sustained while in competition. In any sport it is important to know the rate of injury in training compared to competition. This study only showed injuries sustained in competition and thus does not provide the larger scope of injuries sustained by participants in these rugby adaptations.

- The data recording sheet was the CSSA form (Appendix A) (Korporaal, 2002) which was established at a hockey event, is a widely used form at a variety of sporting events but it is limiting in that specific information regarding the particular sport and the injuries sustained are not recorded. The definitions and descriptions are broad and thus information specific to that sporting code is not necessarily recorded accurately.
- Treatment offered by the chiropractic treatment facility was free of charge and therefore some participants are more likely to seek care if it is a free service. This could have attributed to an overuse of the facility and thus the over-reporting of injuries which could have affected the results of the study.
- The data collection forms were completed by senior chiropractic students and thus the information recorded was based on their clinical observations under the supervision of qualified chiropractors. This implies the diagnoses, clinical impressions and knowledge may have been limited in terms of their scope of practice and may have been affected by inter-examiner/student reliability.
- Fewer injuries may have been included in the study as a result of the exclusion and inclusion criteria as defined in Chapter Three.
- Irregularities in reporting and recording may have resulted due to the lack of a consensus of the knowledge of clinical terms and definitions, particularly those listed on the CSSA form (Appendix A) (Korporaal, 2002).
- The accuracy of the information recorded on the CSSA form (Appendix A) (Korporaal, 2002) is largely due to participant recall. Therefore the accuracy of the description from the participant would have affected the clinical impression and diagnosis selection chosen by the chiropractic student. This affects the accuracy of the data recorded and therefore affects the results of the study.
- The lack of response from sevens participants reduced the sample size and meant it was not possible to compare these injuries to those sustained by the tens and touch participants. Therefore Objective Four was only partially completed.

6.4 Recommendations

- A prospective approach to injury surveillance research should be implemented to accurately record information of injuries sustained. Research needs to change from isolated cross-sectional descriptive studies to continuous prospective studies (Finch, 2006).

- Descriptive research is limited by un-validated surveys of self-reported information, inconsistent injury definitions, injury severity and sample sizes (Finch, 2006). It is recommended that this be taken into account for future research.
- The current CSSA form (Appendix A) (Korporaal, 2002) should be updated and validated to provide a consistent definition of injury, clinical impression and diagnosis in order to be be suitable for a variety of events including multi-sport events. The principles of injury reporting and recording as recommended by Finch (2006) and Junge *et al*. (2008) should be implemented in the updated form. These principles include standardization of injury definitions and the recording of information by trained health care practitioners/students on a single form.
- Future research on injury surveillance on these rugby codes could focus more on the risk factors associated with injury.
- A prospective cohort study is recommended for future research in this field that records information across training and competition and across the different grades of play. This will provide accurate information regarding all injuries sustained in the sport(s).
- The introduction of an injury database may assist in the knowledge and prevention of future injuries. Information regarding the injuries sustained by players can be documented into a database that all medical personnel can access in the event that they are required to treat that player.
- This research shows the importance of information recall with regards to the participant and the recorder, in this case the chiropractic student. A pre-event training for the students can be introduced in order to better equip them with knowledge regarding the nature of the sporting activity, the information on the injury reporting form and how to accurately complete the form. This will allow the students to better understand the injuries they will be treating and the importance of the accuracy of the information they are recording.
- Multi-day, multi-sport events that occur over more than one day implies there will be repeat patients. It is important to establish a system of organisation to better manage repeat patients and allow for more controlled data input on the injury reporting form.
- In order to prevent missing data, demographic data can be recorded separately to ensure accurate recording for future data collection which will improve statistical analysis.
- Chapter Five identified certain key areas for further research, these include:
    - The high incidence of lumbar complaints in touch players.
    - The high incidence of overuse injuries in touch players.

- The incidence and types of injuries amongst sevens rugby players.
- The association of history of injury and/or trauma amongst tens and touch players.

REFERENCES

Accident Rehabilitation and Compensation Insurance Corporation. 2002. *ACC Sport smart: educational resource.* ISBN 0–478–10879–6 ACC 524. Printed January 2008.

Alsop, J., Chalmers, D., Williams, S., Quarrie, K., Marshall, S. and Sharples, K. 2000. Temporal patterns of injury during a rugby season. *Journal of Science and Medicine in Sport,* 3(2): 97-109

Arscott-Mills, S., Gordon, G., McDonald, A., Holder, Y. and Ward, E. 2002. A profile of injuries in Jamaica. *Injury Control and Safety Promotion,* 9(4): 227-234.

Austin, D., Gabbett, T. and Jenkins, D. 2011. The physical demands of Super 14 Rugby Union. *Journal of Science and Medicine in Sport,* 14(3): 259-263.

Australian Rugby Union. (2014) *Rugby explained*. [Online] Available from: http://www.rugby.com.au/try-rugby/Playing/RugbyExplained.aspx. [Accessed:15th October 2014].

Bahr, R. 2009. No Injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. *British Journal of Sports Medicine,* 43: 966-972.

Bahr, R. and Krosshaug, T. 2005. Understanding injury mechanisms: a key component of preventing injuries in sport. *British Journal of Sports Medicine*, 39: 324-329.

Bahr, R. and Holme, I. 2003. Risk factors for sports injuries – a methodological approach. *British Journal of Sports Medicine*, 37: 384-392.

Bathgate, A., Best, J., Craig, G. and Jamieson, M. 2002. A prospective study of injuries to elite Australian rugby union players. *British Journal of Sports Medicine,* 36: *265-269.*

Beardmore, A., Handcock, P. and Rehrer, N. 2004. Return to play after injury: practices in New Zealand rugby union. *Physical Therapy in Sport,* 6:24-30.

Best, J., McIntosh, A. and Savage, T. 2005. Rugby World Cup 2003: Injury Surveillance Project. *British Journal of Sports Medicine,* 39: 812-817.

Best, J. 2003. Making rugby safer: from grass roots to the elite level. *Sports Medicine Australia,* 6(4): 2.

Bernard, R. 2000. *Social research methods.* California: Sage Publications.

Berry, J. 2006. The relative effectiveness of myofascial trigger point manipulation as compared to proprioceptive neuromuscular facilitative stretching in the treatment of active myofascial trigger points a pilot clinical investigation. M.Tech dissertation. Durban University of Technology.

Blair, J. 1990. *Rugby fitness*. Auckland: SeTo Publishing, as cited by Noakes, T. and du Plessis, M. 1996. *Rugby without risk*. Pretoria, J.L van Schaik Publishers.

Bleakly, C., Tully, M. and O'Connor, S. 2011. Epidemiology of adolescent rugby injuries: a systematic review. *Journal of Athletic Training,* 46(5): 555-565.

Bird, Y., Waller, S., Alsop, J., Chalmers, D. and Gerrard, D. 1998. The New Zealand Rugby Injury and Performance Project: V. Epidemiology of a season of rugby injury. *British Journal of Sports Medicine,* 32: 319-325.

Braham, R., Finch, C., McIntosh, A .and McCroy, P. 2004. Community level Australian Football: a profile of injuries. *Journal of Science and Medicine in Sport,* 7(1): 96-105.

Brooks, J and Kemp, S. 2008. *Recent trends in Rugby Union injuries*. Clinics in Sports Medicine. Philadelphia: Elsevier Saunders.

Brown, J., Verhagen, E., Viljoen, W., Readhead, C., Van Mechelen, W., Hendricks, S. and Lambert, M. 2012. The incidence and severity of injuries at the 2011 South African Rugby Union (SARU) Youth Week tournaments. *South African Journal of Sports Medicine,* 24(2): 49-54.

Butt, C., 2008. An investigation into the knowledge and perception of rugby coaches in the greater Durban area with regards to chiropractic and other sports medical personnel. M.Tech dissertation. Durban University of Technology.

Caine, D., Maffulli, N. and Caine, C. 2008. Epidemiology of injury in child and adolescent sports: injury rates, risk factors, and prevention. *Clinical Sports Medicine,* 27: 19-50.

Chaitow L. and DeLany J. 2002. *Clinical application of neuromuscular techniques*. Volume 2 – The Lower Body. Edinburgh: Churchill Livingston, Elsevier Science Limited.

Chalmers, D., Simpson, J. and Depree, R. 2004. Tackling rugby injury: lessons learned from the implementation of a five-year sports Injury prevention programme. *Journal of Science and Medicine in Sport;* 7(1): 74-84.

Chalmers, D., Samaranayaka, A., Gulliver, P. and McNoe, B. 2012. Risk factors for injury in rugby union football in New Zealand: a cohort study. *British Journal of Sports Medicine*, 46: 95-102.

Chiropractic Association of South Africa (CASA). 2015. [Online] Available from http://www.chiropractic.co.za. [Accessed: 28th January 2015]

Clark, D., Roux, C. and Noakes, T. 1990. A prospective study of the incidence and nature of injuries to adult rugby players. *South African Medical Journal,* 77: 559-562.

Clarsen, B., Myklebust, G. and Bahr, R. 2012. Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire. *British Journal of Sports Medicine*, 47: 495-502.

Cloete, K. 2008. A study to determine the international federations' perception and utilization of chiropractors and other sports medical personnel. M. Tech Dissertation. DUT. Durban University of Technology

Coetzee, C. 2013. An injury profile of amateur and semi-professional Kwa-Zulu Natal triathletes. M.Tech dissertation. Durban University of Technology

Collins, C., Micheli, L., Yard, E. and Comstock, R. 2008. Injuries sustained by high school rugby players in the United States, 2005-2006. *Archives of Pediatrics and Adolescent Medicine,* 162(1): 49-54.

Committee on Trauma Research.1985. *Injury in America: a continuing public health problem.* Washington, DC: National Academy press as cited by Bahr, R. and Krosshaug, T. 2005. Understanding injury mechanisms: a key component of preventing injuries in sport. *British Journal of Sports Medicine*, 39:324-329.

Conradie, E. 2013. The effect of chiropractic adjustments on sprint times and vertical jump height in rugby players. M.Tech dissertation. University of Johannesburg.

Croisier, J. 2004. Factors associated with recurrent hamstring injuries. *Sports Medicine*, 34(10): 681-695.

Dagenais, S. and Haldeman, S. 2011. *Evidence-based management of low back pain.* Mosby.

Dainoff, C. 2014. Rugby About: *How sevens is different*. [Online] Available from: http://rugby.about.com/od/rugbyadmina/a/Rugby-Sevens.htm. [Accessed:2nd February 2014]

Department of Sports and recreation of South Africa. 2005. Participation patterns in sport and recreation activities in South Africa: survey.

Deroche, T., Stephan, Y., Brewer, B. and Le Scanff, C. 2007. Predictors of perceived susceptibility to sport related injury. *Personality and Individual Differences,* 43: 2218-2228.

Donson, H. 2003. The National Rugby Injury Surveillance Study (NRISS) of South Africa 2001-2002. *Journal of Science and Medicine in Sport*, 6(4): 45.

du Toit, J., Durandt, J., Joshua, J., Masimla, H. and Lambert, M. 2012. Playing time between senior rugby players of different ethnic groups across all levels of South African rugby, 2007-2011. *South African Journal of Sports Medicine*, 24(3) :81-85.

Dutfield, R., Savage, T., McIntosh, A. and Romiti, M. 2007. Rugby Union Injury Surveillance Study 2002-2006: five years of injury surveillance in Rugby Union. *Journal of Science and Medicine in Sport*, 10: 114

Elphinstone, J. 2005. An Investigation to determine the effect of short term low-dye taping on vertical ground reaction forces in asymptomatic pes planus, cavus and normal feet. M.Tech dissertation. Durban University of Technology

England Rugby. 2014. Forms of rugby. [Online] Available at: http://www.englandrugby.com/my-rugby/players/forms-of-rugby/touch-rugby/. [Accessed: 22nd July 2014]

Ernst, E. and Canter, P. 2006. A systematic review of systematic reviews of spinal manipulation. *Journal of the Royal Society of Medicine*, 99: 192-196.

Esterhuizen, T. 2014. Personal communication. [Email: 14th October 2014]

Federation of International Touch. 2003. Rules and their interpretations and explanations. 3rd edition.

Finch, C., 1997. An overview of some definitional issues for sports injury surveillance. *Sports Medicine,* 24(3): 157-163.

Finch, C. 2006. A new framework for research leading to sports injury prevention. *Journal of Science and Medicine in Sport,* (9): 3-9.

Finch, C. and Mitchell, D. 2002. A comparison of two injury surveillance systems within sports medicine clinics. *Journal of Science and Medicine in Sport*, 5(4): 321-335.

Finch, C., Valuri, G. and Ozanne-Smith, J. 1999. Injury surveillance during medical coverage of sporting events – development and testing of a standardized data collection form. *Journal of Science and Medicine in Sport*, 2(1): 42-56.

Fukuchi, R., Stefanyshyn, D., Stirling, L., Duarte, M. and Ferber, R. 2013. Flexibility, muscle strength and running biomechanical adoptions in older runners. *Clinical Biomechanics*, 29(3): 304-10.

Fuller, C. and Drawer, S. 2004. The application of risk management in sport. *Sports Medicine,* 34(6): 349-356.

Fuller, C., Molloy, M., Bagate, C., Bahr, R., Brooks, J., Donson, H., Kemp, S., McCrory, P., McIntosh, A., Meeuwisse, W., Quarrie, K., Raftery, M. and Wiley, P. 2007. Consensus statement on injury definitions and data collection procedures for studies of injuries in rugby union. *British Journal of Sports Medicine,* 41: 328-331.

Fuller, C., Raftery, M., Readhead, C., Targett, S. and Molloy, M. 2009. Impact of the International Rugby Board's experimental law variations on the incidence and nature of match injuries in southern hemisphere professional rugby union. *South African Medical Journal,* 99(4): 232-237.

Gabbe, B. and Finch, C. 1999. The Sports Medicine Injury Surveillance (SMIS) project: Australian football results. *Journal of Science and Medicine in Sport*, 2(1): 6.

Gabbe, B. and Finch, C. 2001. A profile of Australian Football injuries presenting to sports medicine clinics. *Journal of Science and Medicine in Sport,* 4(4): 386-395.

Gabbe, B., Finch, C., Wajsweiner, H and Bennell, K. 2002. Australian Football: injury profile at the community level. *Journal of Science and Medicine in Sport,* 5(2): 149-160.

Gabbett, T. 2002. Incidence of injury in amateur rugby league sevens. *British Journal of Sports Medicine*, 36: 23-26.

Gabbett, T. 2003. Incidence of injury in semi-professional rugby league players. *British Journal Sports medicine,* 37: 36-44.

Gabbett, T. 2008. Incidence of injury in junior rugby league players over four competitive seasons. *Journal of Science and Medicine in Sport,* 11: 323-328.

Gabbett, T., Minbashian, A. and Finch, C. 2007. Influence of environmental and ground conditions on injury risk in rugby league. *Journal of Science and Medicine in Sport,* 10: 211-218.

Garraway, M. and Macleod, D. 1995. Epidemiology of rugby football injuries. *The Lancet,* 345: 1485-87.

Gerrard, D., Waller, A. and Bird, Y. 1994. The New Zealand Rugby Injury and Performance Project: II. Previous injury experience of a rugby playing cohort. *British Journal of Sports Medicine,* 28(4): 229-233.

Gianotti, S.M., Quarrie, K.L. and Hume, P.A. 2009. Evaluation of RugbySmart: A rugby union community injury prevention programmeme. *Journal of Science and Medicine in Sport* (12): 371–375

Glaun, R., Egnal, A., Allen, J. and Noakes, T.D. 1984. Are high schools adequately prepared to cope with serious rugby injuries? *South African Medical Journal,* 66(20): 768-70, as cited by Tuck, A. 2010. An investigation into the risk factors and management of rugby injuries in the greater Durban area. M.Tech dissertation. Durban University of Technology.

Hamid, N., Omid, R., Yamaguchi, K., Steger-May, K., Stobbs, G. and Keener, J. 2012. Relationship of radiographic acromial characteristics and rotator cuff disease: a prospective investigation of clinical, radiographic, and sonographic findings. *Journal of Shoulder and Elbow Surgery*, 21: 1289-1298.

Higham, D., Pyne, D., Anson, J. and Eddy, A. 2012. Movement patterns in rugby sevens: Effects of tournament level, fatigue and substitute players. *Journal of Science and Medicine in Sport,* 15:277-282.

Hodgson Phillips, L., Standen, P. and Batt, M. 1998. Effects of seasonal change in rugby league on the incidence of injury. *British Journal of Sports Medicine,* 32: 14-148, as cited by Gabbett, T. 2002. Incidence of injury in amateur rugby league sevens. *British Journal of Sports Medicine*, 36: 23-26.

Hoskins, W., Pollard, H., Hough, K. and Tully, C. 2006. Injury in Rugby League. *Journal of Science and Medicine in Sport,* 9(1-2): 46-56.

Hoskins, W., Pollard, H. and Garbutt, P. 2009. How to select a chiropractor for the management of athletic conditions. *Chiropractic and Osteopathy*, 17(3): 1-4.

International Rugby Board (IRB). 2008. *Laws of the Game Rugby Union 2008*. Incorporating the Playing Charter. IRB Laws of the Game Book. Dublin, Ireland.

International Rugby Board (IRB). 2009. *Laws of the game: Rugby Union.* [Online] Available at: http://laws.worldrugby.org/?variation=2. [Accessed: 19th July 2014].

In2Touch: Touch Rugby Leagues. 2014. General information regarding touch Rugby. [Online} Available at: http://www.touchrugby.co.za/show_sub.asp?id=220. [Accessed 22nd July 2014].

iSport Rugby. 2014. *Rugby sevens explained*. [Online] Available from: http://rugby.isport.com/rugby-guides/ [Accessed: 19th July 2014].

Jakoet, I. and Noakes, T. 1998. A high rate of injury during the 1995 Rugby World Cup. *South African Medical Journal,* 88(1): 45-47.

Julian, C., Hoskins, W. and Vitiello, A. 2010. Sports chiropractic management at the World Ice Hockey Championships. *Chiropractic and Osteopathy*, 18: 1-9.

Junge, A., Cheung, K., Edwards, T. and Dvorak, J. 2004. Injuries in youth amateur soccer and rugby players-comparison of incidence and characteristics. *British Journal of Sports Medicine,* 38: 168-172.

Junge, A., Engebretston, L., Alonso, J., Renstrom, P., Mountjoy, M., Aubry, M. and Dvorak, J. 2008. Injury surveillance in multi-sport events – the IOC approach. *British Journal of Sports Medicine*, 42(6): 413-21.

Karkucak, M., Can, I., Capkin, E., Önder, A., Baki, E. and Batmaz, I. 2014. Local steroid injection accompanied by ultrasonographic imaging in the treatment of facet syndrome. *Journal of Clinical and Experimental Investigations*, 5(1): 125-127.

Kazemi, M. and Shearer, H. 2008. Chiropractic utilization in Taekwondo athletes. *The Journal of the Canadian Chiropractic Association,* 52(2): 96-109.

Kellmann, M. 2010. Preventing overtraining in the athletes in high-intensity sports and stress/recovery monitoring. *Scandinavian Journal of Medicine and Science in Sports*, 20(2): 95-102.

Kerikeri Rugby Football Club. 2014. Introduction to the game of rugby tens. [Online] Available at: http://kerikerirugby.com/2012/introduction-to-the-game-of-rugby-tens-10s-or-ten-a-side/. [Accessed: 19th July 2014].

King, D. and Gabbett, T. 2007. Training injuries in New Zealand amateur rugby league players. *Journal of Science and Medicine in Sport*, 11: 562-565.

King, D., Gabbett, T., Dreyer, C. and Gerrard, D. 2006. Incidence of injuries in the New Zealand national rugby league sevens tournament. *Journal of Science and Medicine in Sport*, 9:110-118.

King, D., Hume, P., Milburn, P. and Guttenbeil, D. 2010. Match and training injuries in Rugby League. A Review of Published Studies. *Sports Medicine,* 40(2): 163-178.

Konczak, C. 2010. Chiropractic utilization in BMX athletes at the UCI World Championships: a retrospective study. *The Journal of the Canadian Chiropractic Association*, 54(4): 250-256.

Korporaal, C. 2002. A retrospective epidemiological investigation of the chiropractic students sports association sports questionnaire, with reference to field hockey: a methodological perspective. M.Tech dissertation, Durban University of Technology.

Korporaal, C. 2014. Personal Communication.

Kwa-Zulu Natal Rugby Union. 2008. Fixtures Booklet 2008. Durban, South Africa.

Labuschagne, K. 2009. Knowledge, perception and utilisation of chiropractic by National Olympic Committees. M.Tech dissertation, Durban University of Technology.

Lund, S. and Myklebust, G. 2011. High injury incidence in TeamGym competition: a prospective cohort study. *Scandinavian Journal of Medicine and Science in Sports,* 21(6): e439–e444.

Maffulli, N, Longo, U, Caine, D. and Denaro, V. 2011. Sports injuries: a review of outcomes. *British Medical Bulletin,* 97: 47-80.

Mahomed, F. 2007. Chiropractic patients in South Africa: a demographic and descriptive profile. M. Tech dissertation, Durban University of Technology.

Malisoux, L., Nielsen, R., Urhausen, A. and Theisen, D. 2014. A step towards understanding the mechanisms of running-related injuries. *Journal of Science and Medicine in Sport*, 7(14): 1-6.

Maruggie, M. 2014. The effect of kinesio tape® on post dry needling soreness in the treatment of trigger point one. M.Tech dissertation, University of Johannesburg.

McBain, K., Shrier, I., Shultz, R., Meeuwisse,W., Klügl, M., Garza, D. and Matheson, G. 2014. Prevention of sports injury II: a systematic review of clinical science research. *British Journal of Sports Medicine*, 46(3): 174-179.

McIntosh, A. 2005. Epidemiology of pediatric sports injuries: team sports. *Journal of Medical Sports Science,* (49): 120-139.

McIntosh A., McCrory P., Finch C., Best J., Chalmers, D. and Wolfe, R. 2009. Does padded headgear prevent head injury in rugby union football*? Medicine and Science in Sports and Exercise,* 41(2): 306–313 as cited by Bleakly, C., Tully, M and O'Connor, S. 2011. Epidemiology of Adolescent Rugby Injuries: A Systematic Review. *Journal of Athletic Training,* 46(5): 555-565.

McKay, G., Goldie, P., Payne, W., Oakes, B. and Watson, L. 2001. A prospective study of injuries in basketball: a total profile and comparison by gender and standard of competition. *Journal of Science and Medicine in Sport,* 4(2): 196-211.

McLean, D. 1989. Use of adhesive strapping in sport. *British Journal of Sports Medicine*, 23(3): 147-149

McManus, A and Cross, D. 2004. Incidence of injury in elite junior rugby union. *Journal of Science and Medicine in sport.* 7(4): 438-445.

McManus, A., Stevenson, M., Finch, CF., Elliott, B., Hamer, P., Lower, A and Bulsara, M. 2004. Incidence and risk factors for injury in non-elite Australian football. *Journal of Science and Medicine in Sport,* 7(3): 384-391.

Mickel, T., Bottoni, C., Tsuji, G., Chang, K., Baum, L. and Tokushige, A. 2006. Prophylactic bracing versus taping for prevention of ankle sprains in high school athletes: a prospective, randomised trial. *Journal of Foot and Ankle Surgery*, 46(6): 360-365.

Miners, A. 2010. Chiropractic treatment and the enhancement of sports performance: a narrative review*. The Journal of the Canadian Chiropractic Association*, 54(4): 210-221.

Morgan, D.L 1998. The Focus Group Guidebook. Thousand Oaks, CA: Sage Publications.

Morgan, B. 2014. *Rugby in South Africa*. [Online] Available from: http://www.southafrica.info/about/sport/rugby.htm#.VGXWDvmUeSo. [Accessed: 2nd November 2014]

Mouton, J. 1996. *Understanding social research*. Pretoria: J.L. van Schaik Publishers.

Mueller-Wohlfahrt, H., Haensel, L., Mithoefer, K., Ekstrand, J., English, B., McNally, S., Orchard, J., van Dijk, N., Kerkhoffs, G., Schamasch, P., Blottner, D., Swaerd, L., Goedhart, E. and Ueblacker, P. 2012. Terminology and classification of muscle injuries in sport: a consensus statement. *British Journal of Sports Medicine*, 47: 342-350.

Murphy, D., Connolly, D. and Beynnon, B. 2003. Risk factors for lower extremity injury: a review of the literature. *British Journal of Sports Medicine*, 37: 13-29.

Nathan, M., Goedeke, R. and Noakes, T. 1983. The incidence and nature of rugby injuries at one school during the 1982 rugby season. *South African Medical Journal.* 64(4): 132-137, as cited by Noakes, T. and du Plessis, M. 1996. *Rugby without risk*. Pretoria: J.L van Schaik Publishers.

National Rugby League Manual, 2013. *Rugby League Laws of the Game.* International Level with Notes on the laws and NRL Telstra Premiership Interpretations. Australian Rugby League Commission. NRL, February 2013.

Neumann, D., McCurdie, I. and Wade, A. 1998. A survey of injuries sustained in the game of touch. *Journal of Science and Medicine in Sport,* 1(4): 228-235.

Noakes, T. and du Plessis, M. 1996. *Rugby without risk.* Pretoria: J.L van Schaik Publishers.

Notarnicola, A., Fischetti, F., Gallone, D., Moretti, L., Pignataro, P., Tafuri, S. and Moretti, B. 2012. Overload and neovascularization of shoulder tendons in volleyball players. *BioMed Central Research Notes*, 5(397): 2-8.

Orchard, J. and Kountouris, A. 2011. Clinical review: The management of tennis elbow. *British Medical Journal,* 342: 1199-1202.

Oxford Learner's Dictionary, The. 2010. Oxford University Press (1998).

Palmer, R. 2009. An investigation into patient management protocols for low back pain by chiropractors in the greater Durban area. M.Tech dissertation. Durban University of Technology

Pfefer, M., Cooper, S. and Nathan, L. 2009. Chiropractic management of tendinopathy: a literature synthesis. *Journal of Manipulative and Physiological Therapeutics,* 32: 41-52.

Posthumus, M. and Viljoen, W. 2008. BokSmart: Safe and effective techniques in rugby union. *South African Journal of Sports Medicine,* 20(3): 64-69.

Quarrie, K., Alsop, J., Waller, A., Bird, Y., Marshall, S. and Chalmers, D. 2001. The New Zealand rugby injury and performance project. VI. A prospective cohort study of risk factors for injury in rugby union football. *British Journal of Sports Medicine,* 35: 157-166.

Robinson, D. 1998. *Rugby a player's guide to the laws.* London: Collins Willow.

Rourke, K., Quinn, F., Mun, S., Browne, M., Sheehan, J., Cusack, S. and Molloy, M. 2006. A comparison of paediatric soccer, gaelic football and rugby injuries presenting to an emergency department in Ireland. *Injury, International Journal of the Care of the Injured,* 38: 104-111.

Roux, C.E. 1992. The Epidemiology of school boy rugby injuries. MSc dissertation, University of Cape Town as cited by Noakes, T. and du Plessis, M. 1996. *Rugby without risk.* Pretoria: J.L van Schaik Publishers.

Rowland, C., Mura, C., Steele, J. and Munro, B. 2012. How does foot plant strategy affect cutting technique in male and female Touch Football players: Implications for ACL injury risk? *Journal of Science and Medicine in Sport,* 15: 127-187.

Rugby Rush. 2014. *Rugby Rush Weekend.* [Online] Available from: http://rugbyrush.co.za/. [Accessed: 2nd February 2014].

Rugby Sidestep Central. 2014. *Basic Rugby Rules.* [Online] Available from: http://www.rugby-sidestep-central.com/basic-rugby-rules.html. [Accessed 15th March 2014].

Schneiders, A., Takemura, M. and Wassinger, C. 2009. A prospective epidemiological study of injuries to New Zealand premier club rugby union players. *Physical Therapy in Sport,* 10: 85-90.

Seering W., Piziali R., Nagel, D. and Schurman, D. 1980. The function of the primary ligaments of the knee in varus-valgus and axial rotation. *Journal of Biomechanics,* 13: 785-94 as cited by Bahr, R and Krosshaug, T. 2005. Understanding injury mechanisms: a key component of preventing injuries in sport. *British Journal of Sports Medicine*, 39: 324-329.

Song, C., Huang, H., Chen, S., Lin, J. and Chang, A. 2014. Effects of femoral rotation taping on pain, lower extremity kinematics, and muscle activation in female patients with patellofemoral pain. *Journal of Science and Medicine in Sport,* in press.

South Africa. 1982. Allied Health Professions Act 63, 1982. Government Gazette no. 1746: 1 August.

South Africa. 2010. Safety at Sports and Recreational Events Act 2, 2010. Government Gazette no. 33232: 27 May.

Taunton, J., Ryan, J., Clement, D., McKenzie, D., Lloyd-Smith, D. and Zumbo, B. 2002. A retrospective case-control analysis of 2002 running injuries. *British Journal of Sports Medicine,* 36:95-101.

Theberge, N. 2008. The integration of chiropractors into healthcare teams: a case study from sport medicine. *Sociology of Health and Illness,* 30(1): 19-34.

Thomle, R. and Ziegler, R. 1991. *Is there a trend toward chiropractic in sports care*. Dynamic Chiropractic, 9(13). [Online] Available from: http://www.dynamicchiropractic.com/mpacms/dc/article.php?id=44384. [Accessed: 12th June 2014]

Thomson, R. 2000. Physical activity through sport and leisure: traditional versus non-competitive activities. *Journal of Physical Education New Zealand*, 33: 34-39.

Timpka, T., Jacobsson, J., Ekberg, J. and Nordenfelt, L. 2011. What is a sports injury? *British Journal of Sports Medicine,* 45: 310-384.

Touch Football Australia. 2014. *About touch football.* [Online] Available at: http://touchfootball.com.au/index.php?id=1224. [Accessed: 22nd July 2014]

Travell, J. and Simons, G. 1983. *Myofascial pain and dysfunction: the trigger point manual*. Baltimore: Williams and Wilkins.

Tuck, A. 2010. An investigation into the risk factors and management of rugby injuries in the greater Durban area. M.Tech dissertation. Durban University of Technology

van Mechelen, W. 1997. Sports injury surveillance systems – 'one size fits all'. *Journal* of *Sports Medicine,* 24(3): 164-168.

Van Mechelen, W., Hlobil, H. and Kemper, H.1992. Incidence, severity, aetiology and prevention of sports injuries: a review of concepts. *Sports Med*icine, 14(2): 82-99.

Van Noordwyk, R. 2007. Personal Interview conducted and recorded by Tuck, A. 2010. An investigation into the risk factors and management of rugby injuries in the greater Durban area. M.Tech dissertation. Durban University of Technology.

Verhagen, E., Van Stralen, M. and Mechelen, W. 2010. Behaviour, the key factor for sports injury prevention. *Journal of Sports Medicine*, 40(11): 899-906.

Viljoen, W. and Patricios, J. 2012. BokSmart – implementing a national rugby safety programmeme. *British Journal of Sports Medicine,* 46(10): 692-693.

Waller, A., Feehan, M., Marshall, S. and Chalmers, D. 1994. The New Zealand Rugby Injury and Performance Project: I. Design and methodology of a prospective follow-up study. *British Journal of Sports Medicine*, 28(4): 223-228.

Wekesa, C., Asembo, J. and Njororai, W. 1996. Injury surveillance in a rugby tournament. *British journal of Sports Medicine,* (30): 61-63.

West, D., Cook, C., Stokes, K., Atkinson, P., Drawer, S., Bracken, R. and Kilduff, L. 2013. Profiling the time-course changes in neuromuscular function and muscle damage over two consecutive tournament stages in elite rugby sevens players. *Journal of Science and Medicine in Sport,* 17(6): 688-692.

Wilson, B., Quarrie, K., Milburn, P. and Chalmers, D. 1999. The nature and circumstances of tackle injuries in Rugby Union. *Journal of Science and Medicine in Sport*, 2(2): 153-162.

Winwood, P. 2011. Strongman: strength and conditioning practices and inter-relationships between strength, anthropometrics and performance. D.Tech, Auckland University of Technology.

Woolmer, B., Noakes, T. and Moffett, H. 2008. *Bob Woolmer's art and science of cricket.* Cape Town: Struik Publishers.

World Federation of Chiropractic. 2015. *Definition of chiropractic.* [Online] Available from: http://www.wfc.org/website/index.php?option=com_content&view=article&id=90&Itemid=110&lang=en. [Accessed: 7th February 2015]

Appendix A: 2014 Durban 'Rugby Rush Tournament' form (CSSA form)

2014 Durban Rugby Rush Tournament

By signing alongside this statement, you agree to have the data collected at the 2014 Durban rugby rush tournament, in respect of your condition documented in research – without disclosure of your name or identifying details.

Sign: _____ Date: _____

Date: 21 22 23 March 2014 Time: _____ FILE No: _____
NAME: _____
POSITION: TENS/SEVENS/TOUCH/MANAGE/MEDTOTHER: _____
RACE: W B IN OTHER:_____AGE:_____SEX: MALE / FEMALE
TRAVEL HISTORY: _____

NEW PATIENT REPEAT PATIENT
NEW COMPLAINT CONTINUATION OF CARE

REGION OF COMPLAINT

HEAD	NECK	THORAX	LUMBAR
SHOULDER	ELBOW	WRIST/HAND	FOREARM
UPPER ARM	HIP	KNEE	FOOT/ANKLE
SHIN/CALF	THIGH	CHEST	ABDOMEN

MECHANISM OF INJURY: _____
DID INJURY CAUSE THE PATIENT NOT TO PARTICIPATE IN THE EVENT? YES NO
HAS THE AREA BEEN INJURED BEFORE? YES NO
PREVIOUSTRAUMA:
_____

CLINICAL IMPRESSIONS:

	ACUTE	CHRONIC	
HEAD/CONCUSSION	JNT SPRAIN	MM STRAIN	PFPS
HEAT EXHAUSTION	ABRASION	CONTUSION	LACERATION
C FACET	T FACET	SI SYNDROME	L FACET

TENDINITIS
MYOFASCIALOF: _____
GEN.MUS.TIGHT (DOMS)OF:_____
NEURO/SYSTEMIC/OTHER: _____
RANGE OF MOTION: _____
OTHER: _____

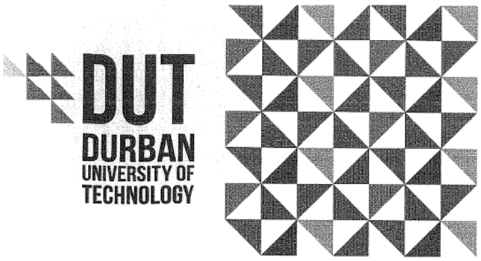
TREATMENT:

MANIPULATION	MOBILISATION	MASSAGE	STRETCH / PNF
STRETCH (STATIC)	TENS	NEEDLE	ISCH COMP
VOLTAREN USED	TRANSACT USED	REFERAL	

Indicate specific regions for the modalities

CONTINUATION OF PLAY: YES NO IF RESTRICTED - WHY ?_____
CLINICIAN NAME_____
SIGN_____
STUDENT: NAME_____
SIGN_____

Appendix B: Institutional Research Ethics Committee (IREC) full approval of proposal



Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

8 August 2014

IREC Reference Number: **REC 37/14**

Ms C McAlery
3 Gainsford Place
La Lucia
Durban

Dear Ms McAlery

An analysis of injury profiles and management strategies utilized by chiropractic students at the 2014 Durban 'Rugby Rush Tournament'

I am pleased to inform you that Full Approval has been granted to your proposal REC 37/14.

The Proposal has been allocated the following Ethical Clearance number **IREC 049/14**. Please use this number in all communication with this office.

Approval has been granted for a period of one year, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

[redacted]

Prof J K Adam
Chairperson: IREC

Appendix C: Permission to use the Chiropractic Day Clinic for research purposes

MEMORANDUM

To : Prof Puckree
Chair : RHDC

Prof Adam
Chair : IREC

From : Dr Charmaine Korporaal
Clinic Director : Chiropractic Day Clinic : Chiropractic and Somatology

Date : 27.03.2014

Re : Request for permission to use the Chiropractic Day Clinic for research purposes

---

Permission is hereby granted to :

Ms Caryn McAlery (Student Number: 20901816)

Research title : "An injury profile at the 2014 Durban Rugby Rush Tournament ".

It is requested that Ms Mc Alery submit a copy of her RHDC / IREC approved proposal to the Clinic Administrators before she starts with her research in order that any special procedures with regards to her research can be implemented prior to the commencement of her seeing patients.

Thank you for your time.

Kind regards

Dr Charmaine Korporaal

Clinic Director : Chiropractic Day Clinic : Chiropractic and Somatology

Cc: Mrs Pat van den Berg : Chiropractic Day Clinic
Dr L O'Connor : Research co-ordinator
Dr G Haswell : Research supervisor

Appendix D: Frequency of Treatment according to Diagnosis

			Treatment									
			Rest	Ice	Manipulation	Mobilization	Massage	Stretch/ PNF	Dry Needle	Static Stretch	Ischaemic Compression	Referral
Diagnosis	Head Concussion	Count	0	1	0	0	0	0	0	0	0	0
		Row N %	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	C-Facet	Count	0	2	37	0	8	9	13	0	1	0
		Row N %	0.0%	5.3%	97.4%	0.0%	21.1%	23.7%	34.2%	0.0%	2.6%	0.0%
	Tendonosis	Count	0	3	4	1	4	1	1	0	2	0
		Row N %	0.0%	33.3%	44.4%	11.1%	44.4%	11.1%	11.1%	0.0%	22.2%	0.0%
	Myofascial	Count	0	0	1	0	1	2	1	1	0	0
		Row N %	0.0%	0.0%	25.0%	0.0%	25.0%	50.0%	25.0%	25.0%	0.0%	0.0%
	DOMS	Count	0	0	1	0	2	1	1	0	0	0
		Row N %	0.0%	0.0%	33.3%	0.0%	66.7%	33.3%	33.3%	0.0%	0.0%	0.0%
	Joint Sprain	Count	0	8	45	7	10	11	12	2	1	0
		Row N %	0.0%	12.7%	71.4%	11.1%	15.9%	17.5%	19.0%	3.2%	1.6%	0.0%

	T-Facet	Count	0	0	19	0	3	4	9	1	0	0
		Row N %	0.0 %	0.0 %	95.0%	0.0%	15.0%	20.0%	45.0%	5.0%	0.0%	0.0%
	Muscle Strain	Count	0	12	133	9	142	119	73	14	33	0
		Row N %	0.0 %	4.1 %	45.9%	3.1%	49.0%	41.0%	25.2%	4.8%	11.4%	0.0%
	Contusion	Count	1	1	2	0	0	0	0	0	0	0
		Row N %	25.0 %	25.0 %	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	SI Syndrome	Count	0	1	117	4	28	33	28	4	10	0
		Row N %	0.0 %	0.8 %	90.7%	3.1%	21.7%	25.6%	21.7%	3.1%	7.8%	0.0%
	PFPS	Count	0	0	3	0	1	0	1	0	0	0
		Row N %	0.0 %	0.0 %	75.0%	0.0%	25.0%	0.0%	25.0%	0.0%	0.0%	0.0%
	L-Facet	Count	0	0	40	0	15	9	5	5	2	0
		Row N %	0.0 %	0.0 %	100.0%	0.0%	37.5%	22.5%	12.5%	12.5%	5.0%	0.0%
	Tibial Stress	Count	0	0	1	0	0	0	0	0	0	0

	Syndrome	Row N %	0.0 %	0.0 %	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	ITBS	Count	0	0	7	0	7	2	2	4	1	0
		Row N %	0.0 %	0.0 %	58.3%	0.0%	58.3%	16.7%	16.7%	33.3%	8.3%	0.0%
	Rotator Cuff Syndrome	Count	0	0	1	0	0	0	1	0	1	0
		Row N %	0.0 %	0.0 %	50.0%	0.0%	0.0%	0.0%	50.0%	0.0%	50.0%	0.0%
	Joint Instability	Count	0	2	6	1	3	6	4	0	2	0
		Row N %	0.0 %	15.4 %	46.2%	7.7%	23.1%	46.2%	30.8%	0.0%	15.4%	0.0%
	Dislocation	Count	1	1	2	0	2	0	1	0	1	0
		Row N %	25.0 %	25.0 %	50.0%	0.0%	50.0%	0.0%	25.0%	0.0%	25.0%	0.0%

Appendix E: Frequency of Strapping according to Diagnosis

			Strapping			
			Done for Muscle	Done for Joint	Protective	Not Done
Diagnosis	Head Concussion	Count	1	0	0	0
		Row N %	100.0%	0.0%	0.0%	0.0%
	C-Facet	Count	0	0	0	38
		Row N %	0.0%	0.0%	0.0%	100.0%
	Tendonosis	Count	2	4	0	7
		Row N %	15.4%	30.8%	0.0%	53.8%
	Myofascial	Count	0	0	0	2
		Row N %	0.0%	0.0%	0.0%	100.0%
	DOMS	Count	0	0	0	3
		Row N %	0.0%	0.0%	0.0%	100.0%
	Joint Sprain	Count	1	66	5	37
		Row N %	0.9%	60.6%	4.6%	33.9%
	Abrasion	Count	0	0	2	0
		Row N %	0.0%	0.0%	100.0%	0.0%
	T-Facet	Count	0	0	0	15
		Row N %	0.0%	0.0%	0.0%	100.0%
	Muscle Strain	Count	28	3	0	252
		Row N %	9.9%	1.1%	0.0%	89.0%
	Contusion	Count	0	1	0	4
		Row N %	0.0%	20.0%	0.0%	80.0%
	SI Syndrome	Count	1	0	0	122
		Row N %	0.8%	0.0%	0.0%	99.2%
	PFPS	Count	0	3	0	2
		Row N %	0.0%	60.0%	0.0%	40.0%
	Laceration	Count	0	0	0	1
		Row N %	0.0%	0.0%	0.0%	100.0%
	L-Facet	Count	0	0	0	39
		Row N %	0.0%	0.0%	0.0%	100.0%
	Tibial Stress Syndrome	Count	0	0	0	1
		Row N %	0.0%	0.0%	0.0%	100.0%
	Meniscus	Count	0	1	0	0
		Row N %	0.0%	100.0%	0.0%	0.0%
	ITBS	Count	1	0	0	11
		Row N %	8.3%	0.0%	0.0%	91.7%
	Rotator Cuff Syndrome	Count	0	3	0	1
		Row N %	0.0%	75.0%	0.0%	25.0%
	Joint Instability	Count	2	8	8	13
		Row N %	6.5%	25.8%	25.8%	41.9%
	Asymptomatic	Count	0	0	1	0
		Row N %	0.0%	0.0%	100.0%	0.0%
	Dislocation	Count	0	6	0	2
		Row N %	0.0%	75.0%	0.0%	25.0%