A PILOT STUDY OF THE PROFILE OF INJURIES THAT PRESENTED TO THE STUDENT CHIROPRACTIC SPORTS COUNCIL AT THE PICK 'N PAY 94.7 CYCLE CHALLENGE FROM 2002 TO 2004.

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in the programme of Chiropractic
by

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Declaration

I, Gregory David Venning, declare that this dissertation is my own, unaided work. It is being submitted in partial fulfilment for the Master's degree in Technology, in the programme of Chiropractic, at the University of Johannesburg. It has not been submitted before for any degree or examination in any other Tertiary Institute.

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G.D. Venning

Signed at ___________________,

On this day the ________ of the month of _____________ 2005.

Dedication

How do you pay tribute to your family?

Your parents' love, projected always, even when you're oblivious of it is something that is part of who we are. My parents' love and support is a major reason for any successes in my life. All that I owe cannot be repaid, but I hope to make you proud and honour you with who I am, who I become and all that I do.

With our siblings we run the race of life and they share in our experiences more than we know:

Nicky, you are a rock of strength – you've helped me limp through bad times and given me shelter and shade when I was weary. Your spirit inspires me.

Without knowing it, you've served as a role model in my life Andrew, as only a bigger brother can. I look forward to many years of friendship with you and Michaela.

I'm indebted to King Edward VII School in no small way,
it has been my second home for 10 years and has been a major portion of my life.
The ethos that has been instilled in me will be a part of me forever, and I hope
I've been able to pass that on to the boys at School House.

Acknowledgements

To Dr Wilcox, my Supervisor, I owe a great debt of gratitude. Thank you for sticking with me through changes in topic, even if they weren't in your area of interest. Your time and patience is appreciated more than you know. I wish you every success in times to come.

For your attention to detail, and solid advice I am truly grateful, Dr Moodley. I thank you for giving of your time to help me with this body of work.

Abstract

Very little information exists about the acute presentation of overuse injuries specific to cycling. Although there are studies, mainly in the form of surveys, that do detail the incidence and prevalence of overuse injuries in cyclists or triathletes, they all take place weeks or even months after events or focus on a 1 year injury history. (Weiss 1985, Korkia *et al.* 1994, Wilber 1995, Manninen and Kallinen 1996 and Salai *et al.* 1999)

The aim of this study was to describe the historical data obtained when patients presented to the Student Chiropractic Sports Council at the Pick ‘n Pay 94.7 Cycle Challenge from the years 2002 to 2004. The focus of the study was on the profile of injuries with which patients presented.

This was a descriptive study of historical data obtained by students treating at the Pick ‘n Pay 94.7 Cycle Challenge from the year 2002 to 2004. The data was acquired in the form of SOAP (Subjective, Objective, Assessment, Plan) notes held by the Student Chiropractic Sports Council.

The results of this study showed that the most common location of complaints were the anterior and posterior thigh. Musculotendinous strains were by far the most predominant injury with the hamstring being involved more commonly (33.8%) than any other muscle. Overall 72.8% of patients were diagnosed with musculotendinous strains.

Further, the results also showed that 55.8% of patients complained of eck or back pain and 59.7% were diagnosed with cervical facet joint, thoracic facet joint, lumbar facet joint or sacroiliac joint dysfunction.

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CHAPTER ONE – INTRODUCTION

1.1 INTRODUCTION

Cycling is a very popular form of aerobic exercise and recreation with millions of people riding bicycles worldwide. It does not require specialised skills and very basic equipment can be used. (Salai, Brosh, Blankstein, Oran and Chechik 1999)

The popularity of cycling has increased over the passed 25 years and is now included in many cardiovascular fitness programs. It is considered as a low-impact sport and is often used in rehabilitation after hip, knee and ankle surgery. (Derksen, Kepple and Miller 2004)

In the U.S.A. alone there are an estimated 100 000 000 cyclists (Lefever-Button 2001).

When high impact loading and weight-bearing activities are perceived to be contributing factors to injuries sustained, rather than giving up sports, activity modification is prescribed as part of non-operative treatment of the injury. Activities such as cycling are prescribed as it involves low-impact loading and improves muscle strength, joint motion and patient mobility. (Ho, Chan and Rolf 2001)

Cycling is a low impact activity that is perceived to be safe and harmless, however without proper supervision, equipment and the correct settings, cycling may be damaging and result in injuries (Carstens 1997).

Levefer-Button (2001) and Derksen *et al.* (2004) take the view that, in order to avoid and treat cycling injuries effectively the biomechanics of cycling need to be understood. In order to understand the biomechanics of cycling the interaction of the bicycle and the human body need to be appreciated (Derksen *et al.* 2004).

1.2 AIM OF THE STUDY

The aim of this study was to describe the historical data obtained when patients presented to the Student Chiropractic Sports Council at the Pick ‘n Pay 94.7 Cycle Challenge from the years 2002 to 2004. The focus of the study was the profile of injuries with which patients presented.

1.3 BENEFITS OF THE STUDY

By analysing the data available, this dissertation attempted to find out which complaints presented immediately after a 1 day cycling race.

This type of information, where injuries are analysed directly after an event, does not exist anywhere amongst the available literature. This study will begin to shed some light on the acute presentation of overuse injuries in cycling.

From the data obtained and a comparison to the literature review performed, the Chiropractic clinician, or any sports medicine practitioner, will be armed with the knowledge of the types of complaints that commonly present directly after a cycling event, their causes and how they may be prevented in future. Indeed, this information will be of benefit to any health care professional that has an interest in sports injuries.

CHAPTER TWO – LITERATURE REVIEW

2.1 MECHANICS OF THE BICYCLE

Lefever-Button (2001) stated that in order to better understand the sport and be able to successfully treat competitive and recreational cyclists, the bicycle itself has to be understood.

Through an awareness and utilisation of the different components of force, cadence and symmetry and by establishing and maintaining proper position while riding, both the recreational and competitive cyclist can reduce the chances of injury and improve their performance. Making the correct choice in terms of what type of bicycle to use is an important step in this process. (Lefever-Button 2001)

2.1.1 Anatomy of the Bicycle

The Microsoft Encarta Online Encyclopaedia (2005) stated that the basic components of a bicycle are: a frame, wheels with inflatable tyres, a seat or saddle, brakes, handlebars and a drive train (figure 1).

The drive train is the mechanism that propels the bicycle. It begins with the pedals which rotate the crankset which fit into the bottom bracket. Attached to the crank is the chainring which drives the chain, which in turn rotates the rear wheel via the rear sprockets. Between the chain and rear wheel may be the gearing systems, which vary the gear ratio and thus the number of rear wheel revolutions produced by each turn of the pedals. (Microsoft Encarta Online Encyclopaedia 2005)

Gears are comprised of the “crank set” and are located at the centre of the bike next to the right pedal arm and the “cluster” at the rear wheel on the right hand side. Clusters contain six to eight sprockets that gradually increase in diameter, the crank set is usually made up of 1 to 3 sprockets (called chain rings) with one larger than the other. The crank set and cluster are joined by the chain and gearing is manipulated by shifting the chain between combinations of crank and cluster levels. (Green, Johnson and Maloney 1999)

The vast majority of bicycles today have derailleurs that mechanically derail the chain, moving it from one set of sprockets to another and thus changing gears (Microsoft Encarta Online Encyclopaedia 2005).

Handlebars are used for balance and steering and are mounted above the front wheel on the head or fork tube. Handlebars may be flat or have "drops" where they are curved downwards at the ends; this allows the cyclist to assume several aerodynamic positions. Some bicycles have a further V shaped attachment called an aerobar on which the cyclist rests their forearms and crouches forward in a streamlined position. (Microsoft Encarta Online Encyclopaedia 2005)

Figure 1: The Structure of the Bicycle (Microsoft Encarta Online Encyclopaedia 2005)

Frames can be thought of as two triangles (figure 2). The chainstay, topstay, and seat tube make up the rear triangle. The front triangle is formed by the top tube, the seat tube, and the down tube. The angles within each of these triangles affect handling and maneuverability. (Asplund and St Pierre 2004)

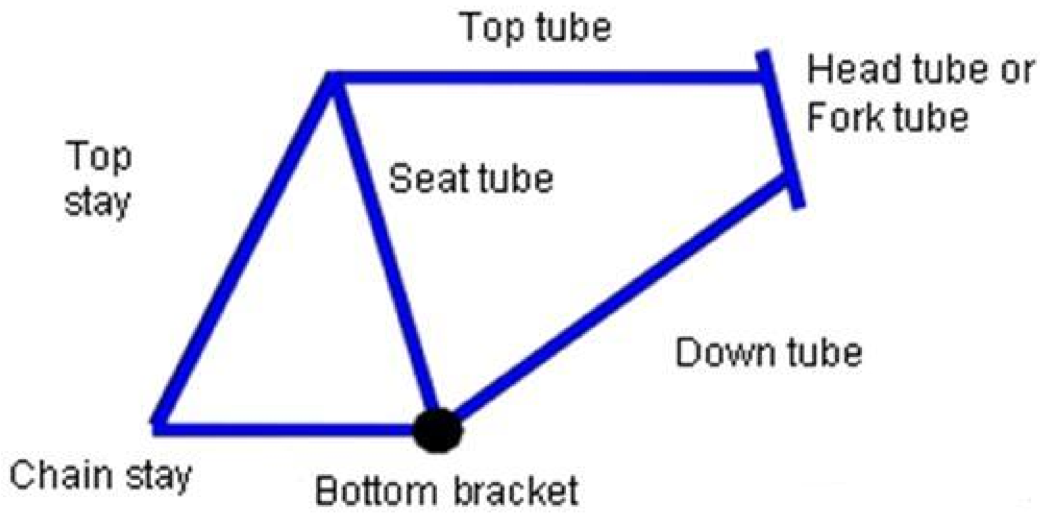

Figure 2: Diagram of a Bicycle Frame (Brain 2002)

Pedals are the link that transfer the force generated by the cyclist to the bicycle itself. Older bicycles had pedals that allowed the cyclist's foot to simply rest on the pedal, this allowed the cyclist to transfer force to the pedal only when pushing down on the pedal. (Microsoft Encarta Online Encyclopaedia 2005)

By fixing the cyclists' foot to the pedal, a mechanical advantage is gained by virtue of the fact that, not only can he or she push down on the pedal, but the cyclist can now pull the pedal up too. One of the means of doing this is by using a cleat: a permanent projection from the bottom of a special hard-soled cycling shoe that locks the foot onto the pedal. (Microsoft Encarta Online Encyclopaedia 2005)

"Clipless" or "cleatless" systems are now becoming popularised where there is a recessed attachment on the underside of the shoe and a clip on the pedal itself. The cyclist uses a twisting motion of the ankle to attach or un-attach themselves from the pedal. (Microsoft Encarta Online Encyclopaedia 2005)

The bicycle saddle is generally narrow so as not to interfere with the movement of the thighs during cycling. Adjustments to the saddle can be made by elevating or dropping the seat post in the seat tube, by sliding it forward or backwards on two rails attached to its frame and by raising or lowering the nose. (Microsoft Encarta Online Encyclopaedia 2005)

2.1.2 Types of Bicycles

There are four different types of bicycles according to Lefever-Button (2001): racing or road, mountain, touring and the hybrid type. All bicycles include the same components but each type has variations in their tyre types, geometry with relation to the angle the seat tube makes with the ground and the length of the various tubes. (Lefever-Button 2001)

Mountain bikes (figure 3) are designed to allow riding on uneven terrain (Gassner, Tuli, Emshoff and Waldhart 1999). Levefer-Button (2001) stated that mountain bicycles have a shallow frame angle (resulting in an upright riding position), wide tyres, and easy access to gear shift and brake levers on the flat handle bars.

According to Toumanov (2003) touring bicycles (figure 4) are designed for comfort over periods of weeks or even months. They have a moderately steep angle as opposed to a steep angle in racing bicycles; this makes the touring bicycle the best suited one for a comfortable but responsive and stable ride. Touring bicycles use wide tyres. (Lefever-Button 2001 and Asplund and St Pierre 2004)

Figure 3: Mountain Bicycle (Hoobly.com 2003)

Figure 4: Touring Bicycle (Harros Cyclery 2004)

Hybrid bicycles (figure 5) combine the comfort and responsiveness of mountain bicycles and the pace and light weight design of the racing and touring bicycles (Lefever-Button 2001 and Toumanov 2003). They give you a choice of drop or flat handle bars and semi-wide tyres (Lefever-Button 2001).

Figure 5: Hybrid Bicycle (Velocity 2005)

Racing bikes (figure 6) are designed for speed and comfort (Toumanov 2003). They are used by cyclists that participate in competitive racing, including triathlons, group riding or even riding for fitness. Racing bikes are characterised as being very responsive and lightweight. The frame angle is steeper on racing bikes than in sport or touring bikes. (Lefever-Button 2001 and Asplund and St Pierre 2004)

Figure 6: Racing Bicycle (Connondale Bicycle Corp. 2005)

2.2 BIOMECHANICS OF BICYCLING

Biomechanical analysis is not only important in maximising an athlete's performance, but also in the management and prevention of injury (Parks 1988a). Levefer-Button (2001) suggested that the best possible care can be given by linking the information about the bicycle and the cyclist.

In order to show how important the biomechanics of cycling are in treatment and prevention of injury, consider that a recreational rider might pedal at an average of 90 revolutions per minute (rpm). This means that in one hour of cycling that rider has completed 5400 revolutions, if a person cycles 5000 miles in a year – they will perform up to 1.5 million pedal revolutions. A typical professional cyclist might churn out up to 7.5 million pedal strokes in a year. It is surprising that there are not more overuse injuries reported amongst cyclists, given the high intensity and continuous motion achieved. (Derksen *et al.* 2004)

2.2.1 Basic Cycling Biomechanics

Derksen *et al.* (2004) explained that the energy created by the contraction of a cyclists muscles is transmitted through the lower limbs which exert a force onto the pedal which is transmitted to the crankset via the crank arm. The crankset moves the chain which attaches to the cluster which in turn produces rotation of the rear wheel.

The force the cyclist applies to the pedals must be greater than the forces of rolling resistance (friction force created by the tyres), wind resistance and gravity in order to accelerate the cyclist and bicycle (Levefer-Button 2001).

A complete crank cycle requires the crank arm to move through 360°, one complete rotation is described as a "stroke". This cycle of rotation can be divided into two phases: 0°-180° is phase 1, involves limb extension and is termed the propulsive phase. Phase 2 is 180°-360° is called the recovery phase and involves limb flexion. (Levefer-Button 2001 and Derksen *et al.* 2004)

When the pedal is at 0°, it is also referred to as Top Dead Centre (TDC) and 180° is called Bottom Dead Centre (BDC) (Mestdagh 1998 and Levefer-Button 2001).

The amount of motion through which the hip and knee joints move during each phase is shown in table 1, as is their total range of motion achieved during a cycling stroke. The ankle joint typically moves from 15° dorsiflexion to 20° of plantarflexion for a total of 35° of movement with maximum dorsiflexion at 50-70° of crank angle. (Levefer-Button 2001)

Table 1: A Description of the Motion Achieved by the Hip and Knee During Cycling (Levefer-Button 2001)

	Start phase 1 (end phase 2)	End phase 1 (start phase 2)	Total range of motion
Hip	71°	28°	43°
Knee	111°	37°	74°

Levefer-Button (2001) stated that during cycling the trunk of the cyclist is flexed to approximately 20-35° and the abdominal muscles and erector spinae muscles are contracting to hold this posture.

The muscles acting at different points within the cycle or stoke was set out by Derksen *et al.* (2004). The authors state that from the start of phase one (0°) the gluteus maximus and adductor magnus muscles work to extend the hip while the vastus medialis, vastus intermedius and vastus lateralis muscles extend the knee. From 90° the ankle begins plantar flexing through the action of the gastrocnemius and soleus muscles.

From 180° (phase two) the hip and knee are flexed, iliacus and psoas muscles act on the hip while the short head of biceps femoris muscle moves the knee. The ankle is dorsiflexed by tibialis anterior muscle from 270° of crank rotation. (Derksen *et al.* 2004)

Derksen *et al.* (2004) further stated that during the changeover from knee flexion to extension, the rectus femoris muscle reduces deceleration of the crank as does the hamstring muscle group during the extension-flexion transition.

According to Carstens (1997) the main power generators are the quadriceps muscle group as well as the gastrocnemius and soleus muscles.

2.2.2 Correct Bicycle Positioning

Burke (1994) held the view that the bicycle was adjustable and the cyclist, adaptable and that this was the main thought to remember when positioning a cyclist on a bicycle.

According to Mestagh (1998) in fit and healthy cyclists with no major anatomical abnormalities, upper extremity and neck injuries are related to handlebar positioning, and lower back and lower extremity injuries are related to saddle positioning; these injuries can be prevented with the correct bicycle settings and by adopting the right posture.

Saddle height and setback, shoe cleat position and crank length affect the ‘posture height’. ‘Posture length’ is determined by reach, handlebar level and handlebar width. By addressing both of these components of overall posture, correct adjustment of the bicycle will lead to correct posture on the bicycle. (Mestdagh 1998)

Saddle height:

With the pedal in the BDC position the knee should be extended to a maximum of 150° (Mestdagh 1998 and Levefer-Button 2001). At TDC the knee angle should not be less than 65° (Mestdagh 1998). Another method involves measuring the distance from the floor to the pubic symphysis and multiplying it by 1.06 to 1.09 - that is the height the seat is then set to (Levefer-Button 2001).

Saddle setback:

The ideal position in terms of saddle setback allows the posterior portion of the patella to be directly above the axle of the pedal (pedal spindle) with the crank arm at 90° (Mestdagh 1998). Levefer-Button (2001) claimed it is the axis of rotation of the knee (taken from the lateral femoral condyle) that should be above the pedal spindle.

Shoe cleat position:

The head of the first metatarsal should be positioned above the pedal spindle (Mestdagh 1998). Levefer Button (2001) confirmed this and adds that a neutral foot position should be used; this is accomplished by ensuring that the toes are not forced in or out.

Crank arm:

There is no clear consensus on how best to determine crank arm length and the most precise method would entail testing each cyclist ergonomically to determine the muscle fibre type of each cyclist. A rough guide is taken by measuring the inside leg length, anything less than or equal to 75cm uses a 16.5cm crank. For every 3cm added in leg length, 0.25cm is added to the crank length. (Mestdagh 1998)

Handlebars:

The height of the handlebars determines the amount of flexion occurring in the lumbar spine. To achieve an aerodynamic advantage the deepest possible position is ideal, however too deep a position will lead to lower back and neck pain. The back should be slightly lower than a 45° angle with the neck held in an extended position. (Mestdagh 1998 and Levefer-Button 2001)

2.2.3 Cadence and Gearing

The cyclist's cadence (crank arm revolutions per minute) and gearing should not be ignored. A combination of high gearing and low cadence increases the force placed on the knee and other joints and has a greater tendency to cause fatigue and lead to overuse injuries. (Green *et al.* 1999)

2.3 INJURIES

2.3.1 Brief Review of Microscopic Anatomy

In order to understand the pathological damage and the healing processes that take place at cellular level there must be a basic understanding of the microscopic structure of the muscle, tendon and ligament (Anderson and Hall 1995).

2.3.1.1 Microscopic Structure of Muscle

Muscle is one of the four main tissue types (Martini 2001). Skeletal muscle makes up about 40% of the total body weight (Guyton and Hall 2000).

Microscopically, skeletal muscle is composed of muscle fibres ranging from 10 to 100 micrometers in diameter (Moffett, Moffett and Schauf 1993, Simons, Travell and Simons 1999, Guyton and Hall 2000 and Martini 2001).

Muscle fibres are surrounded by a connective tissue covering called endomysium and arranged into bundles called fascicles. These fascicles are in turn surrounded by perimysium and grouped together to form the muscle itself. The entire muscle is surrounded by a further layer of connective tissue termed epimysium. (Figure 7) (Reid 1992, Moffett *et al.* 1993, Anderson and Hall 1995, Simons *et al.* 1999, Guyton and Hall 2000 and Martini 2001)

Muscle fibres are made up of smaller units called myofibrils which are 1-2 micrometers in diameter and extend for the entire length of the fibre. Myofibrils in turn are composed of light and dark myofilaments formed by actin and myosin. These myofibrils are responsible for the skeletal muscle contraction. (Reid 1992, Moffett *et al.* 1993, Anderson and Hall 1995, Simons *et al.* 1999, Guyton and Hall 2000 and Martini 2001)

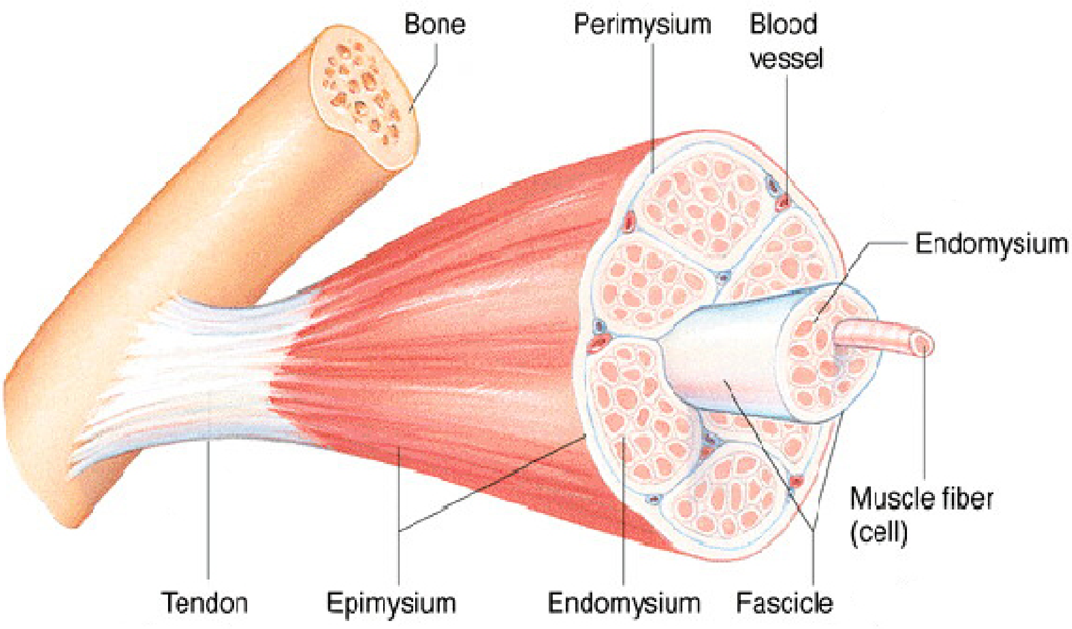

Figure 7: The Structure of Muscle (Online Anatomy and Physiology Resources 2003)

Muscle fibres are present for life; if they are irreparably damaged they are not replaced (Moffett *et al.* 1993, Simons *et al.* 1999, Guyton and Hall 2000 and Martini 2001).

Muscular injuries that cause major cell disruption lead to removal of those damaged cells and the production of non-contractile scar tissue. The fact that muscle cannot fully regenerate after significant injury without production of scar tissue means that healed muscle will be particularly susceptible to re-injury but correct treatment may lessen this risk. (Reid 1992)

2.3.1.2 Microscopic Structure of Tendons

Tendons are formed by the interweaving of the epimysium, the perimysium and the endomysium at the ends of the muscle fibres and are made up largely of connective tissue (Martini 2001). Tendons usually attach muscle to bone and so transfer any force generated by a muscle contraction to the bone (Reid 1992, Moffett *et al.* 1993, Anderson and Hall 1995 and Martini 2001).

Tendons are classed as dense, organised connective tissue (Reid 1992, Anderson and Hall 1995 and Martini 2001). Collagen is a flexible yet strong connective tissue fibre arranged in a linear fashion, predominantly parallel to the long axis of the muscle and almost entirely makes up tendons (Reid 1992, Moffett *et al.* 1993, Anderson and Hall 1995 and Martini 2001). Tendons also contain small amounts of elastin (Anderson and Hall 1995).

Tendons are arranged from the basic unit of the fibril which are grouped into fascicles which in turn form the tendon itself. The tendon can be covered by a paratendon or a synovial sheath. (Reid 1992)

As with muscle, the repair process of tendons involves the laying down of collagenous scar tissue. The orientation of the fibres within the scar is not as organised as those in the tendon itself, which leads to a decreased overall structural integrity of the repaired tendon. (Reid 1992)

2.3.1.3 Microscopic Structure of Ligaments

Ligaments are also classed as dense, regular connective tissue and are made up primarily of collagen fibres (Reid 1992, Moffett *et al.* 1993, Anderson and Hall 1995 and Martini 2001). More elastin is found in ligaments than in tendons, resulting in the fact that ligaments are more elastic than tendons (Anderson and Hall 1995).

As in tendons, the fibres in ligaments are arranged in a parallel fashion, although they are also intertwined with each other. This allows the ligament to withstand large tensile forces along its axis and also smaller forces from different directions. (Anderson and Hall 1995)

The repair process of ligaments is the same as was described under tendons and bears out the same result, that of decreased strength with increased scar tissue formation (Reid 1992).

2.3.2 Classification of Cycling Injuries by Aetiology

Cycling injuries can be divided into two groups according to the cause of the injury: the first category is termed a direct injury and is caused by blunt trauma or a collision with an object. The second is called an indirect injury and is caused by overuse. (Schwellnus and Derman 2000a and Lefever-Button 2001)

Schwellnus and Derman (2000a) state that the following aetiological classification of acute muscle injuries is generally accepted:

a) Direct injuries: follow blunt trauma and are more common in contact sports (for example, muscle contusions).

b) Indirect injuries: further divided into

- Acute – these injuries arise with sudden overloading of the musculotendinous complex (for example, sprinting).
- Overuse or chronic – follows recurring overload and/or frictional resistance, very common in sports that involve repetitive actions (for example, running, cycling and swimming).
- Acute on chronic – Occurs when there is sudden failure of a previously weakened structure (for example, strain of a muscle where there was a pre-existing musculotendinous injury).

The American Academy of Orthopaedic Surgeons (2000) defined a strain as: "a twist, pull and/or tear of a muscle and/or tendon." Acute strains could be caused by excessive muscle contraction, a direct blow to the body, prolonged repetitive movement or overstretching. (American Academy of Orthopaedic Surgeons 2000).

The American Academy of Orthopaedic Surgeons (2001) stated that predisposing factors to muscle strains include:

- Muscle fatigue – this reduces the energy absorbing ability of muscles
- Poor conditioning – weaker muscles are unable to handle abnormal stress
- Muscle imbalance – between agonist/antagonist
- Muscle tightness
- Insufficient warm-up – warm-up increases the range of motion

Collisions and accidents tend to result in injuries to the upper extremities while overuse injuries tend to involve the upper extremity in older cyclists and the lower extremity in younger ones (Lawson 1997).

Tendonitis, bursitis, chronic stretching of ligaments, stress reaction and stress fracture of bone are all sequalae of overuse and are thus termed overuse syndromes (Reid 1992).

2.3.3 Classification of Soft Tissue Injuries by Grading Severity

According to Anderson and Hall (1995) muscle or tendon strains and ligament sprains result in rupturing of the tissue and, if severe enough, haemorrhage and swelling.

General signs of muscular or tendinous strain include pain, muscle weakness and spasm, inflammation and cramping (American Academy of Orthopaedic Surgeons 2000).

The degree of tissue rupturing or tearing and its resultant effects are classified into three grades (table 2) (Reid 1992, Schwellnus and Derman 2000a and Magee 2002).

2.3.4 Overuse Injuries in Cycling

Injuries resulting from repetitive actions of the body's joints and soft tissue are the most common risks related to exercise (Wilber, Holland, Madison and Loy 1995).

A report on 155 British triathletes said that overuse was the causative factor in injury in 41% of cases (Korkia, Tunstall-Pedoe and Maffulli 1994).

Causes of overuse injuries in cycling include those secondary to repetitive microtrauma as a result of incorrect settings, biomechanical misalignment, poor bike fit or bad cycling technique, poor training methods such as sudden changes in an exercise programme or insufficient warm-up or cool-down (Carstens 1997, Lefever-Button 2001 and Derksen *et al.* 2004).

Table 2: **Classification of Muscle, Tendon and Ligament Injury by Severity**

Grade	Clinical Presentation	Pathology	Related Factors
Grade I (Mild)	• Mild pain when injury occurs or within 24 hours [2] • Mild tenderness (if present) on palpation and localised [2] • Pain when structure stressed [2,3]	• Minimal structural damage and resultant haemorrhage [1] • Only microscopic disruption of muscle, ligament or tendon fibres (few fibres torn) [2,3] • Early resolution [1]	• Sudden contraction, overload or overstretch.[1,3] • Eccentric contraction [1] • Poor warm-up [1] • Poor flexibility [1]
Grade II (Moderate)	• Pain present during activity [2,3] • Moderate tenderness to palpation [2] • Moderate to severe pain when structure is stressed [1,2,3]	• Partial tear (roughly half of fibres torn) [2,3] • Macroscopic, partial disruption apparent [2] • Further haemorrhage [1,3] • Added resultant scarring [1] • Functional deficit [1,3]	• As for Grade I [1,2,3] • Crushing mechanism of injury [3]
Grade III (Severe)	• Severe pain [1,2,3] • Palpable defect [2,3] • Moderate to severe loss of function [2,3] • May be painless when structure is stressed. [2,3]	• Complete or near complete tear or avulsion [1,2,3] • Large spectrum of injury [1] • May necessitate aspiration and/or surgery [1]	• As Grade I [1,2,3] • Previous injury [1] • Collagen disease [1] • Steroid use [1]
1 – Reid (1992) 2 – Schwellnus and Derman (2000a); 3 – Magee (2002)			

The aetiology of overuse injuries can be divided into intrinsic and extrinsic factors (Lefever-Button 2001). Table 3 contains a summary of these factors.

Table 3: Aetiology of Overuse Cycling Injuries (Lefever-Button 2001)

Category	Factors	Examples
Intrinsic	• Biomechanical factors	Genu valgum, genu varum, forefoot varus, forefoot valgus, leg length discrepancies.
Extrinsic	• Poor training methods	Sudden changes in training time, distance or intensity.
	• Improper Cyclist-Bicycle Fit	Saddle height, saddle fore/aft position, crank arm length, handle bar height, frame size.
	• Riding Technique	Incorrect posture, locked elbows, flared knees.

Holmes, Pruitt and Whalen (1994) stated that overuse injuries related to cycling can be linked to the contrast between the symmetrical design of the bicycle and the asymmetric deviations produced by the body (that is tendons and muscles receiving unusually focussed stress loads). The high number of repetitions involved in cycling in comparison to other sports and the fact that newer equipment fixes the cyclist to the bike also contributes to overuse injuries (Holmes *et al.* 1994).

These overuse injuries are common in both recreational and professional cycling and, over time, can lead to longer breaks in training and competition than traumatic injuries (Temme, Riepenhof and Henche 2003).

In a survey of 440 amateur cyclists who were asked to complete a 1 year injury history by Wilber *et al.* (1995), it was reported that severe overuse injuries caused cyclists to stop cycling for a mean of 43 days. Symptoms of overuse injuries severe enough to warrant medical treatment persisted for a mean of 3.7 months.

The authors further detailed an overall incidence of one or more overuse injuries at any time in the past as 85%.

Temme *et al.* (2003) found that the most common overuse injuries in cycling were diagnosed as tendinosis of either the quadriceps or achilles tendons, or lower back pain.

2.3.4.1 The Knee

Subotnick (1989) cited knee pain as the most common complaint in cyclists and further reported that the knee accounts for 25% of the reported cycling injuries.

Wilber *et al.* (1995) differed from the previous authors in that knee pain was said to be the second most common complaint behind neck stiffness or soreness.

Schwellnus and Derman (2000b) stated that 70-80% of all overuse injuries in cycling involve the knee and went on to say that overuse injuries in sport most frequently present with anterior knee pain.

Lefever-Button (2001) and Derksen *et al.* (2004) concurred with Subotnick (1989) and Schwellnus and Derman (2000b) and rated knee pain as the most common complaint in cycling.

The knee complex (figure 8) is not very mechanically sound based on its osteological incongruity and it relies on accessory ligaments and menisci to reinforce it (Moore 1992, Anderson and Hall 1995 and Martini 2001).

There are three articulations which make up the knee joint: the patellofemoral joint and the medial and lateral tibiofemoral joints (Moore 1992, Anderson and Hall 1995 and Martini 2001).

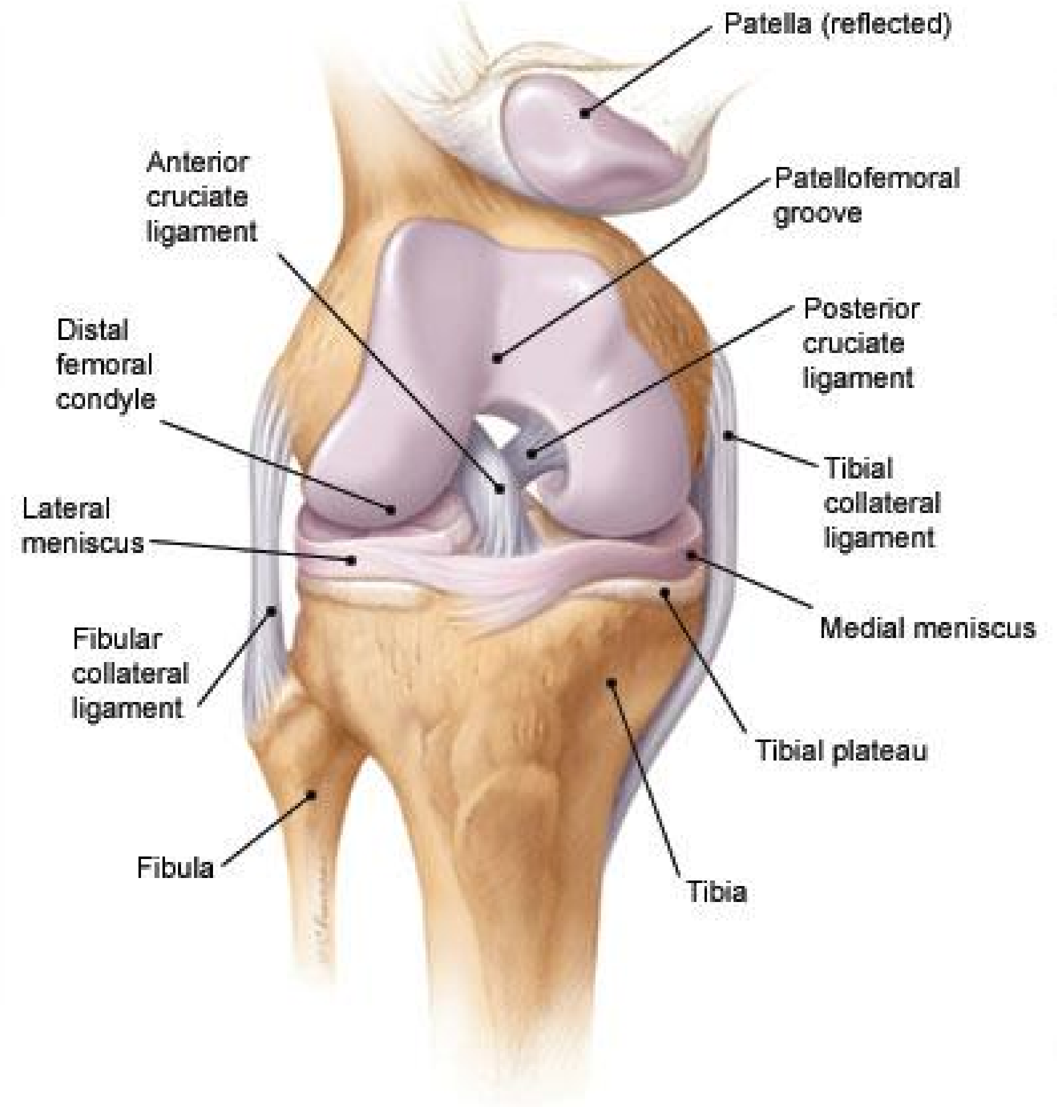

Figure 8: The Knee Joint (Tandeter and Shvartzman 2003)

The distal portion of the femur forms two condyles (medial and lateral) that are convex anteroposteriorly and mediolaterally. These condyles are separated by an intercondylar fossa, however the anterior aspect of each condyle is bridged by the patellar surface. The medial femoral condyle is slightly larger than the lateral condyle. (Levangie and Norkin 2001)

Two condyles (medial and lateral) are also formed on the proximal tibia, each with an articulation surface or plateau. These condyles are separated by intercondylar tubercles and the medial tibial condyle is larger than its lateral counterpart. (Levangie and Norkin 2001)

The corresponding condyles of the distal femur and proximal tibia articulate to form the tibiofemoral joint (Moore 1992, Anderson and Hall 1995 and Martini 2001).

The congruity of the tibiofemoral joint is greatly improved by the presence of two fibrocartilagenous crescents called menisci. These menisci are accessory structures within the joint, one medially and one laterally. They are wedge shaped in cross-section and serve to disseminate the forces of weight-bearing, decrease joint friction and absorb shock. (Levangie and Norkin 2001)

The muscles acting across the knee (table 4 and figure 9) bring about flexion and extension of the joint and to a lesser degree medial and lateral rotation also occurs. The anterior muscles, the quadriceps, made up of rectus femoris, vastus medialis, vastus lateralis and vastus intermedius muscles, extend the leg at the knee. The biceps femoris, semimembranosus and semitendinosus muscles all flex the leg at the knee and compose the hamstring muscle group. (Levangie and Norkin 2001)

The patella is a sesamoid bone formed within the quadriceps tendon. It is triangular in shape and has 2 (or sometimes 3) articular facets on its posterior surface that meet the anterior portion of the distal femur at the patellofemoral joint. (Levangie and Norkin 2001)

The patella improves the mechanical advantage of the quadriceps muscle group by increasing the angle of pull of the patella tendon on the tibia (Anderson and Hall 1995).

Levangie and Norkin (2001) stated that the patellofemoral joint is the least congruent joint in the body.

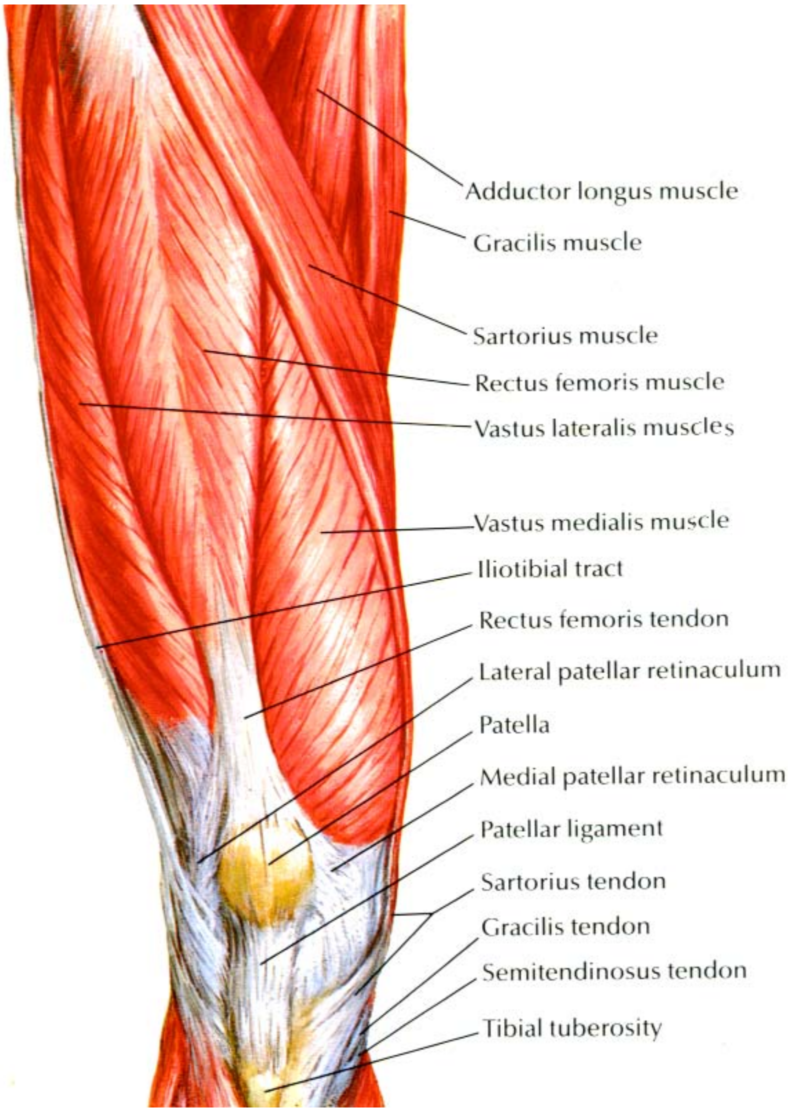

Figure 9: Anterior View of the Thigh and Knee (Netter 1989)

In light of this fact, it is no surprise then that the region most commonly associated with anterior knee pain is the patellofemoral joint (Anderson 2003).

Henry (2004) concurred with Levangie and Norkin (2001) with regard to the congruency of the knee patellofemoral joint. This fact predisposes the anterior portion of the knee to many injuries and it is no surprise that patellofemoral pain is one of the most common knee problems seen in a physician's office (Henry 2004).

Table 4: Anatomy of the Main Muscles Acting Across the Knee (Travell and Simons 1999)

Muscle	Proximal Attachment	Distal Attachment	Innervation	Action
Rectus Femoris	Anterior inferior iliac spine of pelvis and groove above the acetabulum	Via quadricep tendon to proximal patella and via patella tendon to tibial tuberosity of tibia	Femoral nerve, $L_{2\text{-}4}$	Flexion of thigh at hip, extension of leg at knee
Vastus Medialis	Entire length of posteromedial surface of shaft of femur	Via quadriceps tendon and patella to tibial tuberosity of tibia by patella ligament	Femoral Nerve. $L_{2\text{-}4}$	Extension of the leg at the knee
Vastus Intermedius	Anterolateral surface of the femur			
Vastus Lateralis	Entire length of posterolateral surface of shaft of femur			
Biceps Femoris	Long head: ischial tuberosity Short head: Posterior middle ⅓ of linea aspera of femur	Below knee to lateral, posterior aspect of tibia	Long head: tibial portion of sciatic nerve $S_{1\text{-}3}$ Short head: peroneal portion of sciatic nerve L_5-S_2	Long head: Extension and lateral rotation of thigh at hip Both heads: Flexion and lateral rotation of leg at knee
Semitendinosus	Ischial tuberosity	Medial surface of tibia distal to tibial condyle as part of "pes anserinus"	Tibial portion of sciatic nerve, L_5-S_2	Extension of thigh at hip, flexion and medial rotation of leg at knee
Semimembranosus		Posteromedial surface of medial condyle of tibia		

Powers, Ward, Chen, Chan and Terk (2004) went further and said that patellofemoral pain is one of the most predominant problems of the lower extremity.

Bicycling is often used in preference to running in the rehabilitation of knee disorders since, biomechanically the patellofemoral reaction forces are 5 times lower in cycling when compared to running (Lawson 1997).

Eisele (1991) stated that knee pain may be attributed to patellar tendonitis, bursitis, quadriceps myotendinitis or more commonly chondromalacia patella. Travell and Simons (1999) stated that iliotibial tract friction syndrome also causes tenderness and pain at the lateral aspect of the knee. Patellofemoral pain is a frequent source of knee pain and is often mistakenly called chondromalacia patella (Schwellnus and Derman 2000b).

Derksen *et al.* (2004) took the view that the knee is hardly ever the principal cause of the injury, rather that the joints directly proximal and distal to the knee and leg length differences attribute to knee injuries

Increased stress on the knee can be caused through two mechanisms. The first is related to incorrect positioning and settings on the bicycle: if the saddle or seat is set too low and the resulting angle at the knee is greater than 30° of flexion when the peddle is in BDC then the increased flexion at the knee increases patellofemoral joint forces (Cipriani, Swartz and Hodgson 1998). Derksen *et al.* (2004) stated that the angle of the knee in BDC must not be greater than 25°.

Results of a low saddle include popliteus tendonitis, plica syndrome, chondromalacia patella, inflammation of the medial patellofemoral ligament and patellar tendonitis (Derksen *et al.* 2004).

If the saddle is too high the knee has to fully extend which may cause locking of the knee, in addition the knee flexors will not be functioning optimally and will become unduly fatigued, predisposing them to strains (Mestdagh 1998). Conditions associated with knee pain that are caused by a saddle set too high are pes anserine tendonitis/bursitis, iliotibial band syndrome and biceps femoris tendonitis. (Derksen *et al.* 2004).

The second mechanism occurs when the cyclist pedals at a lower cadence for extended periods, this means a heavier gear has to be used and more power has to be generated by the quadriceps muscles and transferred across the knee to complete each revolution. The increase in force across the knee increases the patellofemoral joint force and may lead to patellofemoral pain syndrome. (Cipriani *et al.* 1998 and Schwellnus and Derman 2000b)

Travell and Simons (1999) defined patellofemoral dysfunction as "anterior knee pain coming from the patellofemoral articulation without any gross abnormality of the articular cartilage of the patella. The pain is attributed to abnormal tracking of, or pressure on, the patella".

Patellofemoral pain syndrome is caused by a combination of factors which can be divided into intrinsic and extrinsic factors. Intrinsic factors are those that are genetic or acquired and extrinsic factors are usually training or equipment errors (Schwellnus and Derman 2000b). Examples of intrinsic and extrinsic factors are listed in table 5.

Derksen *et al.* (2004) attributed patellar tendonitis to riding in too hard a gear or riding too far with inadequate training or excessive hill training.

Another injury cited in the literature presents as tendonitis along the superior border of the patella, is was termed quadriceps tendonitis or tendinopathy or spring knee, and this was attributed to the very aggressive rides cyclists carry out in the spring months in the northern hemisphere. The cold weather of this season may be a contributing factor. (Travell and Simons 1999, Schwellnus and Derman 2000b and Derksen *et al.* 2004)

Table 5: Factors Contributing to Patellofemoral Pain Syndrome (Schwellnus and Derman 2000b)

Intrinsic Factors	1. Leg length discrepancy 2. Abnormal tracking or stress on the patella 3. Increased Q angle 4. Vastus medialis weakness 5. Genu valgus 6. Rearfoot valgus 7. Forefoot varus
Extrinsic Factors	1. Sudden increases in distance or duration of training 2. Use of heavy gears 3. Cleat or shoe abnormalities 4. Incorrect saddle height 5. Hill training

Iliotibial band (friction) syndrome is an overuse injury more common in runners but seen frequently in cyclists (Holmes, Pruitt and Whalen 1993). Is it caused by repetitive friction of the iliotibial band across the lateral femoral condyle (Holmes *et al.* 1993 and Travell and Simons 1999). Derksen *et al.* (2004) stated that iliotibial band syndrome can be caused by improper cleat positioning and a saddle that is set too high.

2.3.4.2 The Hip, Thigh and Buttocks

The fact that the hip has a very secure bony anatomy means that injuries to this region are not as common as those occurring in other lower extremity joints (Anderson and Hall 1995). The nearly entire osseous socket of the hip joint supported by the large, strong ligaments, robust articular capsule and muscular padding further reinforce the stable osteology of this region. (Anderson and Hall 1995 and Martini 2001)

Weiss (1985) reported that 32.8% of amateur cyclists in a 500 mile, 8 day bicycle tour complained of buttock pain, it was the most common non-traumatic injury.

Wilber *et al.* (1995) in their questionnaire based study of 440 recreational cyclists ranked buttock pain as the third most common site for overuse injuries while hip complaints were eleventh.

According to Green *et al.* (1999) overuse injuries of the hip and buttocks in cycling were rare and as a result of this were not well documented in literature.

The primary function of the hip joint is not to move the foot through space but is to bear the weight of the head, arms and trunk (Levangie and Norkin 2001).

The osteology of the hip joint is composed of the articulation of the head of the femur with the acetabulum of the pelvis (Moore 1992, Anderson and Hall 1995 and Levangie and Norkin 2001).

The acetabular fossa is deep and this affords the hip joint substantial stability (Anderson and Hall 1995). The stability of the hip is further improved by the presence of the acetabular labrum, a fibrocartilage ring that covers the entire perimeter of the acetabulum. This labrum deepens the acetabular socket and also increases the concavity of the acetabulum. (Levangie and Norkin 2001 and Martini 2001).

The femur (thigh bone) is the longest, heaviest and strongest bone in the body (Moore 1992, Martini 2001 and Levangie and Norkin 2001). The head of the femur articulates with the acetabulum at the hip joint and femoral condyles meet the tibia at the knee joint (Moore 1992 and Martini 2001).

The head of the femur forms two thirds of a sphere. Near the centre of the head is the fovea capitis into which the ligament of the head of the femur attaches. (Moore 1992, Martini 2001 and Levangie and Norkin 2001)

The joint capsule adds significantly to the stability of the hip joint as do the ligaments of the hip (Anderson and Hall 1995, Martini 2001 and Levangie and Norkin 2001).

The muscles of the thigh (table 6) fall into three main categories based on their actions, location and innervation; namely anterior, medial and posterior. Another group of muscles that act across the thigh are those located in the gluteal region (figure 10), which is located posterior to the pelvis. (Moore 1992)

The anterior muscle group is made up of the iliopsoas, sartorius, quadriceps femoris (composed of the rectus femoris, vastus medialis, vastus lateralis and vastus intermedius muscles) and tensor fascia latae muscles (Moore 1992).

The medial muscles of the thigh are the pectinius, the adductor longus, adductor magnus and adductor brevis, the gracilis and the obturator externus muscles. Their main function is adduction of the thigh. (Moore 1992)

In the posterior thigh are located the hamstring group of muscles. This group is composed of the semimembranosus, semitendinosus and biceps femoris muscles. Their main functions are extension of the thigh at the hip and flexion at the knee. (Moore 1992)

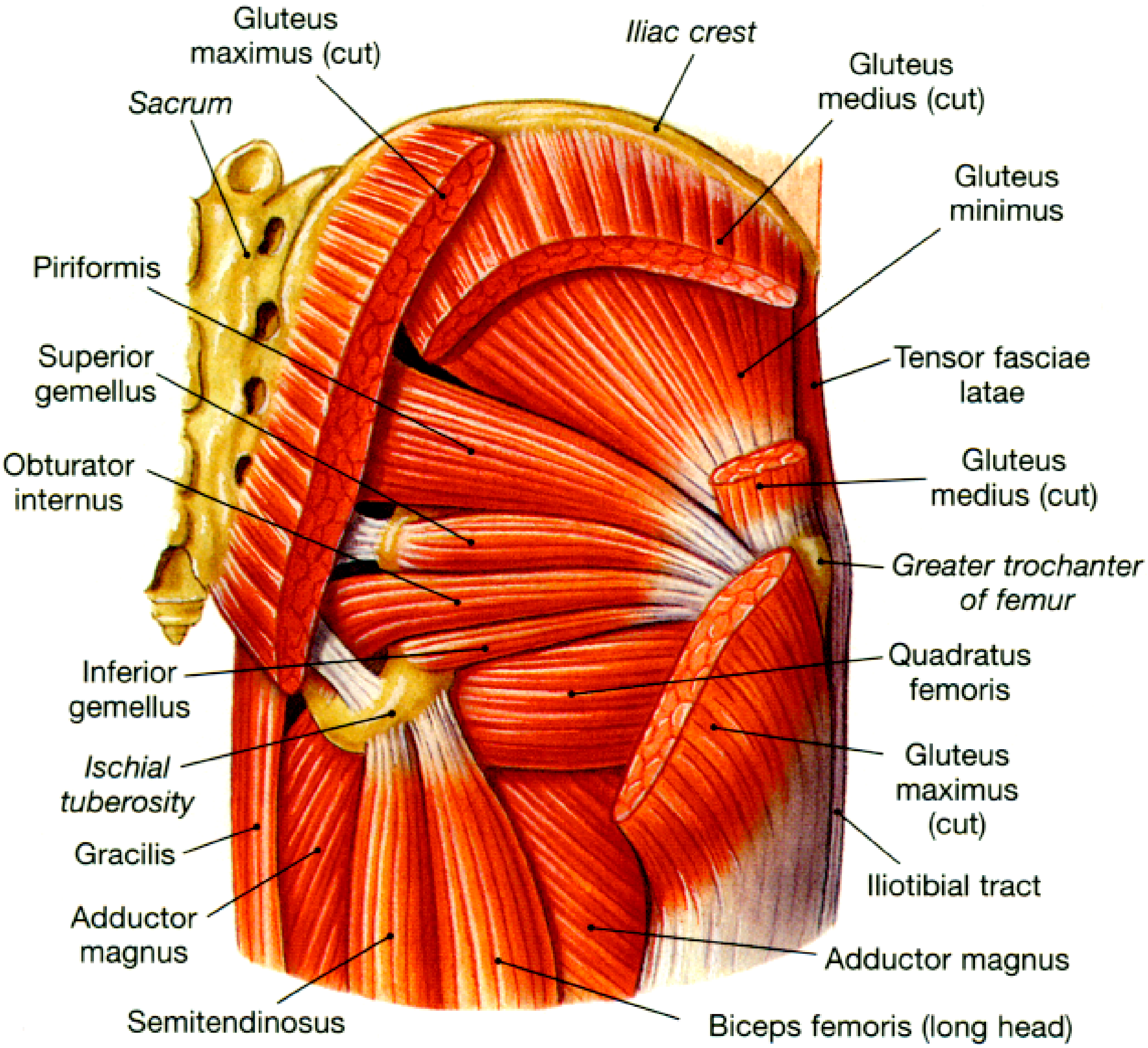

Figure 10: Posterior View of Gluteal Region (Martini 2001)

Gluteus maximus, medius and minimus muscles as well as the piriformis, obturator internus, quadratus femoris and superior and inferior gemelli muscles are all gluteal muscles. The large gluteal muscles are mainly abductors and extensors of the thigh at the hip joint while the remaining gluteal muscles are lateral rotators of the thigh at the hip joint (Moore 1992).

Table 6: Anatomy of the Main Muscles that Act Across the Hip Joint (Travell and Simons 1999)

Muscle	Proximal Attachment	Distal Attachment	Innervation	Action
Iliacus	Upper ⅔ of the iliac fossa	Via common tendon to the lesser trochanter of femur	Branches of lumbar plexus from $L_{2,3}$	Flexion of the thigh at hip, may assist in abduction and external rotation of thigh
Psoas	Along sides of lumbar vertebrae and intervertebral discs		Branches of Lumbar plexus L_{2-4}	Flexion of the thigh at hip, may assist in abduction and external rotation of thigh. Assist extension of lumbar spine
Rectus Femoris	Anterior inferior iliac spine of pelvis	Via quadricep tendon to proximal patella and via patella tendon to tibial tuberosity of tibia	Femoral nerve, L_{2-4}	Flexion of thigh at hip, extension of leg at knee
Sartorius	Anterior superior iliac spine of pelvis	Medial surface of body of tibia, part of "pes anserinus"	Femoral nerve, $L_{2,3}$	Assist hip and knee flexion. Hip abduction and Lateral rotation.
Tensor Fascia Latae	Anterior iliac crest to anterior superior iliac spine.	Via iliotibial band (ITB) to lateral tubercle of tibia, via tendinous fibres to lateral patellar retinaculum	Superior gluteal nerve, L_4-S_1	Assists stabilisation of pelvis. Flexion, abduction and medial rotation of thigh.
Adductor Longus	Lower borders of pubic ramus and ischial ramus to ischial tuberosity	Linea aspera on middle ⅓ of femur	Anterior division of obturator nerve, L_{2-4}	Adduction, flexion and medial rotation of thigh at hip
Adductor Brevis		Linea aspera, lateral to and behind adductor longus		
Adductor Magnus		Linea aspera from below lesser trochanter to adductor hiatus and medial condyle of femur.	Anterior division of obturator nerve, L_{2-4}. Sciatic nerve L_4-S_1	Adduction, flexion and medial rotation of thigh at hip.
Gracilis	Lower rim of pelvis at junction of body of pubis and inferior pubic ramus	Medial surface of tibia distal to tibial condyle as part of "pes anserinus"	Anterior division of obturator nerve, $L_{2,3}$	Adduction and flexion of thigh at hip. Assists flexion of knee.

Pectinius	Crest of superior ramus of pubic bone	Pectinial line on medial posterior aspect of femur	Femoral nerve, L_{2-4}	Adduction and flexion of thigh at hip.
Obturator Externus	Outer surface of obturator membrane	Greater trochanter of femur	Obturator nerve $L_{3,4}$	Lateral rotation of thigh at hip
Gluteus Maximus	Posterior iliac crest, lateral sacrum and coccyx	Iliotibial band and gluteal tuberosity of femur	Inferior gluteal nerve L_5-S_2	Extension and lateral rotation of thigh at hip
Gluteus Medius	Anterior ¾ iliac crest	Greater trochanter of femur	Superior gluteal nerve L_4-S_1	Abduction of thigh at hip, stabilisation of pelvis
Gluteus Minimus	Outer surface of pelvis between anterior and inferior gluteal lines	Greater trochanter of femur	Superior and inferior gluteal nerves L_5-S_1	
Piriformis	Inner surface of sacrum	Greater trochanter of femur	$S_{1,2}$	Lateral rotation of thigh at hip (hip extended); Abduction of thigh at hip (hip flexed 90°)
Biceps Femoris	Long head: ischial tuberosity Short head: Posterior middle ⅓ of linea aspera of femur	Below knee to lateral, posterior aspect of tibia	Long head: tibial portion of sciatic nerve S_{1-3} Short head: peroneal portion of sciatic nerve L_5-S_2	Long head: Extension and lateral rotaton of thigh at hip Both heads: Flexion and lateral rotation of leg at knee
Semitendinosus	Ischial tuberosity	Medial surface of tibia distal to tibial condyle as part of "pes anserinus"	Tibial portion of sciatic nerve, L_5-S_2	Extension of thigh at hip, flexion and medial rotation of leg at knee
Semimembranosus		Posteromedial surface of medial condyle of tibia		

Muscles that cross more than one joint are particularly susceptible to strain. Since all 3 muscles of the hamstring group cross both the hip and knee joints (with the exception of the short head of the biceps femoris), while only the rectus femoris muscle of the quadriceps muscle group does the same, the hamstring group is at a higher risk of strain when compared to the quadriceps muscle group. (American Academy of Orthopaedic Surgeons 2000)

Anderson (2003) stated that the most commonly strained muscles in the body are the hamstrings.

2.3.4.3 The Achilles Tendon

The Achilles tendon is the common tendon that serves to attach the gastrocnemius and soleus muscles to the calcaneus (Moore 1992 and Martini 2001). (See table 7)

Wilber *et al.* (1995) ranked the Achilles as the anatomical location least affected by overuse injury in cyclists while Cipriani *et al.* (1998) and Temme *et al.* (2003) rated Achilles tendonitis as one of the most common diagnoses of overuse injuries in cycling.

Achilles tendonitis usually develops with excessive plantar flexion of the foot and ankle associated with pedalling on the toes, which occurs when the cleat is placed distally to the ball of the foot (Derksen *et al.* 2004).

Table 7: Anatomy of the Muscles Attaching to the Achilles Tendon (Travell and Simons 1999)

Muscle	Proximal Attachment	Distal Attachment	Innervation	Action
Gastrocnemius	As two heads to distal femur	Via tendo calcaneous (Achilles tendon) to posterior surface of calcaneous	Medial Popliteal and Tibial nerves. $S^{1,2}$	Plantar flexion of foot at ankle, contribute to stabilisation of knee
Soleus	Posterior head and middle ⅓ of fibula, middle ⅓ of tibia and tendinous arch in between.		Tibial nerve. $S^{1,2}$	Plantar flexion and inversion of foot at ankle

Carstens (1997) suggested that patients who have achilles tendonitis should not pull up on the pedal during the recovery phase (phase 2) since this causes the foot to dorsiflex and increases the tension on the achilles tendon.

2.3.4.4 The Lumbar Spine

Wilber *et al.* (1995) found that back pain affected 30% of cyclists and was characterised by lower back discomfort.

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In a study of 92 triathletes Manninen and Kallinen (1996) concluded that cycling is a major risk factor for low back pain and that it could possibly be of a serious nature. The same study noted that 32% of respondents suffered from lower back pain in the preceding year.

Salai *et al.* (1999) reported that the incidence of back pain (cervical, dorsal or lumbar) in cyclists was between 30-70% and that the actual incidence of back pain as a result of cycling is probably much higher. The authors also stated that back pain is a common cause for cyclists to give up cycling completely (Salai *et al.* 1999).

The lumbar spine is composed of five adjacent vertebrae that articulate with the twelfth thoracic vertebra above and the sacrum below (Reid 1992, Moore 1992 and Martini 2001). The lumbar vertebrae have to bear the largest load of any vertebrae (Martini 2001). At the same time the lumbar region is responsible for a considerable portion of spinal motion (Reid 1992).

The sacrum is made up of five fused vertebrae and is wedge or triangular in shape, the base is formed by the superior surface and the apex is the narrow, inferior segment. The fused segments are curved with an anterior concavity. (Moore 1992 and Martini 2001)

The lower half of the sacrum is non-weight bearing and so, much smaller than the upper half. The body weight received by the sacrum from the lumbar vertebrae is transmitted to the pelvic girdle through the sacro-iliac joints at the auricular surfaces located laterally on the sacrum. (Moore 1992)

There is extensive muscle attachment onto the posterior surface of the sacrum and to the lumbar vertebrae. These muscles act across the lower back and the hip (Martini 2001). (see table 8)

The coccyx is the embryological remnant of the tail and is usually made up of four vertebral segments. These segments are usually fused together late in adulthood and may fuse to the sacrum during old age. (Martini 2001 and Moore 1992)

The coccyx serves as a muscle and ligament attachment site but plays no part in weight bearing (Moore 1992).

The pelvic ring is the fusion of the ilium, the pubis and the ischium and their articulation with the sacrum and the coccyx. The ilium, ischium and pubis all meet at the cup-shaped acetabulum which articulates with the head of the femur. (Moore 1992 and Martini 2001)

The major force acting in the sagittal plane on the anterior lumbar spine of a cyclist is a tensile one, acting chiefly on the anterior longitudinal ligament (Salai *et al.* 1999). This force is caused in part by the anatomical extension between the spine and pelvis (Salai *et al.* 1999). Being in an extended position exposes the lumbar spine and hamstrings to increased strain (Lefever-Button 2001).

Schofferman (2004) stated that the primary cause of lower back pain in cyclists are the facet joints, the lumbar intervertebral discs and the sacroiliac (SI) joints. Of secondary concern and not rated as an independent cause of lower back pain are the muscles.

In cyclists not maintaining the lumbar lordosis by flexing the lower back and not the hips, there is an increased stress on the posterior annulus of the intervertebral disc. Since the disc is nocioceptive, this may result in pain that could be aggravated by road vibrations. (Schofferman 2004).

Table 8: Anatomy of the Lumbar Extensors

<table>
<tr><th>Muscle</th><th>Proximal Attachment</th><th>Distal Attachment</th><th>Innervation</th><th>Action</th></tr>
<tr><td>Quadratus Lumborum</td><td>12th rib, transverse processes L_{1-4} [2]</td><td>Crest of ilium, iliolumbar ligament, transverse processes $L_{2-4/5}$ [2]</td><td>Adjacent thoracolumbar spinal nerves $T_{12-L4/5}$ [2]</td><td>Bilaterally: extension and stabilisation of lumbar spine Unilaterally: lateral flexion of lumbar spine, hike hips [2]</td></tr>
<tr><td>Iliocostalis Lumborum</td><td>Inferior surface ribs 5-12 [4]</td><td>Iliac crest, sacral crests and inferior lumbar spinous processes [1,4]</td><td>Dorsal ramus of inferior thoracic and lumbar spinal nerves [4]</td><td rowspan="2">Bilaterally: Extension and stabilisation of lumbar spine Unilaterally: lateral flexion of lumbar spine [1]</td></tr>
<tr><td>Longissimus Thoracis</td><td>Broad aponeurosis, transverse processes or inferior thoracic and superior lumbar vertebrae[3,4]</td><td>Transverse processes all thoracic vertebrae, tubercles of inferior 9/10 ribs [1,3]</td><td rowspan="3">Dorsal ramus adjacent thoracic and lumbar spinal nerves [2]</td></tr>
<tr><td>Multifidus</td><td rowspan="2">Spinous process thoracic and lumbar vertebrae[3,4]</td><td>Transverse processes 2-4 segments inferiorly and sacrum[3,4]</td><td rowspan="2">Extension or rotation (towards opposite side) of lumbar spine[4,2]</td></tr>
<tr><td>Rotatores</td><td>Transverse processes of adjacent segment or 2 segments inferiorly[2]</td></tr>
<tr><td colspan="5">1 – Moore (1992); 2 - Travell and Simons (1999); 3 –Simons et al (1999) 4 - Martini (2001);</td></tr>
</table>

Muscular pains usually cause little more than discomfort during and after riding but commonly dissipate in a few hours or with rest (Schofferman 2004).

According to Carstens (1997) minor strains of the lumbar and thoracic paravertebral muscles can be eased by adjusting the fore/aft position of the saddle or raising the position of the handlebars.

The results of Salai *et al.* (1999) in a study of 40 cyclists over six months, showed that by dropping the nose of the saddle by 10°-15° below the horizontal, lower back pain was reduced in 20% of participants and 72% reported having complete resolution of all lower back pain.

2.3.4.5 The Upper Extremity

Wilber *et al.* (1995) reported an incidence of overuse injury or complaint in the hands of 31.1% of cyclists.

The neck and upper extremity injuries sustained by cyclists are usually a result of poorly positioned handlebars, and as in the case of the lower back and lower extremity injuries, can be avoided by correct bicycle settings and good posture on the bike. (Mestdagh 1998)

The osteology of the wrist is composed of eight carpal bones, which are collectively known as the carpus (Moore 1992, Martini 2001 and Levangie and Norkin 2001). These bones are arranged into a proximal and distal row made up of four carpals each; the proximal row is made up (medial to lateral) of the scaphoid, lunate, triquetrum and pisiform bones. The distal row is composed (medial to lateral) of the trapezium, trapezoid, capitate and hamate bones. (Moore 1992, Martini 2001 and Levangie and Norkin 2001)

The anterior portion of the wrist has a groove between the scaphoid and the hamate, this is known as the carpal groove or sulcus. The tough, fibrous flexor retinaculum covers this groove by attaching to the scaphoid and trapezium laterally and the hook of the hamate and the pisiform medially. The groove, bridged by the flexor retinaculum, is transformed into the carpal tunnel. (Moore 1992)

The carpal tunnel (figure 11) transmits the tendons of the flexor digitorum profundus, flexor digitorum superficialis, flexor carpi radialis and the flexor pollicis longus (Moore 1992). The median nerve also runs through the carpal tunnel (Moore 1992, Reid 1992, Anderson and Hall 1995 and Martini 2001).

The boundries of the carpal tunnel are the scaphoid and the trapezium medially, the hook of the hamate and the triquetrum laterally, the roof is formed by the flexor retinaculum and the concave arch of the carpals forms the floor. (Reid 1992 and Moore 1992)

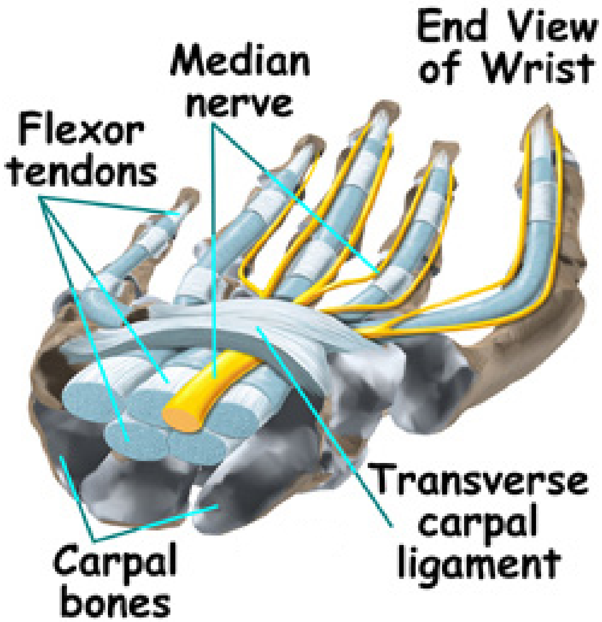

Figure 11: The Carpal Tunnel (Hand University 2001a)

The cutaneous distribution of the median nerve is shown in figure 12 and the muscular innervation of the hand and action of those muscles is detailed in table 9.

Another canal in the wrist that transmits a nerve is the canal of Guyon (figure 13) (Moore 1992, Reid 1992 and Anderson and Hall 1995). This canal is located anterior-medially in the wrist and is formed by the pisohamate ligament (which is an extension of the flexor carpi ulnaris tendon) as the floor, the roof is the fascia deep to palmaris brevis (Reid 1992). The walls are formed by the pisiform and the hamate (Reid 1992 and Anderson and Hall 1995).

Table 9: The Muscles of the Hand Innervated by the Median Nerve and their Actions (Moore 1992)

Muscle	Action
Abductor pollicis brevis	Abducts the thumb
Flexor pollicis brevis	Flexes the thumb
Opponens pollicis	Opposes and medially rotates the thumb
1st and 2nd lumbricals	Flex 2nd and 3rd digits at metacarpophalangeal joints, extend interphalangeal joints

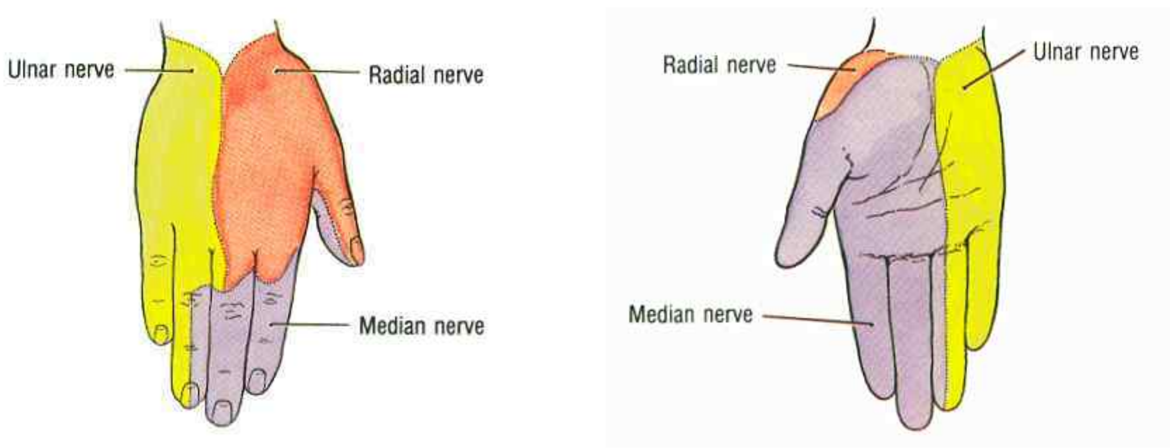

Figure 12: Cutaneous Distribution of the Nerves of the Hand (Moore 1992)

The ulnar nerve and artery run through Guyon's canal (Moore 1992, Reid 1992 and Anderson and Hall 1995). The muscular innervation of the ulnar nerve and the functions of those muscles have been summarised in table 10.

According to Braithwaite (1992), Reid (1992), Richmond (1994), Anderson and Hall (1995), Lawson (1997), Lefever-Button (2001) and Patterson *et al.* (2003) a common upper extremity complaint involves compression neuropathies occurring in the region of the wrist and hand.

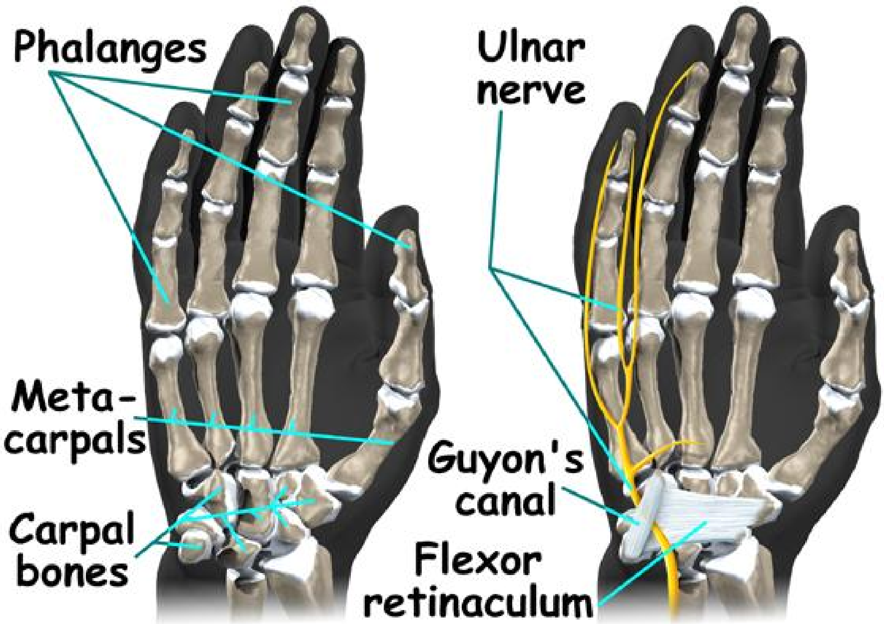

Figure 13: Guyon's Canal and Related Structures (Hand University 2001b)

Although Reid (1992), Anderson and Hall (1995) and Patterson *et al.* (2003) cited only ulnar nerve involvement, Braithwaite (1992), Richmond (1994), Lawson (1997) and Lefever-Button (2001) stated that either the ulnar or median nerves may be compressed.

The terms "Cyclists Palsy" or "Handlebar Palsy" are used exclusively for compression of the ulnar nerve (Anderson and Hall 1995, Lawson 1997 and

Patterson *et al.* 2003). This is far more common than median nerve palsy (Braithwaite 1992, Richmond 1994 and Lefever-Button 2001).

Table 10: The Muscles of the Hand Innervated by the Ulnar Nerve and their Actions (Moore 1992)

Muscle	Action
Adductor digiti minimi	Adducts 5th digit
Flexor digiti minimi	Flexes proximal phalanx of 5th digit
Opponens digiti minimi	Draws 5th metacarpal forward and rotates it, bringing 5th digit into opposition with thumb
3rd and 4th lumbricals	Flex 4th and 5th digits at metacarpophalangeal joints, extend interphalangeal joints
Dorsal interossei	Abduct digits
Palmer interossei	Adduct digits

Compression of the ulnar nerve occurs as it passes through Guyon's Canal, between the hook of the hamate and the pisiform. Pressure within Guyon's canal is caused by oedema and inflammation within the canal, secondary to repetitive trauma or prolonged pressure on the palmar surface of the hand by the handlebar. The condition is also commonly seen in baseball or softball catchers and in racquet sports. (Reid 1992 and Anderson and Hall 1995)

Both the median and the ulnar nerve compression injuries present with motor and/or sensory deficit specific to the distribution of the involved nerve (figure 12, table 9 and table 10). Ulnar nerve palsy will present with predominantly motor weakness and minimal sensory changes while median nerve palsy will present with both motor and sensory symptoms in equal measure (Lawson 1997).

Lefever-Button (2001) stated that ulnar nerve palsy may present with motor or sensory symptoms, or a combination of both while median nerve palsy will only result in sensory changes.

In a prospective study by Patterson *et al.* (2003) there was no significant variation in the incidence of motor symptoms between cyclists using mountain bike handlebars and those using road bike handlebars. There was a significantly greater incidence of sensory deficit in mountain bike riders than in road bike riders. The study was not specific in terms of which nerve was affected.

Prevention of both the median and ulnar nerve compression injuries includes using padded handlebars and gloves and frequent changes of hand position. Treatment includes the prevention actions listed above and conservative treatment (Reid 1992, Braithwaite 1992, Anderson and Hall 1995, Lawson 1997 and Lefever-Button 2001). Bicycle settings that may prevent and alleviate symptoms include reducing the stem length and raising the handlebars (Lefever-Button 2001).

Ulnar and median compression neuropathies rarely result in lasting injury if recognised and managed promptly (Richmond 1994).

2.3.4.6 The Cervical Spine

Overuse injuries of the spine are common in cycling, and are related to increased loading on the upper extremities when supporting the cyclist, and also due to hyperextension of the neck (Mellion 1994 and Lefever-Button 2001). Injuries to the cervical spine are more common than those to the dorsal or lumbar spine because of handlebar positioning and the cycling posture (Lefever-Button 2001).

Because the head and neck are held in hyperextension when the bicycle fit is incorrect or the posture of the cyclist is poor, neck pain usually results (Schofferman 2004).

The neck contains many important structures such as the spinal cord, nerves, blood vessels, lymph vessels, lymph glands and endocrine glands. It connects the head, trunk and upper limbs. (Moore 1992)

The cervical spine also helps to transfer forces between the head, the trunk and the upper limb (Anderson and Hall 1995).

Seven vertebrae form the bony anatomy of the cervical spine, around which soft tissues are arranged and within which the spinal cord is enclosed (Moore 1992 and Martini 2001).

Typical vertebral articulation (figure 14) occurs through the facet or zygapophyseal joints and the intervertebral disc (Moore 1992, Anderson and Hall 1995, Martini 2001 and Levangie and Norkin 2001).

Two adjoining vertebrae and the soft tissue between are referred to as a motion segment; this is the functional unit of the spine (Anderson and Hall 1995).

On top of the vertebral column sits the skull, which is relatively large when compared to the cervical vertebrae (Martini 2001). The head is supported and controlled by several large muscles that attach posteriorly just below the occiput of the skull (Reid 1992). (See figure 15 and table 11)

The main function of these posterior cervical muscles is to extend the head and cervical spine (Reid 1992, Moore 1992, Simons *et al*. 1999 and Martini 2001).

These large cervcal muscles are the trapezius most superficially, the splenius capitis and semispinalis capitis muscles progressively deeper (Reid 1992, Moore

1992, Simons *et al*. 1999 and Martini 2001). Lateral to the splenius capitis muscles lies the longissimus capitis muscle (Moore 1992, Simons *et al*. 1999 and Martini 2001).

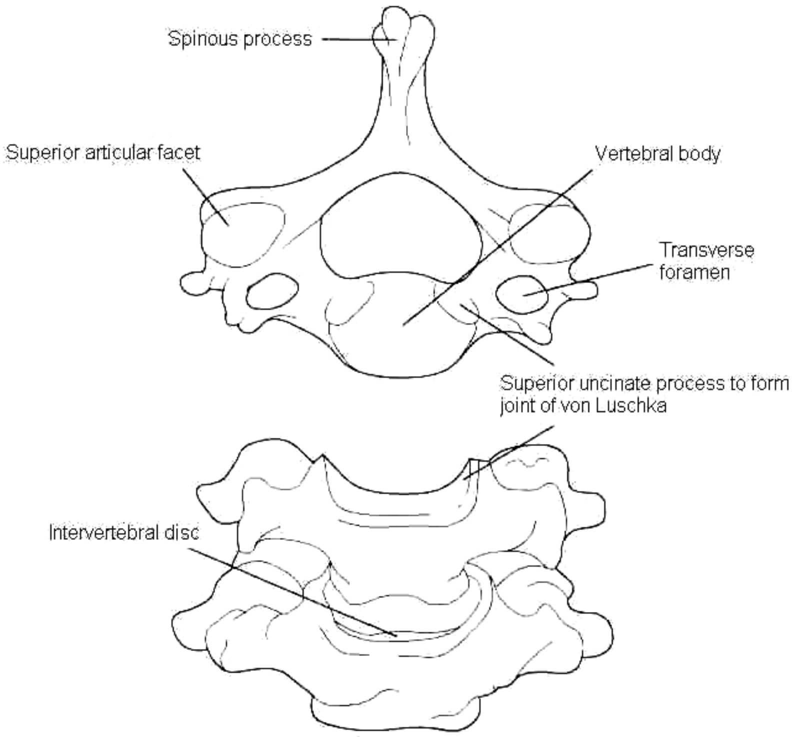

Figure 14: Typical Cervical Vertebra (Reid 1992)

Deep to these muscles are the sub-occipital group of muscles (table 11): rectus capitus posterior major, rectus capitis posterior minor, obliquus capitis superior and obliquus capitis inferior muscles (Moore 1992 and Simons *et al.*1999).

The posterior muscles of the cervical spine not attaching to the skull (table 11) include levator scapule, scalenus posterior, semispinalis cervicis, longissimus cervicis and splenius cervicis. Deep to these muscles are the small multifidi and rotatores. (Moore 1992, Simons *et al*. 1999 and Martini 2001)

Mellion (1994) specified two overuse injuries of the neck: myofascial trigger points and “multiple microwhiplash injury.”

Simons *et al.* (1999) defined a myofascial trigger point as: "a hyperritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful to compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction and autonomic phenomena".

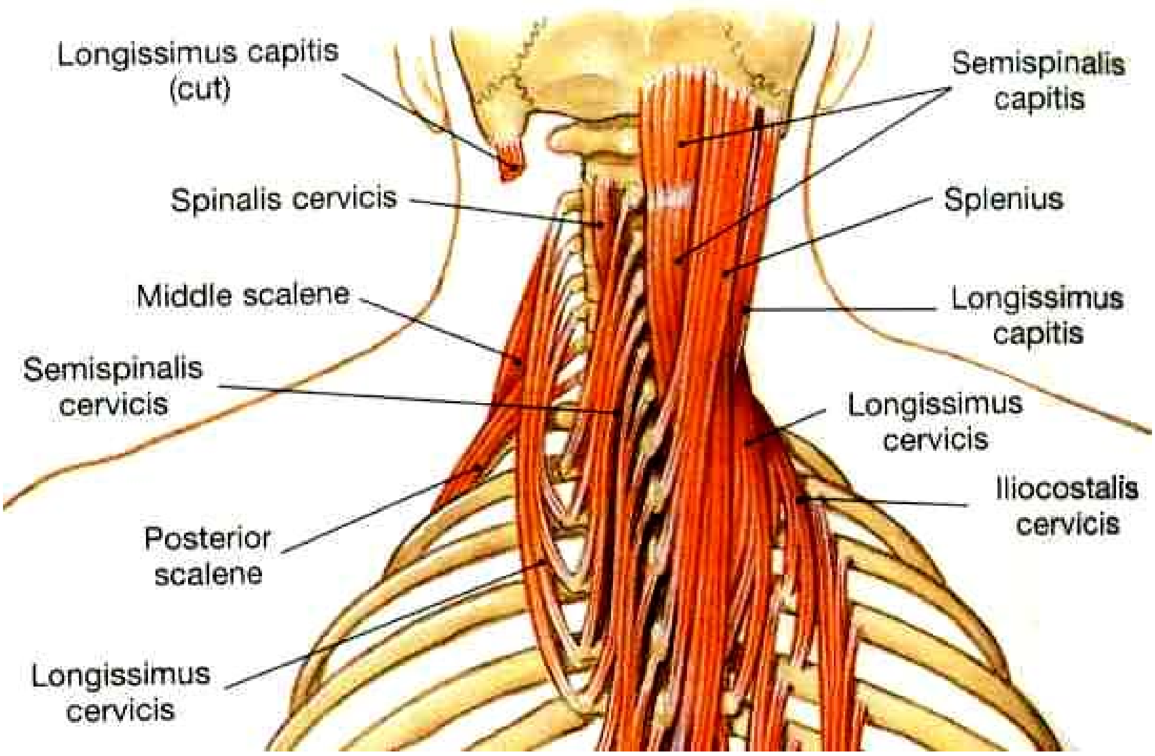

Figure 15: Posterior Cervical Musculature (Martini 2001)

Trigger points in cyclists are commonly found in the levator scapulae, splenius capitis, trapezius, sternocleidomastoid, infraspinatus, supraspinatus and rhomboid muscles and are directly attributable to the sustained posture used by cyclists (Mellion 1994).

Microwhiplash injury is the cumulative result of the many jarring motions that are absorbed by the cervical tissues. These repetitive forces result in severe pain and the inability to hold the neck in an extended position. This type of cervical injury is associated with sustaining the neck in an overextended position, using over inflated tyres and endurance cyclists using the drops (the lower, curved portion of the handlebars). (Mellion 1994)

Table 11: Anatomy of Posterior Cervical Muscles (Simons *et al.* 1999)

Muscle	Proximal Attachment	Distal Attachment	Innervation	Action
Trapezius	Occipital bone, ligamentum nuchae, spinous processes of thoracic vertebrae	Acromion and scapular spine of scapula and lateral ⅓ of clavicle	Spinal root of accessory nerve (CN XI) and $C_{2\text{-}4}$	Bilaterally: extend the head and neck Unilaterally: rotate and laterally flex neck ipsilaterally
Levator scapula	Transverse processes $C_{1\text{-}4}$	Superior angle of scapula	$C_{3,4}$ and dorsal scapular nerve (C_5)	Bilaterally: controls neck flexion Unilaterally: rotates neck ipsilaterally
Splenius capitis	Mastoid process of skull	Spinous processes of lower cervical and upper thoracic vertebrae	Lateral branch of dorsal primary divisions $C_{2\text{-}4}$	Bilaterally: extends head and neck Unilaterally: rotates head and neck ipsilaterally
Splenius cervicis	Tranverse processes of upper cervical vertebrae			
Semispinalis capitis	Occiput between superior and inferior nuchal lines	Articular processes $C_{4\text{-}6}$, transverse processes $T_{1\text{-}6}$	Posterior primary division $C_{1\text{-}4/5}$	Extends head
Semispinalis cervicis	Spinous processes $C_{2\text{-}5}$	Transverse processes $T_{1\text{-}5/6}$	Posterior primary division $C_{3\text{-}6}$	Extends cervical spine, rotates contralaterally
Longissimus capitis	Posterior margin mastoid process	Articular processes $C_{3/4\text{-}6/7}$, transverse processes $T_{1\text{-}4/5}$	Posterior primary division $C_{1\text{-}8}$	Bilaterally: extends head Unilaterally: lateral flexes ipsilaterally
Rectis capitis posterior major	Lateral part inferior nuchal line	Spinous process C_2	Branches of dorsal primary division of suboccipital nerve (C_1)	Rotates head ipsilaterally
Rectis capitis posterior minor	Medial ½ inferior nuchal line	Posterior arch C_1		Extends head
Obliquus capitis superior	Between inferior and superior nuchal lines	Transverse process C_1		Extends head, laterally flexes head ipsilaterally
Obliquus capitis inferior	Spinous process C_2	Transverse process C_1		Rotates neck ipsilaterally
Multifidi	Spinous processes $C_{2\text{-}5}$	Articular processes $C_{4\text{-}7}$	Posterior primary division $C_{1\text{-}8}$	Extension, rotation of neck
Rotatores	Spinous processes C_2 onwards	Articular processes C_3 onwards		

Jacobs, Nichols, Holmes and Buono (1995) concluded that neck pain may not be due to muscular weakness, but rather to fatigue due to the sustained muscle contraction needed to maintain position when cycling.

Schofferman (2004) maintains that neck pain in cyclist can result from the following: muscular fatigue from maintaining the isometric contraction in order to maintain a hyperextended position. Muscular neck pain as a result of fatigue and a build-up of toxic metabolites such as lactate usually dissipates in a few hours or with rest. Fatigued muscles may place added stress on the discs and facet joints. (Schofferman 2004)

Schofferman (2004) went on to include facet joints and intervertebral discs as the other cause of neck pain in cyclists. With a loss of lumbar lordosis, the resulting thoracic kyphosis may cause a secondary hyperlordosis of the cervical spine according to Schofferman (2004). This hyperlordosis may put added stress through the facet joint and intevertebral disc, both of which are nocioceptive: the joint capsule of the facet and the outer layers of the annulus fibrosis of the disc (Gatterman 1995, Cramer and Darby 1995 and Troyanovich, Harrison and Harrison 1999).

The most common result of this posture is facet joint pain and there is the potential to injure the thin posterior annulus of the disc (Schofferman 2004).

In order to avoid the over extended position, bicycle adjustments need to be made. Using handlebars with less drop, moving the seat forward, using a shorter stem or raising the stem are all methods of decreasing the cervical spine extension whilst on the bicycle. Other equipment modifications include using minimally inflated tyres, padded handlebars and padded gloves and these all help to reduce the amount of road shock. (Mellion 1994)

Changing to a more upright posture with the arms, upper back and elbows relaxed (unlocked), regularly changing hand positions and performing cervical spine stretches can all help to prevent and reduce shoulder and neck pain. (Mellion 1994)

2.3.5 Traumatic Injuries in Cycling

Each year in the United States there are approximately 9000 deaths, 23000 hospital admission, 580000 emergency department visits and about 1.2 million physician visits through bicycle injuries alone. Traumatic injuries are commonly abrasions, lacerations, contusions, fractures or dislocations and sprains. (Rivara, Thompson and Thompson 1997)

Wilber *et al.* (1995) reported that traumatic injuries involved a lone rider in 34.6% of reported cases, a collision with a motor vehicle in 25.2% and collision with another cyclist in 22.0% of reported cases.

In a study of literature on cycling injuries by Noakes (1995), the author found that an average of 21% of injuries in hospital-based studies were fractures, 35% were contusions and 26% were lacerations. Lacerations also made up 20% of the total number of reported injuries. The head and facial region were the most commonly injured areas, making up an average of 51% of injuries, next was the upper extremity at 33% and then the lower extremity at 31%. (Noakes 1995)

While adults are more likely to sustain injuries to the extremities, children under 10 years of age are more likely to injure their head and face (Rivara *et al.* 1997). The upper extremities remain the most common site for fractures in recreational cyclists 35 years old and over, accounting for 41.9% of all fractures in this age group (Lefever-Button 2001).

A study from Helsinki by Gassner *et al.* (1999) showed 60% of all sports related trauma patients that presented to the Department of Oral and Maxillofacial Surgery, University of Innsbruck were mountainbikers, while only 27% were road cyclists. The same study concluded that mountainbiking resulted in 55% more facial bone fractures when compared to road cycling.

Noakes (1995) reported that while boys between 6 to 12 years of age have the highest injury rates, boys between 10 to 14 years of age have the highest fatality rates. Neck injuries increase the risk of death 15 times compared to injury to the rest of the body (Rivara *et al.* 1997).

According to Noakes (1995) the epidemiological factors associated with traumatic cycling injuries include:

1. Sex (males have greater incidence of injury than females)
2. Age (highest injury rates below 12 years of age)
3. Failure to obey traffic laws
4. Use of alcohol and prescription medicines
5. Bicycle malfunction
6. Poor road surface
7. Inappropriate activities (for example, doing "wheelies" or going too fast)
8. Emotional state (yet to be established)
9. Site of accident (straight roads and road junctions are equally dangerous)
10. Nature of accident (majority of accidents don't result from collision with a car)
11. Time of day and year (poor visibility does increase the risk of a cyclist being struck by a motorist) (Noakes 1995)

2.4 SUMMARY

Cycling, although a low impact activity and perceived to be harmless, has an inherent risk of overuse and traumatic injury (Wilber *et al.* 1995).

With the knowledge of the biomechanics of cycling and aetiology and incidence of injuries the majority of overuse cycling injuries can be prevented and treated successfully (Lefever-Button 2001).

CHAPTER THREE - METHODOLOGY

3.1 THE STUDENT CHIROPRACTIC SPORTS COUNCIL

The Student Chiropractic Sports Council (SCSC) is a student run organisation that operates under the auspices the Faculty of Health Sciences Board at the University of Johannesburg. The council is affiliated with the South African Sports Chiropractic Association (SASCA) which is the professional body of sports Chiropractic in South Africa.

The SCSC organises and runs it's own events subject to the SCSC Constitution (Appendix A) and Rules and Regulations (Appendix B). A comprehensive list of recent sporting events attended by the SCSC has been included in the portfolio as Appendix C.

Students registered with the SCSC may treat at official sporting events under the supervision of a Doctor of Chiropractic. Only 5th year students and above may carry out adjustive techniques while 3rd and 4th year students may perform soft tissue techniques, such as therapeutic or sports massage.

Subjective Evaluation, Objective Evaluation, Assessment, and Protocol (SOAP) notes (Appendix D) are filled out for each patient at each event at which the Student Chiropractic Sports Council treats. These notes are reviewed and signed by a Doctor of Chiropractic prior to any treatment taking place.

3.2 THE "PICK 'N PAY 94.7 CYCLE CHALLENGE"

The "Pick 'n Pay 94.7 Cycle Challenge" is the second largest timed cycling event in the world with 68387 participants in the past 3 years. The event was first held in 1996. The course runs in and around Johannesburg and is 94.7 km long. (figure 16 and 17)

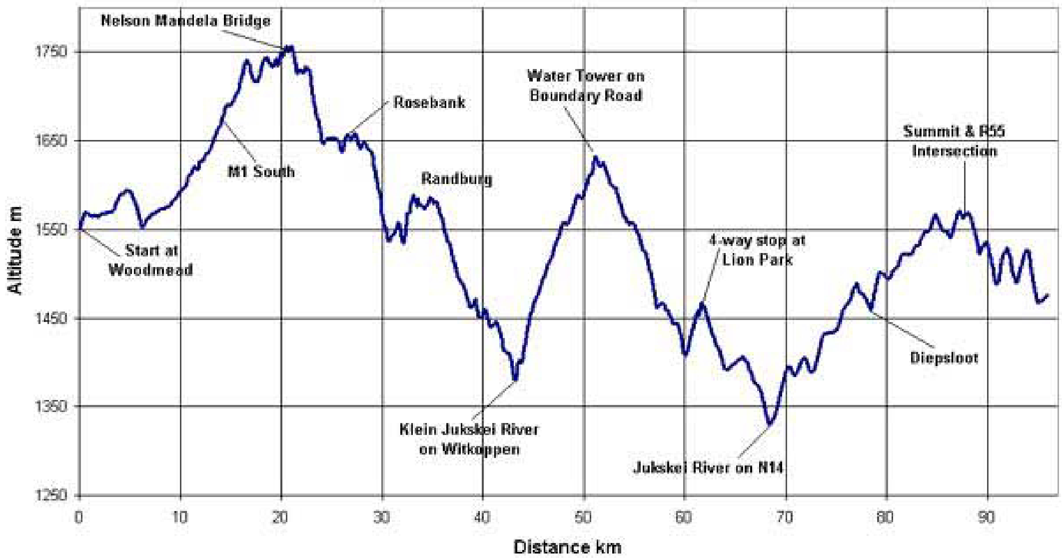

Figure 16: Pick 'n Pay 94.7 Cycle Challenge Route Profile

The SCSC has had students treating at the Cycle Challenge every year since 2002. Students are positioned at stations throughout the route and at the end. It is only the students that treated at the finish line that completed SOAP notes, along the route students only used soft tissue techniques under the supervision of a qualified physiotherapist. Fifth and 6th year students assessed and treated patients at the finish line under the direct supervision of a Chiropractic Doctor.

Physiotherapeutic and medical staff were also present at the finish.

Since emergency medical services (EMS) were present at the finish line, only patients with soft tissue injuries presented to the Chiropractic students treating at the 94.7 Cycle Challenge. All traumatic injuries were referred to the EMS for splinting, wound care or emergency medical evaluation.

EMS personal were also present along the route and dealt with all injuries resulting from falls or collisions along the course. This meant that only the overuse type of injuries presented to the Chiropractic students treating at this event.

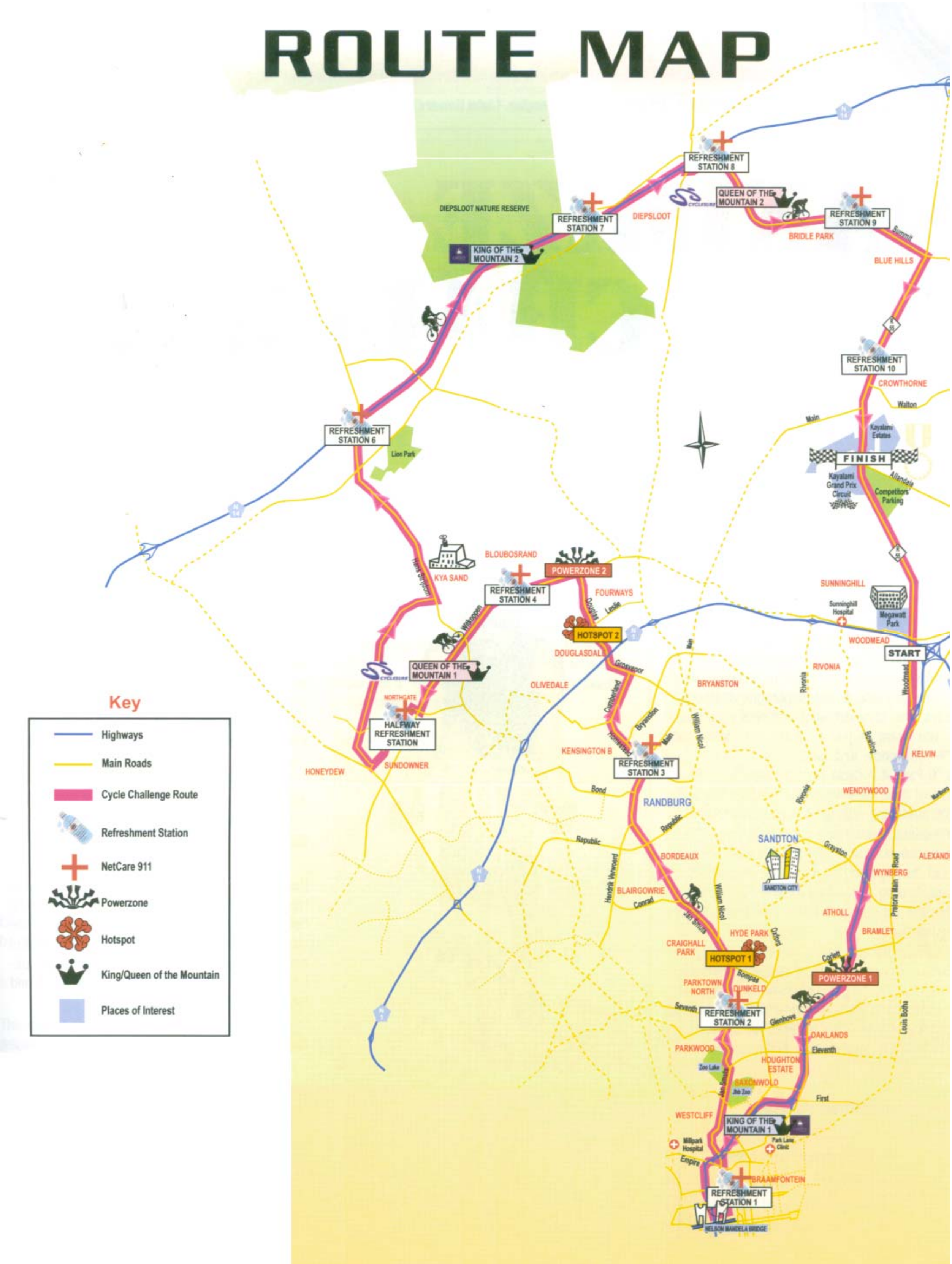

Figure 17: Route Map for Pick 'n Pay 94.7 Cycle Challenge (Race Brochure 2004)

3.3 DATA ANALYSIS

The SOAP notes for the "Pick 'n Pay 94.7 Cycle Challenge" for the years 2002 to 2004 were analysed and all data entered into a database in the Microsoft Excel 2003 spreadsheet. Forms in which patient details were not completed were excluded as were those where the area of involvement, clinical impression or treatment were incomplete or not clear.

Of the 356 SOAP notes that were processed in this study 305 were used and the remaining 51 were excluded.

This data was then processed by the Statistical Consultation Service (Statkon), situated on the Kingsway Campus of the University of Johannesburg.

The data was converted into Basic Descriptive Tables and Contingency Tables; the Chi-Square tests (p value) were applied to test for statistical significance ($p < 0.05$). If a statistically significant value existed ($p < 0.05$), then Cramer's V, a Symmetric Measure (V value), was applied as a measure of association.

The results of Cramer's V as a measure of association are interpreted as follows: if $V > 0.1$ there was no measure of association, if $0.1 \leq V < 0.3$ there was said to be a small measure of effect. If $0.3 \leq V < 0.5$ a medium measure of effect was noted and if $V \geq 0.5$ then there was a large measure of effect.

CHAPTER FOUR – RESULTS

4.1 GENERAL DEMOGRAPHICS

Over the three years 305 patients were treated by the Student Chiropractic Sports Council at the 94.7 Pick ‘n Pay Cycle Challenge which makes up 0.45% of the 68387 riders that started the races over those years.

Table 12: Number of Patients Treated by Year

Year	Number of patients treated	Total number of cyclists
2002	102	21163
2003	130	22067
2004	73	25157

Table 12 shows how many patients were treated by the SCSC each year. The highest number (n = 130) was seen in 2003 and the least number of cyclists that were seen (n = 73) was in the following year, 2004.

The mean age of patients was 32.7 (±9) years old. The youngest patient was 13 years old while the oldest was 60 years old.

4.2 RELATIVE DEMOGRAPHICS

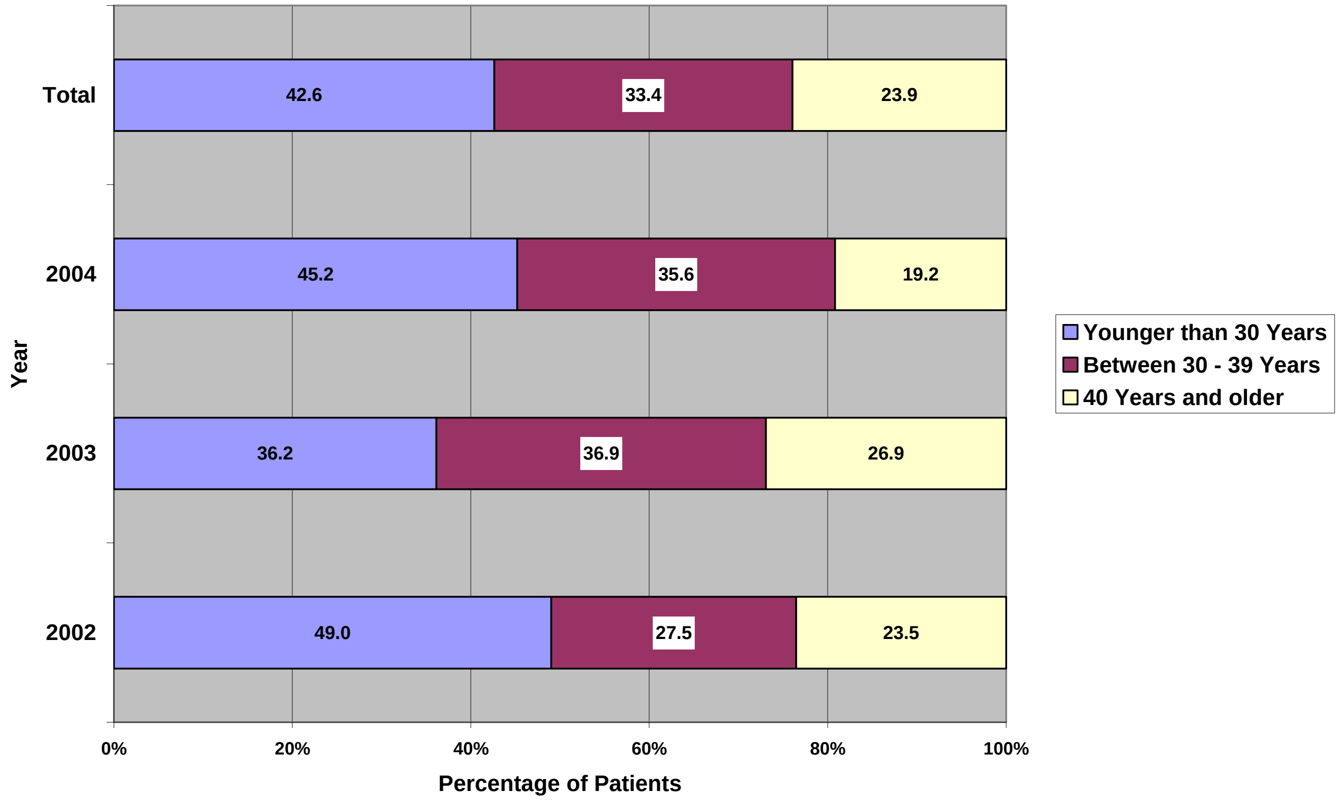

Figure 18: Description of the Relative Percentages of Total Number of Patients Made up by Each Age Group

Of all the patients treated 42.6% (n = 130) were younger than 30 years old, 33.4% (n = 102) were between 30 and 39 and 23.9% (n = 73) were 40 years or older. Figure 18 depicts how this figure varied between the years and in total.

4.3 COMPARITIVE DEMOGRAPHICS

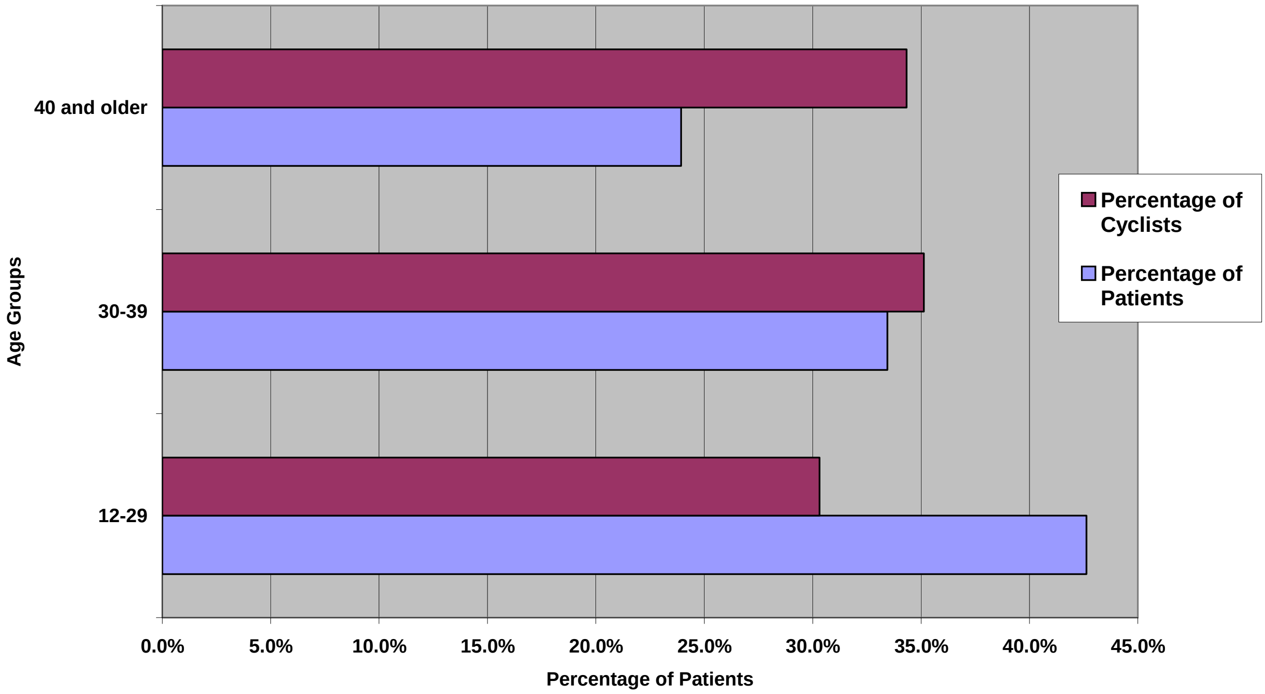

Figure 19: A Comparison Between the Relative Percentage of Patients that Presented to the SCSC and the Percentage of Cyclists that Started in Each Age Group in 2004

Figure 19 shows a comparison between:

- The percentage of cyclists from each age group that started the 2004 94.7 Pick n' Pay Cycle Challenge out of the total number of participants.
- The percentage of cyclists from each age group that were treated by the SCSC out of the total number of patients that were treated.

The SCSC saw 23.9% (n = 73) of its patients from the 40 years of age and older group while this same group made up 34.3% (n = 8638) of the competing field. Of the remaining patients that were treated, 33.4% (n = 102) were between 30-39 years old and made up 35.1% (n = 8837) of the competing field. The 12-29 year old grouping made up only 30.3% (n = 7627) of the competing population but made up 42.6% (n = 130) of the patient population.

4.4 RACE COMPLETION

Table 13: Description of Percentage of Patients Treated That Finished the Race

		Count	%
Year	**2002**	96	94.1%
	2003	127	97.7%
	2004	67	91.8%
	Total	290	95.1%

Over all 3 years, 95.1% (n = 290) of presenting patients managed to finish the race. Four point nine percent (4.9%) (n = 15) of patients reported that their injuries where too severe to complete the race distance. Table 13 describes how this trend varied across the years and how these numbers related to the total number of patients treated in that year. The lowest percentage of patients that finished was 91.8% (n = 67) in 2004 while the highest percentage (97.7%) was in 2003 (n =127).

4.5 NEW INJURIES

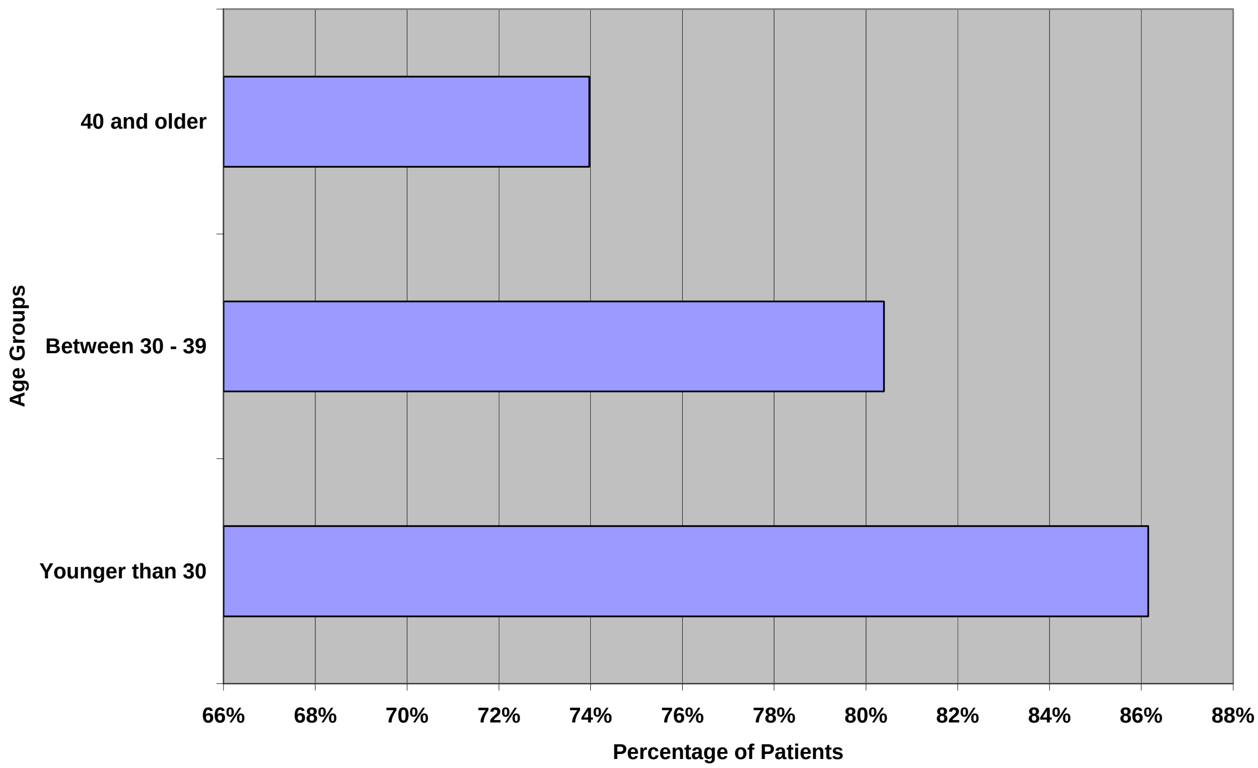

Figure 20: Percentage of Patients who Reported New Injuries Within Each Age Group

Overall, 81.3% (n = 248) of patients presented with new injuries while 18.7% (n = 57) reported aggravation of previously sustained injuries. The most common age group to report new injuries were those younger than 30 years old with 86.2% (n = 112) of patients within this age group reporting a new injury, followed by the 30-39 year olds with 80.4% (n = 82) and then the 40 years of age and over group with 74.0% (n = 54) of patients within this age group reporting a new injury, as shown in figure 20.

Table 14: Description of New Injuries Reported by Year

		Count	% within Year
Year	**2002**	81/102	79.4%
	2003	102/130	78.5%
	2004	65/73	89.0%
Total		248	81.3%
Pearson Chi-Square		**0.149**	
Cramer's V		**0.112**	

Table 14 shows that the variation in the number of new injuries in 2004 when compared to the years 2002 and 2003 is not statistically significant ($p = 0.149$) but there is a small measure of association ($V = 0.112$) between the year 2004 and the higher percentage (89.0%, $n = 65$) of new injuries.

4.6 AREAS OF INVOLVEMENT

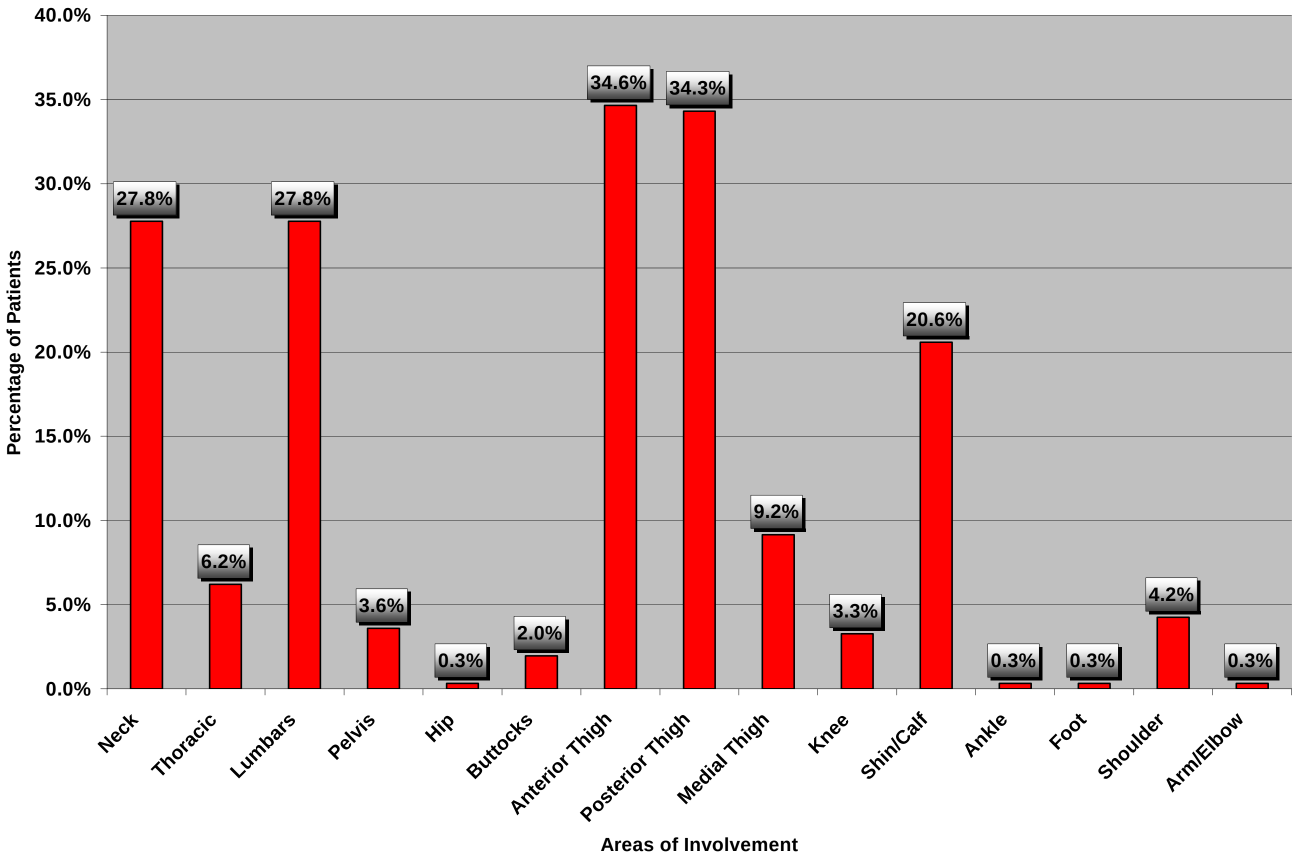

Figure 21: Most Common Areas of Involvement as a Percentage of the Total Number of Patients

The most common areas of involvement reported by patients were the anterior and posterior thigh, being reported in 34.6% (n = 106) and 34.3% (n = 105) of cases respectively. The neck and lumbar region were the next most prevalent complaints, involved in an equal number of cases (27.8%, n = 85). The shin and calf were a source of discomfort or pain in 20.6% (n = 63) of patients treated. Other areas of involvement are the thoracic region, the pelvis, hips, buttocks, the knee, ankle, foot, shoulder and arm/elbow. Their prevalence is depicted in figure 21. These figures are all averages from all three years of treatment and patients may have reported more than one area of involvement.

Table 15: Incidence of Area of Involvement Between Age Groups Described as the Number of Patients that Presented and the Relative Number of Patients that Presented Within the Age Groups.

		Shin/Calf	Medial Thigh	Posterior Thigh	Anterior Thigh	Lumbars	Neck
Age	**12 – 29** (130)	35	13	44	39	40	40
		26.9%	10.0%	33.8%	30.0%	30.8%	30.8%
	Between 30 – 39 (102)	17	12	36	41	24	23
		16.7%	11.8%	35.3%	40.2%	23.5%	22.5%
	40 and older (73)	11	3	25	26	21	22
		15.1%	4.1%	34.2%	35.6%	28.8%	30.1%
Total		63	28	200	106	85	85
		20.7%	9.2%	65.6%	34.8%	27.9	27.9%
Pearson Chi-Square		0.064	0.205	0.973	0.266	0.466	0.098
Carmer's V		0.134	0.102	0.013	0.093	0.071	0.123

Locations of complaint showed no statistically significant measures ($p > 0.05$) when the Chi-Square test was applied to each injury between all 3 age groups. (See table 15)

Although not statistically significant ($p > 0.05$) there is a small measure of association ($0.3 > V \geq 0.1$) between the following:

- The higher percentage of shin/calf complaints (26.9%, n = 35) and the 12-29 year old age group
- The lower percentage (4.1%, n = 3) of medial thigh complaints and the group of 40 years of age and older.
- The lower percentage (22.5%, n = 23) of neck complaints and the 30-39 year olds.

4.7 CLINICAL IMPRESSION

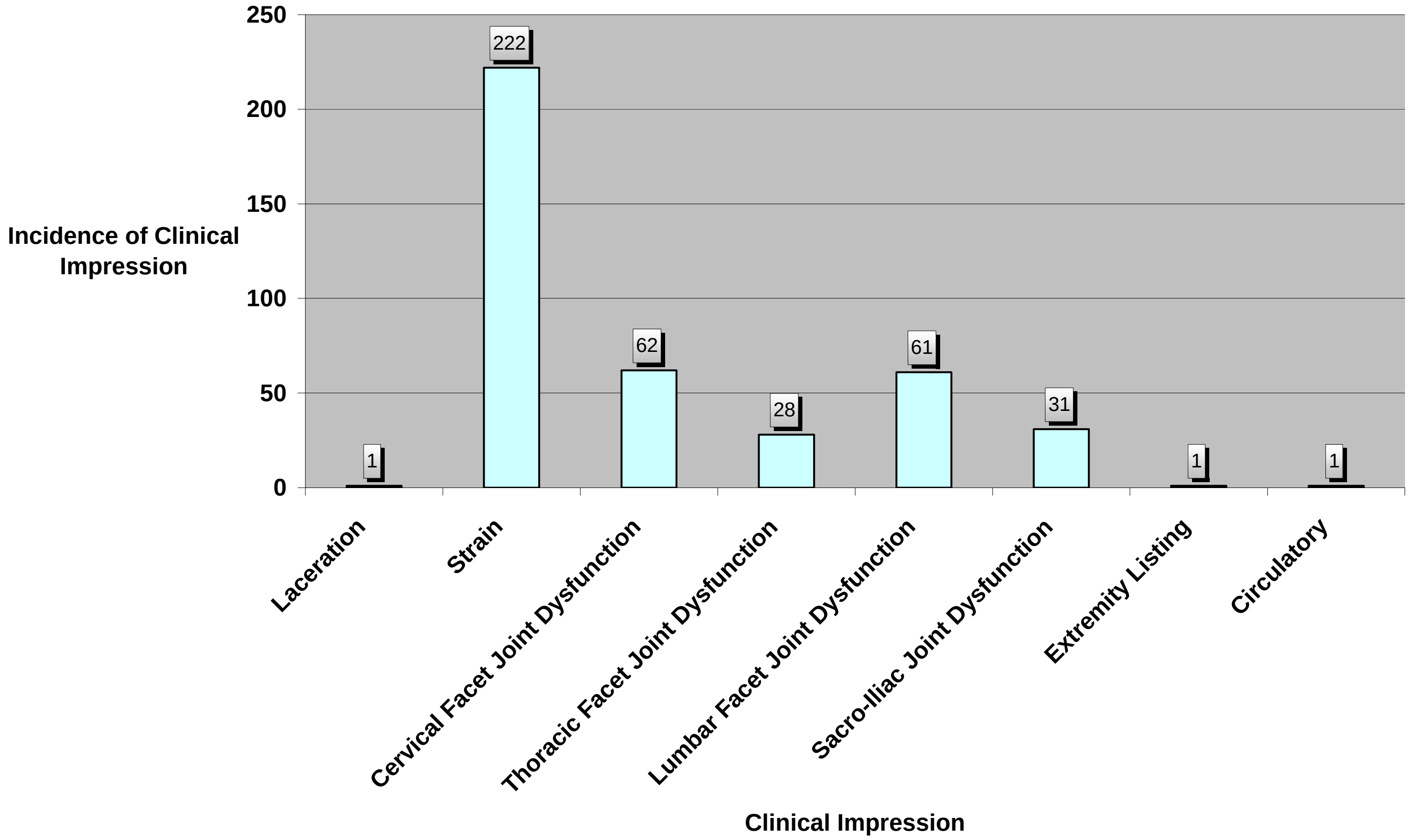

Figure 22: Description of Clinical Impressions Given Over All 3 Years

As figure 22 shows, the most common clinical impression given by the students treating at the 94.7 Pick 'n Pay Cycle Challenge was that of a muscular strain (n = 222, 72.8%), the second most common was cervical facet joint dysfunction (n = 62, 20,3%) closely followed by lumbar facet joint dysfunction (n = 61, 20.0%). Other common clinical impressions made were sacro-iliac joint dysfunction (n = 31, 10.2%) and thoracic facet dysfunction (n = 28, 9,2 %).

There were no statistically significant trends with regard to clinical impression and age groups.

4.8 SPECIFIC MUSCULAR INVOLVEMENT

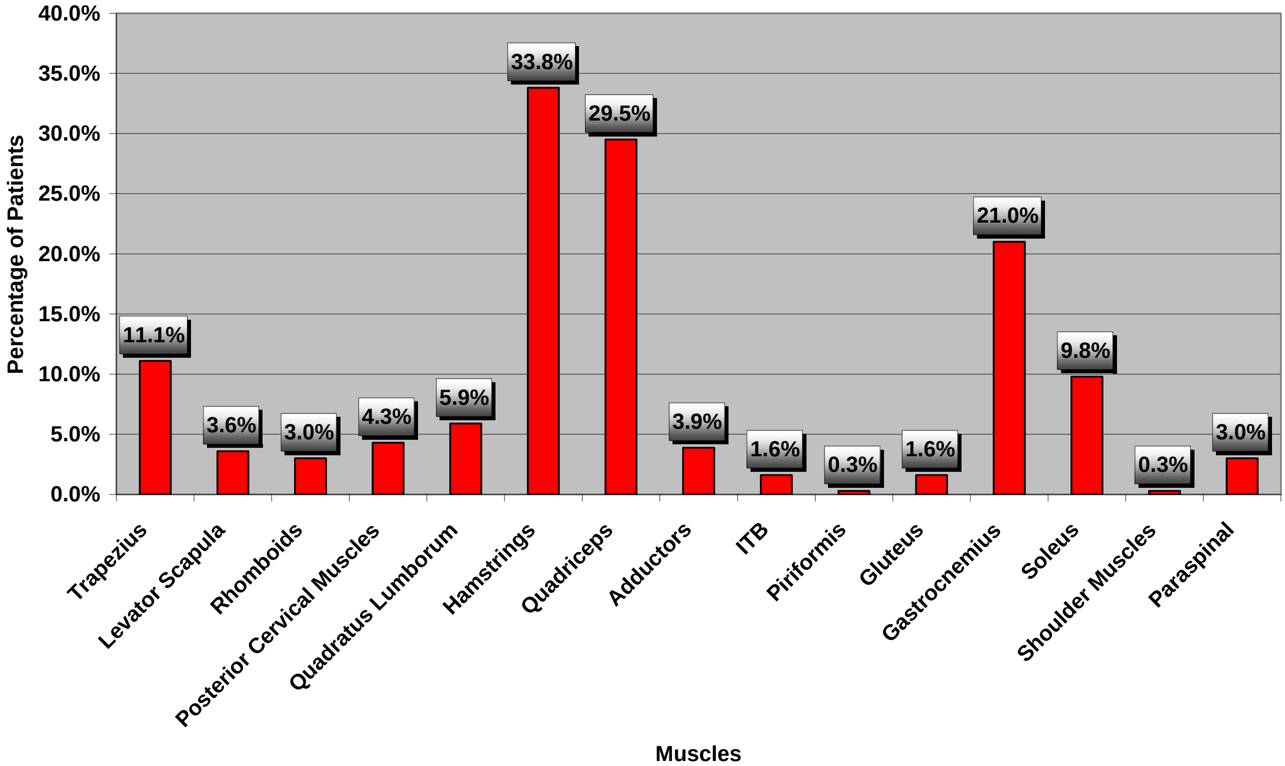

Figure 23: Percentage of Patients with Specific Musculotendinous Involvements

The hamstring muscles were diagnosed as being the most common muscles that were symptomatic in 33.8% (n = 103) of patients. The quadriceps muscle group were symptomatic in 29.5% (n = 90) of patients, the gastrocnemius muscles were the third most common (21.0%, n = 64) and the trapezius muscles were fourth (11.1%, n = 34). Figure 23 details the percentage of patients presenting with specific symptomatic muscles.

There were no statistically significant variations with regards to specific muscles diagnosed as being symptomatic between any of the 3 years nor was there any statistical significance with regards to specific symptomatic muscles between the 3 age groups.

CHAPTER FIVE - DISCUSSION

This chapter will deal with the results obtained from this study and, where possible, comparisons will be made with previous literature.

5.1 GENERAL

In 2004 there were 25157 cyclists competing in the 94.7 Pick ‘n Pay Cycle Challenge, which was more than any other year. The fewest patients were also seen in the same year. This may be attributable to a number of factors:

- a change in position of the SCSC stand in the medical tent at the end of the race which may have decreased their visibility
- the number of chiropractic students working in a given year
- the number of physiotherapy students working in a given year
- a decrease in the number of overuse injuries.

5.2 DEMOGRAPHICS

Overall the 12-29 year old age group made up the majority of the patients treated (42.6%, n = 130) and comprised only 30.3% (n = 7627) of the competing field. This may, in part, be linked to the fact that this same age group reported the highest percentage of new injuries (86.2%, n = 112). This data concurs with Ho *et al.* (2001) in that the youngest age groups have the highest incidence of new injuries while older age groups have fewer new injuries but rather re-injure older lesions.

5.3 NEW INJURIES AND RACE COMPLETION

Two thousand and four saw the highest percentage of new injuries reported (89.0%, n = 65) when compared to 79.4% (n = 81) in 2002 and 78.5% (n = 102) in 2003. This may be related to the fact that 2004 saw the biggest field of cyclists, 25157. The majority of these cyclists are classed as recreational and it is possible that their pre-race preparation was inadequate.

5.4 AREAS OF INVOLVEMENT

The most common areas of involvement were the anterior (34.6%, n = 106) and posterior thigh (34.3%, n = 105). The next most common complaints involved the cervical and lumbar spines (27.8%, n = 85 each) and then the shin/calf (20.6%, n = 63).

The results from this study differ from Subotnick (1989), Schwellnus and Derman (2000b), Lefever-Button (2001) and Derksen *et al.* (2004) who all rated knee pain as the most common complaint in cyclists.

The survey of 440 amateur cyclists done by Wilber *et al.* (1995) reported that the neck was the most common site of injury (49.6%), the knee was the second most prevalent (41.9%) followed by groin/buttocks (35.6%), hands (31.3%), shoulders (31.2%), back (30.1%), feet (15.2%) and then thighs (8.7%).

The results of this study do not seem to correlate directly with any of the studies cited in the literature review. The reason for this may have been that this is the only study where data was obtained directly after a race and not a period of days, weeks or months after an event.

The high incidence of anterior and posterior thigh involvement (which were the most common) may in fact lead to knee pain (reported by the majority of cited studies) in the longer term. These two muscle groups in particular, when symptomatic and fatigued may cause abnormal tracking of the patella and thus cause knee pain. This is supported by Schwellnus and Derman (2000b) when they stated that muscular dysfunction can lead to abnormal tracking of the patella, producing knee pain.

5.5 CLINICAL IMPRESSION

By far the most common clinical impression given was that of musculotendinous strain with n = 222 cases recorded, affecting 72.8% of patients treated. As stated earlier, most of the participants may not have performed sufficient pre-race preparation, this means that their muscles were not conditioned to such vigorous and sustained contractions. This result correlates with the mechanism of injury stated by the American Academy of Orthopaedic Surgeons (2000) and Schwellnus and Derman (2000a) where musculotendinous strains occur when the muscle is subjected to prolonged recurring movement or overload, especially where poor conditioning is a factor.

The second most common clinical impression given was cervical facet joint dysfunction n = 62 (20.4%), followed by lumbar facet joint dysfunction n = 61 (20.1%), SI joint dysfunction n = 31 (10.2%) and thoracic joint dysfunction n = 28 (9.2%).

Only in the article written by Schofferman (2004) is there any direct link made between the sport of cycling and its biomechanics and the diagnosis of cervical facet joint, lumbar facet joint and SI joint dysfunction. Schofferman (2004) maintains that the major cause of lower back and neck pain is not muscular in origin, but rather from facet joint dysfunction, SI joint dysfunction and pain originating from intervertebral discs.

Some parallels between different sets of literature may be drawn to support this theory:

Mellion (1994) classified the neck pain as arising from myofascial trigger points or from a mechanism he termed “microwhiplash”.

Simons *et al.* (1999) did state that trigger points and zygapophyseal joint dysfunction that occur at roughly the same level may have similar symptoms that could easily confuse physicians. This would mean that Mellion (1994) could have identified trigger points when, in fact zygapophyseal joint dysfunction was present.

In the microwhiplash mechanism itself, Mellion (1994) uses the term “cervical tissues” when describing which structures absorb the cumulative force. This would seem to include the cervical zygapophyseal joints and repetitive microtrauma would indeed lead to zygapophyseal joint dysfunction (Gatterman 1995).

Mestdagh (1998) and Levefer-Button (2001) stated that an improper cycling position where trunk flexion is greater than 45° puts strain on the cervical and lumbar spine, so it may be that there is a high incidence of incorrect bicycle-cyclist fit and cyclist positioning among the patients treated.

Through incorrect bike fit and cycling posture undue stress may be placed on the cervical and lumbar facet joints, SI joints and interverterbral discs which causes dysfunction and pain (Schofferman 2004).

Schofferman (2004) went on to say that facet joint dysfunction would probably cause longer lasting and more chronic pain than that arising from muscle.

5.6 MUSCULAR INVOLVEMENT

The most common muscles that were diagnosed as strained were the hamstring group n = 103 (33.8%) followed by the quadriceps n = 90 (29.5%), gastrocnemius n = 64 (21.0%) and trapezius n = 34 (11.1%).

In this study the anterior and posterior thigh were cited almost equally as areas of involvement and the hamstring muscles have been diagnosed as strained more often than the quadriceps group. This result correlates with the American Academy of Orthopaedic Surgeons (2000) when they stated that muscles that cross more than 1 joint are more susceptible to strain. All 3 of the hamstring muscles (semitendinosus, semimembranosus and biceps femoris muscles) cross both the hip and the knee, whereas only one of the quadriceps muscles (rectus femoris) does the same.

5.7 SUMMARY

Initially the results of this study do not seem to concur with any of the studies in the cited literature and this makes sense since this is the only study, amongst the gathered literature, that has evaluated the presentation of overuse injuries directly after a cycling event.

However, in can be seen that the results shown here may, in the longer term, lead to similar injury patterns described by Wilber *et al.* (1995), Schwellnus and Derman (2000b) and Schofferman (2004).

CHAPTER SIX – CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The aim of this study was to describe the historical data obtained when patients presented to the Student Chiropractic Sports Council at the Pick ‘n Pay 94.7 Cycle Challenge from the years 2002 to 2004. The focus of the study was on the profile of injuries with which patients presented.

No comparable study of this kind, where the nature of overuse injuries recorded directly after a competition of any kind could be found. This makes this study the first of its kind amongst the available literature.

Lower extremity complaints, which were the most common, can be attributed to musculotendinous strains particularly of the hamstring muscles. These injuries are caused by poor conditioning and bad bicycle fit.

Back and neck complaints were mostly diagnosed as cervical facet joint, thoracic facet joint, lumbar facet joint or SI joint dysfunction. The main causes include incorrect posture, poor bicycle fit and the “microwhiplash” mechanism of injury.

It is the results that show that the spine is a common cause for complaint among recreational cyclists that will interest Chiropractic practitioners the most. This holds true even for those practitioners who do not treat at any sporting events since pain arising from facet or SI joint dysfunction causes longer lasting pain than that caused by muscle. This means patients will present days, weeks or even months after having taken part in an event and not just at the event itself.

It is believed that if the nature and presentation of injuries presenting directly after activity are better understood, diagnosis and treatment of these injuries at this early stage may be improved. This bettering of the earliest diagnosis and treatment may be beneficial to the longer term prognosis of overuse injuries, resulting in shorter periods of recovery and better methods of rehabilitation to prevent recurrence of these injuries.

6.2 RECOMMENDATIONS

This was a pilot study and was the first time the SCSC SOAP notes were used for statistical purposes.

From the outset of this study it was understood that the source data, the SOAP notes from the SCSC, was not specifically collected for the purposes of statistical analysis. This means that although they do contain a large amount of valuable information, there is much more information that could have been added to these SOAP notes that would have added significantly to this study. Such additions would include:

- Sex
- Pre-race preparation
- Level of experience
- Type of bicycle used

The scope of this study was purposely limited at the onset so that proper focus could be given to the profile of injuries. It was a pilot study and it was understood that the results of this study would serve to gauge how feasible follow-up studies may be.

From the results of this study, further studies could investigate the following topics:

- diagnostic evaluation of injuries - much value may be found in analysing what diagnostic techniques are used to diagnose injuries and how these compare to current literature, this information could then be used to improve the diagnostic capabilities of Chiropractors treating overuse injuries.

- types of treatment given - the treatment modalities used by the SCSC could also be compared to current literature and this too would prove an invaluable tool for assessing the level of expertise SCSC students have in treating overuse sporting injuries.

The results of this study also showed how the SOAP notes used by the SCSC may be amended, even if for non-statistical purposes. Amendments could include:

- Including the patient's sex
- Have boxes to tick to indicate a choice instead of circling the word itself
- Include the type or character of pain
- Design separate forms for contact sports, and non-contact sports

It is believed that these amendments will aid the students of the SCSC by making the SOAP notes clearer and more concise, therefore aiding them further in the care of sporting patients.

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APPENDIX A

STUDENT CHIROPRACTIC SPORTS COUNCIL

CONSTITUTION

AIM:

- Proactive Chiropractic management and treatment of sports injuries.

GOALS:

- To provide hands-on, sports community based, Chiropractic service targeted at sporting development.
- To recruit patients into the Chiropractic Day Clinic through referrals, after primary assessments have been made under the supervision of a qualified Chiropractor.
- To lead the sporting community to the realisation of the importance of Chiropractic in the management and treatment of sports related injuries, by being present and offering our services at sporting events.
- To be field side and visibly proactive at sporting events.
- To promote and encourage the improvement of athletic performance by providing optimum quality in Chiropractic care, rehabilitation and the prevention of athletic and recreational injuries.
- To provide information to sports authorities and the public about sports Chiropractic.
- To maintain the ethical level of sports Chiropractic through the correct codes of conduct and the usage of the appropriate ethics within the profession.
- To promote academic teaching and advancement of sports Chiropractic through informative lectures and hands-on workshops.
- To work in close collaboration with the South African Sports Chiropractic Association (SASCA) and the Chiropractic Association of South Africa (CASA).

METHOD:

- Proactive dynamic communication by being field side at sporting events.

STRUCTURE:

1. Members of the *Student Chiropractic Sports Council* will include senior students from 4th year and 5th year (this includes students who are currently undertaking their research), and also representatives 3rd year to gain their input and expectations.
   3rd year students may attend sports events as massage therapists (once qualified to do so) and only treat the relevant soft tissue, while 2nd year students may attend in an observational capacity and may help with the completion of forms and patient files.

2. At every event there will be at least one Resident (6th year) student and the presence of a qualified Chiropractor, who preferably has an ICSSD qualification. Chiropractic manipulation may only be administered under the supervision of the Chiropractor on duty at the event.

3. At every event at least one committee member will be present. A committee member will be assigned to co-ordinate the event to make sure everything runs smoothly. Any problems at the event should be addressed through the committee member or the Chiropractor on duty.

4. It is up to the committee member to ensure that a letter is received from the event coordinator to confirm our attendance and participation.

5. It is recognised that the Student Chiropractic Sports Council is the sporting body of the School of Chiropractic at Technikon Witwatersrand and operates under the Faculty of Health Sciences Board, and is affiliated to the Student Chiropractic Association of Gauteng (S.C.A.G.). It is also recognised that the S.C.S.C. is affiliated to the South African Sports Chiropractic

Association (S.A.S.C.A.) as this is the professional body of sport Chiropractic in South Africa. The S.C.S.C. functions as an individual body organising and arranging it's own events and functions. The S.C.S.C. does however offer its full services, cooperation and support to S.A.S.C.A. for the benefit and enhancement of sport Chiropractic in this country.

MEMBERSHIP:

- Membership is open to all Chiropractic students (i.e. 1st to 5th year students).
- 1st and 2nd year students may attend sports events in an observational capacity.
- Before becoming an active member of the Sports Council, each student will be required to observe at least 2 (two) events in order to become *au fait* with treatment and management procedures.
- There will be an annual subscription fee to join the council. This fee is to cover administrative costs as well as necessary equipment, usables and petrol.

    - Annual membership fee: R70.00 (including Sports Council shirt)

CODE OF CONDUCT:

- **DRESS:**
    - All members attending any event are required to wear a Sports Council shirt and black trousers or shorts, unless otherwise advised.
    - White, clean training shoes are to be worn with the shorts, and black regulation shoes to be worn with the black trousers
    - Blue/black Chiropractic windbreakers or blue/black fleece jerseys are to be worn if the weather is cold.
    - Regulation caps may be worn if the weather is hot and sunny.
- **PROFESSIONALISM:**

- Members are to maintain the highest levels of professionalism at all times.
- As students providing medical advice and treatment, we are continually on display and under scrutiny. Never forget that you are not acting as an individual but representing the entire Chiropractic profession, TWR School of Chiropractic and the Student Chiropractic Sports Council.

THE EXECUTIVE COMMITTEE:

- The annual Executive Committee will consist of:
  - Chairperson
  - Vice-chairperson
  - Junior Vice-chairperson
  - Secretary
  - Treasurer
  - Events coordinator/s
  - 4th year representative/s
  - 3rd year representative/s
- The Committee is required to:
  - Uphold the standards and code of ethics within the council and at sporting events.
  - Manage and organise sports events with the view of expanding the annual events program.
  - Achieve the goals of the Student Chiropractic Sports Council.
  - Organise informative lectures, annual strapping courses and opportunities to advance the knowledge of Sports Chiropractic.

The ambition of this Sports Council is ultimately to provide a forum for the senior Chiropractic students to be exposed to sports events, athletes, other professions and hands-on experience in an open interactive environment surrounded by peers and qualified members of our profession.

APPENDIX B

<u>STUDENT CHIROPRACTIC SPORTS COUNCIL</u>
<u>RULES AND REGULATIONS</u>

1. ATTENDANCE:

1.1. Attendance is compulsory if one's name appears on the volunteer list.

1.2. Shift times must be adhered to for the full duration of the specified shift.

1.3. Contravention of these rules will result in a Clinic Disciplinary Council (CDC) hearing being instituted against the offender.

1.4. Any problems or excuses are to be addressed to the Student Chiropractic Sports Council Executive Member on duty.

2. DRESS CODE:

2.1. <u>ONLY</u> black smart pants or shorts, cross trainers or formal black shoes and the regulation SCSC shirt (and the blue or black fleece Chiropractic jersey, or Chiropractic windbreaker in cold weather) may be worn at events. Contravention of this dress code will result in the offender being asked to leave the event immediately.

2.2. Any student wearing the regulation SCSC shirt outside any official event organised by the SCSC will be asked to return the SCSC shirt and disciplinary action may follow.

2.3. The regulation SCSC shirt may also not be worn when attending a beer tent (or similar venue) after the official event etc.

3. MONIES:

3.1. R70.00 (Seventy Rand) annual membership fee is payable to cover SCSC expenditures.

3.2. Failure to pay will result in the non-attendance at organised sporting events.

4. GENERAL:

4.1.3rd and 4th year students MAY NOT - under any circumstances - assess patients,

this is the sole duty of the 5th and 6th year students.

4.2. Should the events get extremely busy, 3rd and 4th year students may assist the

senior students (i.e. 5th and 6th year students) by taking relevant patient details and histories. The patient must then passed to a senior student (i.e. 5th and 6th year students) for evaluation and treatment.

4.3. The 4th year students may only perform STT (Soft Tissue Therapy), with the exception of needling, which is the domain of the higher years (i.e. 5th and 6th year students).

APPENDIX C

THE STUDENT CHIROPRACTIC SPORTS COUNCIL PORTFOLIO:

The Student Chiropractic Sports Council (SCSC) is the sporting body of the Student Chiropractors at the Technikon of the Witwatersrand, and is affiliated with the South African Sports Chiropractic Association (SASCA).

SACSA is the professional sports Chiropractic body of South Africa and is made up primarily of Chiropractors qualified with an ICSSD certification.

The SCSC functions to treat, support and co-operate at any sporting events to further and benefit the enhancement of Sport Chiropractic in South Africa. The services provided by SCSC are to treat any athletes presenting with musculoskeletal injuries sustained during the sporting event. These services include spinal and extremity adjustments, soft tissue therapy including cryotherapy (ice therapy), stretching and strapping.

The SCSC team consists of qualified Doctors of Chiropractic that supervise any treatment protocols administered to injured athletes and participants. Students presently in their fifth and sixth years of study aid the doctor with on-site treatment including assessments, diagnoses and treatments (adjustments and soft tissue work). Students in fourth and third years assist with soft tissue therapy and stretching. First and second year students usually attend the events to help with administrative duties such as the completing of forms, patient files and states of the patients and general observation.

CHIROPRACTIC:

Chiropractic is a discipline of scientific healing concerned with the diagnosis, therapeutics, neurophysiological effects related to statics and dynamics of the musculoskeletal system.

Chiropractors are primarily concerned with diagnosis and treatment of the neuromusculoskeletal conditions. The prime areas for treatment are related to the spine, spinal problems and all nerve / muscle or joint related conditions such as:

- Lower back pain
- Neck pain including neck trauma
- Shoulder / arm pain including "tennis elbow" (lateral epicondylitis) and "golfers elbow" (medial epicondylitis)
- Hip / leg pain including "sciatica", knee pain and foot problems
- However, extremities are assessed, diagnosed, treated and rehabilitated

CHIROPRACTIC EDUCATION:

The curriculum at the Technikon Witwatersrand is based on equivalent courses from the Chiropractic Colleges in the United States, United Kingdom, Australia and Canada.

The subjects included in the curriculum are as follows:

IN THIRD YEAR:

- Psychopathology
- Principles and practice of Chiropractic
- Systemic pathology
- Auxiliary therapeutics
- Diagnostics
- General pathology

- Radiographic normal anatomy

IN FOURTH YEAR:

- Diagnostics
- Clinical Biomechanics and Kinesiology
- Clinical Chiropractic
- Principles and practice of Chiropractic
- Research methods and techniques
- Radiographic anatomy

IN FIFTH YEAR:

- Clinical Chiropractic
- Principles and practice of Chiropractic
- Clinical Biomechanics and Kinesiology
- Practice management and jurisprudence
- Research project and dissertation

IN SIXTH YEAR:

- A residency program during which students spend time with practicing Chiropractors, as well as doing community service. The students attend congress presented by members of the medical profession talking on certain topics that include neurosurgery, neurology and orthopaedics.

- During the fifth and sixth year, a residency program is in place during which students spend time with qualified Chiropractors in an R30-million, multidisciplinary clinic on Doornfontein campus, which includes a radiology laboratory.

TREATMENT PROTOCOL:

- **<u>THE CASE HISTORY:</u>**
  - The Doctor of Chiropractic on duty will firstly take a comprehensive case history, and also assess the injuries of the patient.
  - The fifth and sixth year students assist the doctor with this function.

- **<u>EXAMINATION:</u>**
  - The fifth and sixth year students perform a full physical examination.
  - The physical examination includes neurological and orthopaedic tests, as well as specialised joint motion tests that help the students determine exactly where and what the cause of the pain and injury is.
  - Every student reports his or her findings to the Doctor of Chiropractic who will help in determining the treatment protocol of the patient.

- **<u>TREATMENT:</u>**
  - With all assessments undertaken, the students are now able to safely and effectively treat the patient under the supervision of the Chiropractic doctor.
  - Spinal manipulation is a safe and painless form of treatment delivered by highly trained professionals.
  - The treatment involves a specialised manipulative technique, usually referred to as an adjustment. The adjustment is a specific, high velocity, low amplitude movement done by hand that is applied specifically and carefully to areas of treatment such as the spine and extremities.
  - Patients usually feel instant relief as the joints are adjusted and nerves are freed from restrictive pressure or irritation.

- **<u>FORMS OF TREATMENT PROVIDED:</u>**
  - **FIFTH AND SIXTH YEARS:**
    - Adjustments of the entire vertebral column and all joints, where indicated

    - Mobilisation of joints (the process by which an immovable joint is moved again through its normal range of motion)
    - Cryotherapy (application of cold to the surrounding tissues)
    - Thermotherapy (application of heat to surrounding tissues)
    - Strapping of joints
    - Qualified sports massage therapy
    - Treatment of myofascial trigger points (treatment of hyper-irritable areas usually present within taut skeletal muscles or in muscle fasciae, usually presenting as pain on compression)
    - Rehabilitation of muscle injuries, i.e. stretches and strengthening exercises

- **FOURTH YEARS:**
    - Mobilisation of joints of the entire vertebral column
    - Cryotherapy
    - Thermotherapy
    - Qualified sport massage therapy

- **THIRD YEARS:**
    - Cryotherapy
    - Thermotherapy
    - Qualified sports massage therapy

RECENT SPORTING EVENTS COVERED:

- PICK `N PAY 94.7 CYCLE CHALLENGE, NOVEMBER 2004
- GLENDOWER GOLF DAY, OCTOBER 2004
- 702 "WALK THE TALK", JULY 2004
- PICK 'N PAY 94.7 SPINATHON, MAY 2004
- CBC BOKSBURG RUGBY FESTIVAL, MARCH 2004
- KING EDWARD VII SCHOOL RUGBY AND HOCKEY FESTIVAL, APRIL 2004
- INTER-PROVINCIAL TOUCH RUGBY TOURNAMENT, MARCH 2004

- KING EDWARD VII SCHOOL WATERPOLO FESTIVAL, MARCH 2004
- PICK ‘N PAY MARATHON, FEBRUARY 2004
- PICK ‘N PAY 94.7 CYCLE CHALLENGE, NOVEMBER 2003
- PONDS WALK FOR CANCER AT JOHANNESBURG ZOO, OCTOBER 2003
- ULTIMATE FRISBEE TOURNAMENT, SEPTEMBER 2003
- ST. PETER’S COLLEGE FESTIVAL, AUGUST 2003
- FNB / 702 WALK THE TALK, JULY 2003
- PICK ‘N PAY 94.7 SPINATHON, JULY 2003
- GAUTENG NATIONAL NETBALL CHAMPIONSHIPS, JUNE 2003
- CHRISTIAN BROTHERS COLLEGE RUGBY FESTIVAL, MAY 2003
- TECHNIKON WITWATERSRAND EASTER HOCKEY FESTIVAL, APRIL 2003
- KING EDWARD VII RUGBY AND HOCKEY FESTIVAL, APRIL 2003
- KING EDWARD VII WATERPOLO TOURNAMENT, MARCH 2003
- PICK ‘N PAY MARATHON, FEBRUARY 2003
- PICK ‘N PAY 94.7 CYCLE CHALLENGE, NOVEMBER 2002
- NATIONAL JUNIOR TENNIS CHAMPIONSHIPS AT SUN CITY, NOVEMBER 2002
- PONDS WALK FOR CANCER AT JOHANNESBURG ZOO, OCTOBER 2002
- ALBERTON ATHLETICS CLUB RUN FOR CANCER, JULY – AUGUST 2002
- FNB / 702 WALK THE TALK, JULY 2002
- COMRADES EXPERIENCE (EXPO), JUNE 2002
- SOUTH AFRICAN CATHOLIC SCHOOLS RUGBY FESTIVAL, APRIL – MAY 2002
- KING EDWARD VII CENTENARY RUGBY AND HOCKEY FESTIVAL, MARCH - APRIL 2002
- 94.7 CYCLE CHALLENGE, NOVEMBER 2001
- MTN SATELLITE TENNIS TOURNAMENT AT SUN CITY, 2000 AND 2001
- ST ALBANS (PRETORIA) RUGBY FESTIVAL, MARCH 2000
- WORLD SOFTBALL CHAMPIONSHIPS IN EAST LONDON, 2000
- WORLD WEIGHTLIFTING CHAMPIONSHIPS AT SUN CITY, 2000
- THE ALL AFRICA GAMES, 1999:
- SOUTH AFRICAN SCHOOLS (UNDER 19) NETBALL CHAMPIONSHIP, 1999
- ST JOHN’S RUGBY FESTIVAL, MARCH 1999
- SOUTH AFRICAN J.K.A. KARATE CHAMPIONSHIPS, 1999

APPENDIX D

STUDENT CHIROPRACTIC SPORTS COUNCIL

EVENT: ____

DATE: ____________________

Student name: ____________________ Signature: ____________________

Doctor name: ____________________ Signature: ____________________

(PTT)

CONTINUATION OF PLAY: Yes No

HOSPITALISATION: Yes No

Patient's name: ____________________ Age: ____________________

Player Umpire Manager Official MedTeam Other: ____________

Sport played: ____________________ Position: ____________________

No. of games participated in this tournament: ____________________

New patient **Repeat patient** **New condition** **Continuation of care**

Previous treatment: ____

____

Location of injury:

Head/concussion	Buttocks	Foot
Neck	Anterior thigh compartment	Shoulder
Thoracic	Posterior thigh compartment	Arm / Elbow
Ribs	Medial thigh compartment	Forearm
Lumbars	Knee	Wrist
Pelvis	Shin / calf	Hand
Hip	Ankle	Fingers/Toes

Mechanism of injury:

Previous competition	**Practice**	**Competition**
Running	Sprinting	Side stepping
Colliding with a person	Colliding with a stick	Colliding with a ball
Sliding	Tackling	

Other: ____

Have you injured the area before? No Yes When ____________________

Did it cause you to leave the game then? Yes No

Did the injury cause you to leave the game now? Yes No

Physical examination:

Tests done:	Motion palpation listings and trigger points found:
Neurological evaluation:	ROM:

Clinical impressions:

Acute	**Chronic**		
Contusion	Laceration	Blister	Heat exhaustion
Sprain	Strain	Dislocation	Fracture
Cervical facet	Thoracic facet	Lumbar facet	SI syndrome
Tendinitis	Systemic disease	Neurological	Circulatory

General muscle tightness (specify): ____________________

Other: ____________________

Treatment:

Massage	Ischaemic compression	Static stretching	Cross friction
Fascial release	Strapping	Needling	Ice
PNF	Exercises		

Modality (specify): ____________________

Manipulation: ____________________

Mobilisation: ____________________