THE EPIDEMIOLOGY
OF
SCHOOLBOY RUGBY INJURIES

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This thesis is dedicated to my parents

Walter and Freda

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DECLARATION

I, Charles Edward Roux, hereby declare that the work on which this thesis is based is my original work (except where acknowledgments indicate otherwise) and that neither the whole work nor any part thereof has been, is being, or is to be submitted for another degree in this or any other university.

I empower the University of Cape Town to reproduce for the purpose of research either the whole or any portion of the content in any manner whatsoever.

Part of this study was presented at the First World Congress of Science and Football in Liverpool on 16 April 1987 and has been published in the South African Medical Journal (Roux CE, Goedeke R, Visser GR, Van Zyl AW, Noakes TD. The Epidemiology of Schoolboy Rugby Injuries. S Afr Med J 1987; 71: 307-313.)

The overall findings of the completed study was presented in Edinburgh on 23 October 1991 at a Sports Medicine Congress held during the 1991 Rugby World Cup competition.

C.E.Roux

Cape Town
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ABSTRACT

Schoolboy rugby injuries are a cause for concern in medical and non-medical circles, but few scientific investigations into their nature and frequency have been undertaken. The majority of reported rugby injury surveys are retrospective, have considered only specific injuries, or have reported only those seen at one location. Also, most studies have not distinguished minor injuries from major injuries.

A pilot study conducted at one school in Cape Town during the 1982 rugby season, showed clear patterns of injury related to the age of players, their level of competition, playing position, the stage of the rugby season and the phase of play at the time of injury (Nathan et al. 1983). The studies as reported in this thesis were designed as a comprehensive follow-up study. The research methods and definition were similar but a much larger sample was studied and new areas not covered by the pilot study were introduced.

During two 18-week seasons, in which approximately 4700 players from 26 high schools played 6766 rugby matches, 905 players were prevented from participating in rugby for at least one week due to injury. The incidence and nature of injuries occurring to these players were followed in a prospective study and results were analysed for: (i) overall number and incidence of injured players; (ii) age-group and playing level; (iii) time of the season; (iv) phase of play; (v) playing position; (vi) type of injury; (vii) anatomical site; (viii) specific diagnoses; (ix) match vs practice injuries; (x) number of days off rugby; and (xi) medical treatment.

The use of correspondence as a survey method resulted in 40

to 50% of injuries not being reported over the two-year period of the study. It appeared that the most accurate method of data collection was direct personal contact between the researcher and the injured player.

Of the 905 players who reported injuries, 619 (68.4%) were injured during match play and 286 (31.6%) during practices. When risks were calculated, it was found that players were 10.8 times more likely to be injured during matches than during practices. Serious injuries, particularly cervical spinal cord injuries and concussion, occurred most frequently during match play and no foul play injuries were reported during practices.

Injury was more common during the first four weeks of the season and again in the same period after the mid-season vacation which suggests a lack of match fitness and proper conditioning at the start of the rugby season. On average, one out of every 10.4 players was likely to sustain an injury which would prevent him from participation for at least one week during each season. The incidence of injured players was low in the under-14 age-group, but increased in the under-15 and under-16 and especially the under-19 age groups. More than 50% of all injured players were under-19 players. The percentage that injured under-19 players represented of all injured players is 31.4% higher, and that of injured under-14 players 53.9% lower, than the percentage of players participating in each age-group. This clearly shows the greater risk of injury in the higher age-groups. Under-19 A-team players were especially injury-prone and accounted for 18.8% of all injured players. At all ages, A-team players were most likely to be injured.

Backline players accounted for 51.8% of all injured players. The average backline player had a 16.1% higher injury risk than the average forward player. Eighthmen (13%), wings

(12.1%), full-backs (11%), and centres (10.8%) were the players most frequently injured (corrected percentages - see Chapter 3.8 [e]). The safest playing positions were the tight-forwards; hooker, prop and lock injuries accounted for only 23.4% of all injured players. More than 50% of all players were injured while tackling or while being tackled, and 20% sustained injuries during the loose-scrum/maul. Forty-five percent of all players injured during the two tackling phases of play were wings or centres, and 50.8% of all concussion injuries occurred during this phase of play (*). Younger players were more at risk of being injured during the two tackling phases of play, whilst players in different positions were likely to sustain predictable injuries during predictable phases of play. The fewest players were injured during line-outs (1.4%).

The lower limb (32.5%), the head and neck (30.4%) and the upper limb (25.8%) were the anatomical sites at which most players sustained injuries. Eighty percent of all head and neck injuries occurred during matches and so did 61.3% of lower limb injuries to wings and centres (*). In general, forward players sustained more head, neck and trunk injuries, and backline players more upper and lower limb injuries. Fracture (27.9%) and ligament/tendon (27.6%) injuries were the most common types of injury. Concussion injuries (12.8%) were under-reported in 19 of the 26 schools and 75.5% (*) of concussed players did not follow official recommendations and returned to the game within three weeks following an injury.

Predictable injury trends were found when specific injuries were analysed. Players participating in the fast, open phases of play were likely to sustain injuries associated with running, side-stepping, fending off, tackling, being tackled and falling, whilst players participating in the tight, set phases of play were likely to sustain specific

injuries associated with scrummaging, loose-scrums and mauls.

Players who reported only one specific injury, and for who the number of days out of rugby could be determined, were out of rugby for an average of 22.7 days. Fracture injuries kept players out of rugby for the longest period (average 34.8 days) and players sustaining ligament injuries were out of rugby for a period twice as long as those who suffered muscle injuries. Nine players sustained injuries of such a serious nature that they were advised not to play rugby ever again. Only ten percent of all injured players required no professional medical treatment. The decrease in the incidence of injured players in 1984 was attributed to under-reporting of injuries during 1984.

This study shows:

(1) that monitoring rugby injuries through correspondence results in significant under-reporting of injuries;
(2) that rugby injuries show specific trends with age, team level, playing position, time of season, type of injury, phase of play, days out of rugby and medical treatment;
(3) that players in different positions tend to suffer specific injuries during predictable phases of the game.

Speed and the competitive level of play may be the most important aetiological factor in the majority of rugby injuries. Similar findings by Sparks (1985) may indicate that these factors are common in schoolboy rugby players across the world.

* - 1984 data only

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CHAPTER 1

INTRODUCTION

1.1 Rugby injuries in South Africa: a brief overview

Concern has been growing in most rugby-playing countries because the incidence of rugby injuries, particularly serious spinal cord injuries, has increased during the past 20 years, and because first-aid management is inadequate. As a result, members of the medical profession (Noakes 1980; Noble 1984), some rugby administrators, parents and ex-players have called for an in-depth investigation into the incidence and nature of rugby injuries.

Up to 15 years ago, there were very few scientific reports concerning rugby injuries, despite the fact that the game is played in some 104 countries world-wide. According to a report by the Human Sciences Research Council (1982) rugby is, apart from athletics, the sport in which white South African schoolboys most frequently participate. Although a few scientific studies examining the incidence and nature of schoolboy injuries had been conducted in other countries, the only information published on injuries sustained by South African schoolboy players was included as part of two studies conducted at Loftus Versveld rugby ground in Pretoria, and was not detailed (Wessels 1980, Northern Transvaal Rugby Union 1982).

This absence of scientifically accurate information about the possible incidence and consequence of these injuries has led to considerable local speculation. For example, a report by Bateman (1982) stated that "an estimated 50 000 (South African rugby players) will require professional medical attention this year". A not uncommon attitude would seem to be that rugby is a tough contact sport, and that players

should be prepared to accept injury as a natural part of the game; otherwise they should not play it. In some circles, particularly amongst rugby administrators, this view seems to remain and may to some extent explain the lack of detailed research into the nature and cause of these injuries. It is no secret that in some rugby playing countries administrators have seen attempts to investigate the incidence and nature of rugby injuries by members of the medical profession as an invasion of their rights and have labelled such efforts by the academic fraternity as a campaign to seek publicity (Noble 1984) or to discredit the game (Noakes 1980).

1.2 Introduction to the problems studied in this thesis

The understanding of the nature and cause of rugby injuries is hampered by a lack of adequately controlled prospective epidemiological surveys in well-defined rugby-playing communities, despite appeals for such studies more than two decades ago (Editorial 1977; Jenner et al. 1979; Noakes 1980). Thus, the majority of rugby injury surveys are retrospective (Williams and McKibben 1978; Hoskins 1979; Burry and Gowland 1981; Sovio et al. 1984; Kew et al. 1991), have considered only specific injuries (Roy 1975; Durkin 1981; O'Carrol et al. 1981; McCoy et al. 1984; Silver 1984; Taylor and Coolican 1987; Scher 1977-91), or have reported only those injuries seen at one location such as at a medical facility or a rugby field (Walkden 1975; Lingard et al. 1976; Van Heerden 1976; Durkin 1977; Davidson et al. 1978; Davies and Gibson 1978; Ingles and Stewart 1981; Briscoe 1985). Also, most studies have not distinguished minor injuries such as abrasions and haematomas from major injuries, only the latter being of real concern (O'Connel 1954; Weightman and Browne 1974; Roy 1974; Wessels 1980; Addley and Farren 1988). Furthermore, in a number of studies the accuracy of the survey methods is unknown or would appear to be seriously in error (Adams 1977; Sparks 1981;

Dinkelman 1983; Akpata 1990).

The 1982 study, which served as a pilot study for this investigation, documented all serious rugby injuries during one playing season in a well-defined population of schoolboys at one school (Nathan et al. 1983). The accuracy and completeness of the data were ensured by a weekly update of the record and personal interviews with each player injured during the previous week. The results showed clear patterns of injury related to the age of the players, their level of competition (A-team vs lower team) and playing position, the stage of the season, and the phase of play at the time of the injury (Nathan et al. 1983). The major limitations were that the study was limited to one geographical area and that the total number of injuries surveyed had been relatively small.

The writer's study (1983/84), which is an integral part of this thesis and is fully documented in Chapters 3 to 7, was designed as a comprehensive follow-up study of the pilot study. The research methods and definition were similar but a much larger sample was studied and new areas not covered by the pilot study were introduced. As a result, a large body of data was collected, much of which has never been examined before. This information has been carefully analysed and documented. In addition, there is some information which may seem irrelevant, repetitive and even confusing. This information has been included for the sake of completeness. It is hoped that this study will serve not only as a basis for future epidemiological rugby injury studies but will also provide information of immediate practical value to those who wish to reduce the incidence of injury amongst schoolboy rugby players.

The remainder of this Chapter sets out to introduce the problem, as well as the broader and specific aims and limitations of the study. Chapter 2 examines the literature available on the subject of the study and in Chapter 3 the

research methods are discussed. The results of the 1983 and 1984 studies, including some discussion, follow in Chapters 4 and 5 respectively. In Chapter 6 the results and findings of the overall study are discussed and compared, where possible, with existing research. Finally, in Chapter 7, the major findings are concluded and recommendations for reducing schoolboy rugby injuries are made.

1.3 Scope of the study

After a thorough investigation of previous and related research the broader aims of this study were determined as the following:

To conduct a scientifically designed study of prospective rugby injuries within a well-defined population of schoolboy rugby players, in order to remedy the existing lack of information and to offer recommendations aimed at reducing the incidence of these injuries. One of the major considerations was that the study had to be prospective. It was felt that in most retrospective studies many injuries were either not reported at all or the circumstances of the injuries were inadequately documented. This rendered such data suspect and did not give a true perspective of the nature and incidence of rugby injuries.

Another important consideration was that the study had to be conducted within a well-defined rugby playing community. Schoolboy players were selected because of a lack of existing research, particularly in South Africa, and the probability that data could be collected more easily in that group. The high number of catastrophic and serious neck injuries reported among schoolboy rugby players was also a major factor influencing the selection of this group.

Unlike the 1982 pilot study (Nathan et al. 1983), in which junior and high school rugby injuries were studied, this

study (1983/84) was limited to high school players only. This decision was justified by the finding in the 1982 study of Nathan et al. (1983), that very few injuries were reported by junior schoolboy players (under age 13) and most were of a trivial nature. Previous research also indicated that almost all catastrophic and serious neck injuries sustained by schoolboy rugby players occurred to high school players older than 14 (Hoskins 1979; McCoy et al. 1984).

Major consideration was given to the definition of an injury. Many previous studies examined only serious injuries such as cervical spinal cord lesions, whilst others included even the most trivial of injuries such as minor lacerations and abrasions. Sparks (1981, 1985), who has conducted rugby injuries research at Rugby School in Britain for more than 30 years, defines an injury as one which prevents a player from participation for one week. A similar definition was used for this study (1983/84), with the addition that all concussion injuries were considered to constitute an injury, irrespective of the period that the player was out of rugby, and had to be reported.

There were three reasons for selecting this definition of injury. Firstly, this degree of injury would be easily identified by the particular survey methods used, whereas less serious injuries which did not prevent the player from playing for 7 days, would more likely go undetected. Secondly, trivial or minor injuries were of little short-term or long-term consequence, and could safely be ignored, as their inclusion would have overestimated the true risk of playing rugby. Also, this definition would allow comparisons to be made with the studies of Sparks (1981, 1985) and the 1982 pilot study (Nathan et al. 1983).

A further problem identified in previous research was that research samples were relatively small, conducted for one season only, and limited to one geographical area. In this study (1983/84) a large number of schools were selected from

a wide geographical area and studied over a two year period. It was felt that, even with the anticipated under-reporting of injuries suspected when conducting a large study, this would still provide adequate information to determine the true nature and incidence of schoolboy rugby injuries. By conducting the study over a two-year period it would also be possible to compare not only the results with existing research, but to compare the results found in each of the two years. Furthermore, problems identified with the survey methods during the first year of the study could be eliminated or minimized during the second year of the study.

In order to ensure accuracy and completeness of data, survey techniques similar to those in the pilot study were used. However, due to the fact that this study (1983/84) was to be much larger, and the schools spread over a wide geographical area, it would have been impossible to monitor all the schools personally, as was the case in the pilot study. It was therefore decided to divide the schools into two groups. The first group, consisting of six Western Cape schools, was to be monitored personally by the research team. The second group, consisting of four schools from each of five different regions in the Cape Province, was to be monitored through correspondence. By dividing the schools into the above-mentioned two groups and using different survey techniques, it would be possible to evaluate the survey techniques and determine whether, and if so, to what extent, under-reporting of injuries occurred.

A final reason for conducting this study was to determine which relationships existed between the injury patterns found in this study (1983/84), other studies of schoolboy and adult rugby injuries, and in related sports such as Rugby League, Football (soccer), and American Football. This study could then serve as a basis for future comparable studies.

1.4 Specific aims of the study

The specific aims of the study were to determine:

(a) the overall number and incidence of injured players;
(b) the age-group and playing level (team) of the injured players;
(c) the incidence of injury during different periods of the seasons;
(d) the playing position and the phase of play at the time of the injury;
(e) the incidence of players injured during match play and during practices;
(f) the anatomical site and nature of injuries;
(g) the specific diagnoses of the different injuries;
(h) the medical treatment that the players received;
(i) the average number of days that injured players were out of rugby.

Information from the above would then be used to determine:

(a) possible relationships between age, playing level, playing position, phase of play, anatomical site, type of injury, specific injury, medical treatment and days out of rugby;

(b) relationships that might exist between this study (1983/84), the 1982 study conducted by Nathan et al. (1983) and other schoolboy and adult injury studies;

(c) whether, and if so to what extent, under-reporting of injuries had occurred.

(d) similarities and differences that might exist between the results of the two years over which the study was conducted, and between the two groups into which the schools were divided;

Finally, to outline the major findings of the study and to offer recommendations for ways in which the incidence of schoolboy rugby injuries might be reduced.

1.5 Limitations of the study

As mentioned above, almost all previous research on rugby injuries had limitations and shortcomings. These limitations could be effectively remedied by a well-planned, prospective study. However, due to the wide geographical area from which the schools were chosen, it was anticipated that, by using correspondence as a survey method, poor reporting might occur in at least some instances. It was felt that personal contact with coaches and players could greatly enhance the monitoring of injuries and should therefore provide more accurate and reliable data.

Only ten of the 26 selected schools were from the Western Cape region, the area from which the research was conducted. The remaining 16 schools were from distant regions of the Cape Province and personal monitoring of these schools was not possible. It was for this reason that the schools were divided into the two groups. Thus, the fact that it was not possible to have personal contact with all the schools could have been seen as limiting the study. However, in order to minimize the effect that monitoring by correspondence could have had on the results, particular attention was paid to drafting the instruction forms and to designing the report-back procedures.

The second factor that was anticipated as a possible problem was that some headmasters and coaches might have shown indifference or even open antagonism to the study being performed at their schools. Due to the extensive publicity that rugby injuries had received in the media during the previous decade, they had, regrettably, become a very controversial and emotive issue. Continual criticism of

rugby authorities by members of the medical profession as well as constant reporting of injuries, particularly cervical spinal cord injuries, by the media, had divided the parties into two camps.

The University of Cape Town's Sports Science Unit had been in the forefront of the campaign to make rugby a safer game, but unfortunately many people associated with the game perceived the Unit's contribution in a negative light. It was therefore decided that the study should not be conducted by the Sports Science Unit only but in conjunction with the Cape Education Department. The Cape Education Department is responsible for the welfare of all pupils under its jurisdiction and it was felt that, with the official sanction and co-operation of the Education Department, any prejudice or resistance to the project by the schools could be reduced or hopefully eliminated.

Finally, a major part of this research was to be conducted on aspects not examined in previous rugby injury surveys. These included the under-reporting of injuries, an analysis of specific injuries and the relationships that existed between various components of the study. It was therefore anticipated that it would not be possible to compare these data to existing research and determine whether any similarities or differences existed. However, the data would be valuable for comparison with future studies using techniques similar to those used in this study (1983/84).

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

For reasons which remain largely unknown, there is a distinct lack of information on the nature and frequency of rugby injuries, particularly those occurring to schoolboy rugby players. This contrasts with other major contact sports such as American Football and Association Football (Soccer). Although more studies on rugby injuries have been conducted in recent times, most of these are inadequate in one or more ways and are therefore of little practical value. In the section that follows, a historical perspective of existing rugby injury studies will be examined and some possible reasons for the lack of research, particularly during the early part of this century, will be discussed.

2.2 Historical review

2.2.1 The origins of the game

The origins of the modern game of rugby can be traced to England. According to legend the game originated when, in 1823 at Rugby school, William Webb Ellis "with fine disregard for the rules of football as played in his time, first took the ball in his arms and ran with it, thus originating the distinctive feature of the Rugby game". Very little evidence to support this account of the birth of rugby exists and in recent times sports historians have debated the issue at length. What is, however, significant is that rugby was played primarily at public schools from 1840 to 1860. As the boys left school the game spread to universities and cities. That the game was dangerous

during this period is evident from reports at the time. "Hacking" (kicking the shins of an opponent or tripping him) was banned during the 1860's following the death of a Richmond player and the forced cancellation of a match due to too many players "being lamed by hacking".

The game continued to exist in many forms and it was not until 1871, when the Rugby Football Union was formed, that a general code was accepted and rules drawn up. The game was exported to the British colonies by servicemen at the end of the nineteenth century and became popular in South Africa, New Zealand and Australia. It later spread to the United States and Canada via Harvard University, which wanted to mimic Cambridge and Oxford Universities. The game remained popular in Britain, France, South Africa, Australia and New Zealand and has, in the past 30 years, spread to many more countries across the world.

2.2.2 Historical overview of rugby injuries

A review of the literature shows that almost all previous research, conducted into various aspects of the game of rugby, has occurred during the past 35 years. A few studies were conducted in the 1950's and there was a gradual increase in the number of studies during the 1960's and 1970's, which culminated in an unprecedented number of papers being published in medical and sports medical journals in most traditional rugby playing countries. The increase in the number of articles appearing in these journals was not incidental. Current research shows that there had been a similar increase in the number of rugby injuries, particularly of spinal injuries. No research on rugby injuries during the early part of this century exists and it is therefore possible only to speculate on the nature and incidence of injuries during this period.

The only study which covers part of this period, is that conducted by O'Connel (1954). This is also the first known rugby injuries survey. In it O'Connel reports on 600 injuries observed by him over a 20-year period (1930-1950) in Ireland. His findings will be discussed later in this Chapter but it is interesting to note that according to O'Connel, rugby was played mainly by the upper middle classes before the first World War, but since then "the popularity of the game and the change of the times have led to its being played and enjoyed by boys and men from a much wider social scale". What "the change of times" means is difficult to interpret. It may have been economic upliftment of the lower classes, but even this does not seem to be the answer as O'Connel further states that: "Even minor injuries in these days are of much more serious economic import to students, young businessmen, manual workers and members of the professions than they were in the good old days. Employers are not so inclined to take a lenient view of absence from work which may be due to sports injuries, whilst in recent years the premium for accident insurance for sports (and particularly rugby football) has become almost prohibitive for younger players" (O'Connel 1954).

According to Dr Danie Craven, President of the South African Rugby Board and an international player during this period, injuries were as common then as they are now and the nature and mechanism of the injuries were similar. The reason for the lack of research during this period was because "these injuries were not an important issue". He does, however, feel that players have become "softer" in modern times (personal communication).

It would therefore seem that, during this period, a different attitude was prevalent amongst officials, players and the media; "Rugby Union is an amateur game and it is designed for sportsmen who accept any knocks that are going in the spirit of the game" (O'Connel 1954); the

media carried match reports but injuries to players were seen as part of the game and not reported or investigated. Assuming that injuries were as common then as they are now, the lack of official concern by administrators and research by the medical profession is surprising. The next section examines why this should be so.

It is interesting to note that, in America, the medical profession was actively involved, from the turn of the century, in making American Football a safer game. Nichols and Smith (1906) published a comprehensive report of the injuries sustained by 150 members of the Harvard University football squad while playing football during the 1905 season. This report included the methods of data collection, match vs practice injuries, phases of play, specific analysis of injuries, medical treatment, days out of play and college, and a number of observations which certainly make that study (Nichols et al, 1906), although it was conducted almost a century ago, one of the finest sports injury studies ever conducted. What followed this study is even more remarkable.

Before the next season "radical changes were made to the playing rules". These changes were made "partly to avoid the uninteresting mass play , and partly to lessen the number and severity of the injuries received in the game". During the next three seasons the researchers carefully recorded all injuries and were able to report a dramatic decrease in the number and severity of injuries (Nichols and Richardson 1909). Although on average more players participated during each of the following three years, fewer players were injured over the whole period than during the 1905 season alone. The total number of days out of play due to injury, dropped from 1057 (1905) to 312 (1908) or 15 to 4 per injured player. The researchers concluded: "An examination of the figures given shows that there has been a marked and steady diminution in the percentage of injuries since the revision of the football

rules. All the diminution of injuries, however, is not due to the changes in the rules; some is due to the better and enforced protection of the men, to the fact that no cripples were played, and that no man was played to the point of exhaustion. Not less in importance has been the care and attention of a clever, intelligent trainer. Not only has the number of injuries been markedly diminished, but there has been a great diminution in the average of severity, and the character of the game has been changed for the better, not only from the point of view of the player and the spectator, but also from that of the surgeon" (Nichols and Richardson 1909).

Research on American football injuries continued throughout the early part of the century and did not only include injury surveys but started examining other aspects such as anthropometrical profiles of players and psychological behaviour. There was a steady increase in the number of research studies during the fifties and since the sixties a much greater amount of research has accumulated. This has included research at all levels, from professional Football to young schoolboy players, and into all aspects of the game.

It is not easy to postulate reasons for the lack of research and concern on rugby injuries by the medical profession during the early part of the century. That fatalities and cervical spinal cord injuries occurred as a result of playing rugby, although most probably not as many as during the later part of the century, is evident. In the paper by O'Connel (1954) the author states that: "During my 20 years (1930 - 1950) of close contact with the game I have known of five fatal injuries: three occurred from fracture dislocation of the cervical vertebra through charging or collapse of the scrum; one player died from an undiagnosed rupture of the spleen in 1931, and one from tetanus. Of the injuries herein listed the great majority made complete recoveries and returned

to take part in the game, including two players who received serious injury to the cervical spine". According to Durkin (1977) "there have been two deaths attributable to playing rugby in the history of the club (Gloucester). First in 1925 due to a ruptured kidney and the second in 1926 due to a fractured vertebra".

As already mentioned, there was a marked increase in the number of research studies during the past 30 years. From all available evidence, it would seem that this increase in research was caused by a corresponding increase in the number of cervical spinal cord injuries. No popular theory for the increase in cervical spinal cord injuries can be found and it would seem that several factors contributed. Two factors in particular may have been responsible for, or may have contributed directly or indirectly to the increase of these injuries and will be discussed briefly.

(a) The role of television

The advent of television may have contributed greatly in popularising the game of rugby. Although no scientific evidence for this exists, it is generally accepted that television has popularised sport in general. It would therefore stand to reason that this would also be the case in rugby. This certainly seems to be the case in the rest of the world. Five years ago a Rugby World Cup, which created new exposure opportunities for rugby on television, was introduced. It probably led to an increase in the number of players worldwide. However, this may not be the case in South Africa where there has been a decrease in the number of players participating in the game during the past decade. It is not clear what the reasons for the decrease in numbers may be, but some administrators have blamed television even for this; "today's children spend too much time watching

television and have become soft".

The increase in the popularity of the game in other parts of the world also probably led to an increase in the level of competition. Schoolboys model their play on that of their heroes. Aggressive and highly competitive play by top international players is frequently copied by schoolboy players. Often this type of play results in injuries being sustained.

If television were to be indirectly "blamed" for the increase in injuries it almost certainly also contributes to the exposure of these injuries. Television cameras often focus on injured players, and replays of the incidents during which the players are injured occur commonly. Footage from one such incident in South Africa, in which a provincial player died as a result of a tackle and the subsequent maul was shown repeatedly in newscasts. The untimely death of this player and the exposure that it evoked led to a flood of media reports and stimulated debate about rugby. This research study followed as a direct result of that debate.

(b) Positional specialisation

Although the basic structure of the game has not changed much since the rules were first drawn up, several new approaches to the way it was played occurred during the past century. One such approach was positional specialisation and this greatly influenced, in particular, the scrum phase of play. According to Stewart (1979), at the turn of the century, a rugby team consisted of seven backs, seven forwards and one "in between". This "in between" player later became the eighthman amidst considerable controversy in the 1930's. At first, the scrum developed into a 2-3-2 formation and there was no

specialisation. The first two forwards to arrive at the mark formed the front row of the scrum, the next three the middle row and the last two made up the back row. The eighthman fed the ball into the scrum.

The 1905 New Zealand All Blacks were the first team to introduce positional specialisation in the scrum. For the first time the scrum waited until everyone was in his specialist position. Along with specialisation came a change in the scrum formation. The Australians and British favoured a 3-3-2 and the South Africans and All Blacks a 3-4-1 formation. Although the formation of the scrum had changed, attitudes toward the scrum did not change to a marked degree. There was positional specialisation but not physical specialisation. The scrum was merely a phase of play aimed at restarting the game.

This and the entire pattern of the game was to change in 1949. The South Africans introduced new terms such as "loose head" and "tight head" props. Hookers were expected to win the ball on their put-in and scrums became predictable. This led to attacking and defensive positions being taken up by backline players. A more important aspect that resulted from the predictability of scrums was that heavier and stronger forwards were demanded. Stewart (1979) states that "many an international lock or prop represented his country at 13 or 14 stone up to the early 1950's. There were plenty that couldn't even make 13 stone. But from then on, it was 15 and 16 stone men who gained selection as lock or prop".

In 1963 several laws aimed at taking close marking off backline players were introduced. New off side lines during scrums became the back foot of the scrum and not the ball. Scrum theory changed and control of the ball from the scrum became an important factor.

Charging, pushing and swinging the scrum on the opponents ball became common tactics. As positional and physical specialisation increased, pressures in the scrum increased. Scrum machines were introduced to optimise scrumming techniques. The increase in the pressures in the scrum almost certainly resulted in an increase in scrumming injuries, particularly of cervical spinal cord injuries when the scrum collapses.

Specialisation in the scrum led to specialisation in the other playing positions. Backline players became attacking or defensive players. The "advantage line" (an imaginary line that runs through the centre of the scrum or line-out) had to be crossed by attacking players. Defenders had to prevent attacking players from doing so.

Also, players who were never previously involved in certain play phases became involved. For example, during the early part of this century loose forward players were primarily involved in scrums, line-outs and especially loose-scrums and mauls. After specialisation they became specialists at cover defence and were required to put pressure on opposing backline players, particularly half-backs. Under increased pressure, half-backs reverted to kicking in order to cross the advantage line, and became specialist kickers. Wings and centres had to be fast and strong runners in order to beat defensive backline and loose forward players.

This all resulted in an increase in the speed at which backline movements were executed. Greater impact between players, due to increased speed during the tackling and being tackled phases of play, almost certainly resulted in an increase in the number of injuries sustained by backline players.

Finally, it could be argued that positional specialisation should have reduced injury risk. In all positions, players should have become more skilled and physically better prepared for the requirements of playing in specific positions. Although this may have occurred to some extent, it would seem that positional specialisation greatly increased the level of competition, which resulted in the game being played at a greater speed. It seems likely that many injuries occur as a result of the increase in the speed of the game.

2.3 **Rugby injuries research**

The existing literature on rugby injuries can broadly be divided into the following categories:

(1) articles, editorials and correspondence in popular magazines and newspapers;

(2) correspondence and editorials in medical and sports medical journals;

(3) studies which compared rugby injuries to injuries that occur in other contact sports;

(4) studies which have examined aspects such as the availability of medical and first-aid facilities and the management of injuries;

(5) studies which examined only specific injuries such as cervical spinal cord, laceration or orofacial injuries;

(6) epidemiological studies which examined injuries that occur to specific playing populations such as club or schoolboy rugby players.

For the purposes of this literature review the last two categories will be briefly discussed. A comprehensive review of all schoolboy rugby injuries research will follow that discussion.

2.3.1 Specific injury studies

Almost all the studies in this category have been conducted on the occurrence of cervical spinal cord injuries. This is also, and not surprisingly, due to the serious nature of these injuries, the area of rugby injuries into which the most research has been conducted. Most studies were conducted by researchers at Spinal Units or Casualty Departments of hospitals in traditional rugby playing countries. Although almost all these studies were conducted retrospectively, reliable data were obtained fairly easily and the findings of the studies have been significant.

(a) Cervical spinal cord injury studies

Scher (1979 - 91) has reported on 88 players admitted to the Spinal Unit of the Conradie Hospital in Cape Town over a period of 25 years. His findings will not be discussed in this review as a retrospective study, conducted by Kew et al. (1991) at the same Unit and which includes the data of Scher, provides more complete data over a longer period (Scher was a co-author in this study). Their findings show that 117 players with catastrophic neck injuries had been admitted to the Unit over a period of 27 years. Of these, 19 had died as a result of their injuries. The study does not state how many of the remaining players suffered permanent paralysis, but some idea can be obtained from the studies of Scher. During the period 1981 to 1987, 39% of the players admitted were completely paralysed (Scher 1990).

Most cervical spinal cord injuries occurred during the being tackled (30%), tackling (21%), scrum (21%) and loose-scrum/maul (18%) phases of play. Collapsing scrums, high tackles and multiple tackles were the particular play phases during which most occurred. Eighty-one percent were sustained by adult players and 98% occurred during matches. Hookers (26%) were the players most at risk. One of the major findings of the study by Kew et al. (1991) was that there had been a dramatic increase in the number of cervical spinal cord injuries during the past 20 years, particularly during the 1980's.

Comprehensive cervical spinal cord injury studies have also been conducted at the National Spinal Injuries Centre, Stoke Mandeville Hospital in England (Silver 1984; Silver and Gill 1988), at the Cardiff Royal Infirmary in Wales (Williams and Mckibbin 1978, 1987), at the Acute Spinal Cord Injury Unit, Shaughnessy Hospital in Canada (Sovio et al. 1984), at the Fractures Clinics, St Vincent's Hospital in Ireland (O'Carrol et al. 1981) and in a study of all players admitted to six spinal units in Australia (Taylor and Coolican 1987)

Cervical spinal cord injuries that occurred to players in New Zealand were reported by Burry and Gowland (1981), whilst Akpata (1990) reported on all such injuries that were sustained by players in the United States over a 20-year period (1970 - 90). Two studies (Hoskins 1978; McCoy et al. 1984) have reported on cervical spinal cord injuries that occurred to schoolboy players and these studies will be discussed at length at a later stage.

The major findings of almost all cervical spinal cord injury studies correspond very closely and it has therefore been possible to identify particular trends

associated with these injuries. Most important among these trends are: the dramatic and simultaneous increase in the number of these injuries in traditional rugby playing countries during the past 20 years; that almost all these injuries occurred during match play and in particular, during the scrum, tackling, being tackled and loose-scrum/maul phases of play; that most occurred to adult players and at higher levels of play; and that front-row players were most at risk. Many of the studies blamed competitive and aggressive play for the occurrence of cervical spinal cord injuries and called for central injury registers and insurance schemes to be introduced.

Articles and correspondence discussing cervical spinal cord injuries have also appeared in medical and sports medical journals. Most have expressed concern at the alarming increase in the number of these injuries (Schweitzer 1978; Silver 1979; Piggot and Gordon 1979; Jenner et al. 1979; Noakes 1980; Carvell et al. 1983; Noble 1984; Burry and Calcinai 1988; Wigglesworth 1987). Some articles have focused on the immediate management of cervical spinal cord injuries (Walkden 1978, 1981; Carvell et al. 1983; Goddard 1984) and others on prevention of such injuries (Walkden 1975; Cohen and Siff 1979; Thompson and Morris 1982; International Rugby Board 1987; Noble 1988; Milburn 1990). Three authoritative medical journals, the British Medical Journal (1977), Lancet (1984), and the Journal of Bone and Joint Surgery (Horan 1984), expressed concern in editorials about the increase of cervical spinal cord injuries and two called for a register of all such injuries.

Finally, in an interesting article, Burry (1986) examined the costs involved in care for disabled sportsmen. According to Burry (1986) sports injury

insurance claims from a private sector New Zealand company amounted to NZ $15.5 million in 1983. Of this amount, $6.13 million were claims from players injured in rugby union, followed by soccer ($1.58 million) and rugby league ($1.14 million).

(b) Orofacial injury studies

In recent years several studies, examining orofacial injuries and player attitudes to mouthguards, have been conducted. Most of these studies have originated from the dental faculties at two universities.

De Wet et al. (1980, 1981), of the Pretoria University Dental Faculty, reported that the use of mouthguards had significantly reduced the number of orofacial injuries sustained during rugby. Tooth injuries and concussion were reduced to zero from 21% and 12% respectively. They also found that 98% of all players who received mouthguards accepted the idea, but that only 40% had worn them regularly.

Chapman (1985, 1988, 1990), of the University of Queensland Dental School, has conducted several studies examining orofacial rugby injuries and player attitudes to the wearing of mouthguards. His overall findings were very similar to those found by De Wet et al. (1980, 1981). Chapman (1985, 1988) also reports a significant reduction in the number of intraoral and perioral lacerations by wearers of mouthguards. An interesting aspect examined by Chapman (1990) was the different attitudes in players from different countries. Ninety-one percent of players in the United States National rugby team stated that they would not play without mouthguards, compared with 67% and 38% for their British and Australian counterparts.

The findings of the above studies are confirmed in a study performed in Scotland by Kay et al. (1990). However, in a study conducted at the University of Stellenbosch by Blignaut et al. (1987), the authors concluded that the wearing of mouthguards by rugby players did not significantly reduce the number of injuries.

2.3.2 Epidemiological studies conducted amongst different playing populations

Most of the studies in this category have examined rugby injuries that were sustained by adult players and almost all the studies have been conducted in traditional rugby playing countries. Some were general studies and included data for injuries at all ages and levels of play, whilst others have, for example, reported on injuries sustained by players in a touring team during one tour.

The practical value of these studies is limited as most have used different definitions for an injury. Many have examined only match injuries or only injuries that were reported at a medical facility such as a hospital's casualty ward. Also, some studies have not distinguished between minor and serious injuries, whilst some were conducted over a short period of time, or in a small sample group. Some of these studies are discussed below and it follows that differences amongst them complicate attempts to establish reliable injury patterns.

Durkin (1977) conducted a study at Gloucester Rugby Club (England) from 1972 to 1976. Players ranging in age from 19 to 34 years played for the club and only those that were out of rugby for a period of two consecutive weeks due to injury were considered for the study. Durkin (1977) reported an injury rate of one injury per two to three matches, but provided no information on practice injuries.

Williams (1984) conducted one of the most comprehensive studies to date. He examined all injuries sustained by rugby players in Wales during the 1983 and 1984 seasons and his definition for an injury was similar to that of Durkin (1977). Injury reports were made by doctors and coaches. Interestingly, only 710 injuries were reported during this period. It would seem that under-reporting of injuries had occurred. In the study reported in this thesis, 905 players sustained injuries over a similar period and it will be shown that under-reporting of between 40 - 50% of injuries had occurred. Although the definition for an injury was different in the two studies, Williams (1984) gathered his information from more than 80 clubs (in this study [1983/84] 26 high schools were studied). The study by Williams is possibly the most comparable of all studies in this category and the results of the two studies will be compared later in this thesis.

Ingles and Stewart (1981) reported on 1085 players who were treated at the Christchurch Hospital's Accident and Emergency Unit during the 1979 rugby season. Serious and minor injuries were considered for the study and no distinction was made between injuries sustained during matches and practices. Injuries were analysed for age, grade, playing position, preseason training, phase of play, type of injury and anatomical site of injury. Surprisingly, Ingles and Stewart (1981) concluded that age and grade did not affect the number and type of injury, a finding that is contradicted by almost every other study.

They also state "that rugby does not appear to cause an unacceptable number of grievous injuries". This is a questionable conclusion as more than 1000 players, out of a playing population of 16 000, had been treated at the hospital alone. It is further stated that: "These 1085 players do not represent those presenting directly to general practitioners or specialists outside the hospital system or referrals to hospital specialists". The only

significant finding by Ingles and Stewart (1981) was that 44% of all injuries had occurred as a result of the tackle.

During the same season (1979), Myers (1980) conducted a study of all injuries that were sustained by 347 players, **three referees** and **some spectators** at Ballymore rugby ground in Brisbane, Australia. This is the only known study where injuries to spectators were included in a rugby injuries survey. Also, only injuries that occurred during matches were considered for the study and all injuries, however trivial, were included. Myers (1980) concluded with a quote from another rugby injuries study (Weightman and Browne 1974): "The risk element of contact sports cannot be eliminated for it is this which, mixed with the elements of activity, skill and competition, makes the right prescription for so many men".

The above studies were selected for brief discussion to illustrate difficulties in comparing data. Other studies that have been conducted and which fall within this category are the following: at Accident and Emergency Units (Lingard et al. 1976; Adams 1977; Bedford and Macauley 1984); at specific rugby grounds (Walkden 1975; Northern Transvaal Rugby Union 1982; Wessels 1980, 1984); on injuries sustained by touring teams (Davies 1978; Stefani 1987); on data obtained from insurance claims (Melis 1990); at selected clubs (Roy 1974; Van Heerden 1976; Davies and Gibson 1978; Addley and Farren 1988; Clark et al. 1990); in selected geographical areas (Weightman and Browne 1974)

2.2 Schoolboy rugby injury studies

Of all the research conducted on rugby injuries to date, the area most neglected has been that of injuries which occur to schoolboy players. As was the case with adult injury

studies, concern was expressed only once there had been a dramatic rise in the number of cervical spinal cord injuries, this despite reports from several cervical spinal cord injury studies which suggested that schoolboys may be more prone to serious neck injuries (Silver 1979). A few studies have compared the injuries sustained in different sports at school level (Lingard et al. 1976, Watson 1984, Briscoe 1985). A few more have reported on the frequency and nature of injuries (Davidson et al. 1978, Watson 1981, Sparks 1981 and 1985, Nathan et al. 1983, Sugerman 1983, Davidson 1987). Only two studies have to date been conducted on cervical spinal cord injuries that occur to schoolboy players (Hoskins 1979, McCoy et al. 1984), whilst one study examined the medical facilities and first-aid management at rugby playing schools (Glaun et al. 1984).

(a) Rugby vs other school sports

Rugby is the most popular winter sport played by white South African schoolboys (Human Sciences Research Council 1982). Although no reliable statistics exist, it can be safely assumed that it is also the most dangerous sport in which South African schoolboys participate. In New Zealand, where rugby is also the major winter sport, rugby injuries accounted for 56.8% of 2529 sports injuries treated at Wellington and Hutt Accident and Emergency Departments during the winter season of 1972 (Lingard et al. 1976). Almost 500 occurred to rugby players in the 15 to 19 age-group. The incidence of injury amongst schoolboys was slightly higher in rugby than rugby league and both were much higher than the incidence of injury in soccer.

In Britain and Australia the game is not the most popular school sport and is played primarily in private schools. In Australia rugby rates fourth in popularity after soccer, Australian Rules rugby and rugby league

(Taylor and Coolican 1987). However, studies conducted in both countries show that rugby, when compared with all other contact sports in which schoolboys participate, accounted for most serious injuries. A report by Taylor and Coolican (1987) on cervical spinal cord injuries sustained by Australian schoolboys is discussed in the next section. Briscoe (1985) surveyed 346 sports injuries presented at the Eton College Sanatorium (England) between 1971 and 1982. Seventy five percent of these injuries occurred during one of three types of football played at Eton; rugby, soccer and Eton football. The risk and severity of injuries sustained during rugby were much higher than those of the other two forms of football. Rugby players were ten times more likely to sustain concussion injuries than soccer or Eton football players.

(b) Cervical spinal cord injury studies

Only two studies (Hoskins 1979, McCoy et al. 1984) have examined cervical spinal cord injuries that occurred to schoolboy rugby players in particular, whilst several other cervical spinal cord injury studies have included data on schoolboy players. Williams and McKibben (1978) suggested an increase in the number of serious neck injuries and reported on all cases treated at the Cardiff Royal Infirmatory from 1974 to 1977. Of the nine cases four were schoolboys and one player was irreversibly paralysed. Three were frontrow players and two of these players sustained their injuries when the scrum collapsed.

The findings of the Williams and McKibben (1978) study and a suggestion by Silver (1979) that schoolboys may be particularly at risk, led to a decision by the Medical Officers of Schools Association (M.O.S.A.) to conduct a study in order to gain more reliable information. A General Meeting of the M.O.S.A. in 1979

urgently recommended: that schools take out accident insurance for all rugby players; that schoolboy players were subjected to too much "psyching up"; that Old Boy matches be eliminated; and that there existed a need to improve all-round strength and fitness, together with an understanding of basic skills and techniques for each playing position. A meeting specially convened by the Rugby Football Union endorsed the recommendations of the M.O.S.A. and further decided that rule changes, specifically to deal with the scrum and loose-forward play, should be investigated (M.O.S.A. 1979)

Hoskins (1979), as Honorary Secretary of the M.O.S.A., investigated spinal cord injuries in English schoolboys and reported that five cases of cervical spinal cord injury, two fatal and three leading to permanent tetraplegia, had occurred in the 27 years between 1942 and 1968. However, from 1973 to 1978 12 such injuries had occurred, two fatal and ten leading to permanent tetraplegia. A further 16 injuries to the cervical spinal cord, with no permanent neurological damage, were reported in the eight years from 1971 to 1978. Five of these players, including an 11 year-old, had spinal fusion operations. Most occurred to forward players (77%) and as a result of collapsing scrums (39%), but also during rucks and mauls (23%).

The research of Hoskins showed that there had been a dramatic increase of cervical spinal cord injuries amongst English schoolboys in the 1970's, a finding which corresponds with that found among adult players in all major rugby playing countries. Hoskins noted that schoolboys were not always at liberty to choose whether to participate in a sport which produces more serious injuries than other school games, and that few players were covered by accident insurance. The increase in cervical spinal cord injuries found by Hoskins (1979) was confirmed in the only other study

that reported on these injuries in schoolboy rugby players.

McCoy et al. (1984) reported that five schoolboys, out of a playing population of 2500, had sustained cervical spinal cord injuries with neurological damage in Northern Ireland between 1977 and 1983. Two were injured in collapsing scrums and three as a result of poor tackling. Four of the five injuries occurred early in the season which suggested a lack of match fitness. McCoy noted that, before 1977, not a single injury to the cervical spinal cord with neurological damage was recorded in Northern Irish schoolboys and blames the increase in the number of such injuries on more aggressive and dangerous play.

O' Carrol et al. (1981) reported on 12 patients who had sustained cervical spinal cord injuries whilst playing or practising for rugby and who were admitted to the Fracture Clinics of St Vincent's Hospital in Dublin, Ireland. No breakdown of the ages is given but the mean age of 17.9 years (range 13-28 years) suggests that most must have been schoolboys. Scrums and loose rucks had caused 83% of the injuries. Sovio et al. (1984) reported on nine cases admitted from 1975 to 1982 at Shaughnessy Hospital in Vancouver, Canada. Only one, an 18-year old player, may have been a schoolboy but this is not stated. The position in the U.S.A. seems similar to that in Canada. Of 42 cervical spinal cord injuries reported since 1970 only two were sustained by schoolboy players (Akpata 1990). That there were only two is quite understandable as rugby is not played in schools there. These players may have been injured whilst playing for junior club teams.

A literature search has revealed that no studies which examined cervical spinal cord injuries specifically to schoolboys have been conducted in South Africa,

Australia or New Zealand. Data on schoolboy players has been included in reports from all three countries, but no incidence can be established.

Burry and Gowland (1981) found that six out of 28 players who sustained cervical spinal cord injuries during matches in New Zealand between 1973 and 1978, were injured in schools matches. A further 14 players were injured during this period in practice and social matches but no breakdown of the ages was given. The researchers did, however, conclude that injuries occurring to younger players were more likely to have a serious outcome and that these players appear to be particularly at risk in scrums.

Taylor and Coolican (1987) show a dramatic increase in the number of schoolboys sustaining cervical spinal cord injuries whilst participating in rugby union in Australia. From 1960 to 1976 no schoolboy players reported such injuries, but in the eight years that followed 11 cases were reported. During the same eight-year period, three players sustained cervical spinal cord injuries in rugby league, one in Australian Rules and none in soccer. To put the above into perspective, it is interesting to compare the number of participants in each sport. Rugby union players represented only eight percent of all participants in the above-mentioned four sports codes.

In South Africa cervical spinal cord injuries to rugby players were reported as early as 1977 by Dr Scher at the Conradie Hospital, Cape Town. In his first paper, Scher (1977) reported that, of the 20 players who had sustained cervical spinal cord injuries between 1964 and 1976, four were schoolboys. In correspondence two years later Scher (1979) noted the recommendations made by the M.O.S.A. in England and suggested that serious consideration be given to those, particularly that

junior teams be selected by weight rather than age.

Twelve years later it is still not possible to determine the incidence of these injuries to schoolboys in South Africa, although Kew et al. (1991) showed that, of the 117 cases admitted to the Conradie Spinal Unit between 1963 and 1989, 36 were schoolboys. There had also been an increase in the number of schoolboys admitted from 1977 which reached a peak with seven admissions in 1989.

(c) Epidemiological studies

Very few studies which have examined the nature and frequency of schoolboy injuries have been conducted to date. Of these studies, almost all have originated from three institutions.

Sparks (1981, 1985) reported on rugby injuries that were sustained by 13 to 18 year-old boarders at Rugby School in England. His research covered a period from 1950 to 1983 and includes more than 10 000 injuries. The school fields ten teams annually and the number of matches played by each team varies from 13 at under-19 level to five at under-14 B-team level. His definition for an injury was similar to those of the 1982 pilot study (Nathan et al. 1983) and this study (1983/84). It follows that, in order to establish injury patterns amongst schoolboy players, the results of these three studies may be effectively compared. Sparks analysed the injuries reported in his studies according to age, experience, playing position, phase of play, anatomical site and the period out of rugby. The injuries were separated into serious and minor injuries and a breakdown of only serious injuries, such as fractures and torn muscle and ligament injuries, was given.

Davidson et al. (1978) and Davidson (1987) reported on all rugby injuries presented at the sports injury clinic at Newington College in Sydney, Australia. The school educates 1 000 secondary schoolboys ranging in age from 11 to 18 years. Rugby is the major winter sport and more than 70% of the boys participate in the sport.

In the first report (Davidson et al. 1978) all injuries that had occurred over a period of eight years (1969 - 76) were reported and the second (Davidson 1987) includes all injuries that had occurred from 1969 to 1986. The studies include only injuries that were sustained by players playing in matches at the Newington College fields, and all injuries that were presented at the clinic, however minor, were considered. These injuries were analysed for age, date sustained, diagnoses, treatment, and since 1977, playing position, grade of play and mechanism of injury. Injuries were retrospectively classified as minor or severe. Severe injuries included concussions, dislocations, and most fractures. As both studies conducted at Newington College did not include practice injuries and used a different definition of what constitutes an injury, only limited comparisons with this study (1983/84) can be made.

The third institution at which schoolboy rugby injuries research has been conducted is the Sports Science Unit at the University of Cape Town. Research which served as a pilot study for this study (1983/84) was conducted at one school during one season in 1982 (Nathan at al. 1983). The research included all injuries that were sustained by junior and high school players and the definition of an injury was the same as that of this study (1983/84). Injuries were analysed for age and playing level, playing position, phase of play, time of the season, match vs practice injuries, anatomical site

of injury and injury type and severity.

A second study performed at the above-mentioned Unit examined first-aid facilities and injury management, particularly of concussion and cervical spinal cord injuries, at 29 Western Cape high schools (Glaun et al. 1984).

The findings of the above schoolboy studies will be extensively discussed in the Results and Discussion Chapters of this thesis.

CHAPTER 3

MATERIALS AND METHODS

3.1 Selection of schools

Twenty-six high schools in the Cape Province were selected for analysis on the advice of the Cape Education Department. In general, high schools with a tradition of excellence in rugby were chosen for investigation. There were two reasons for selecting schools with such tradition. Firstly, these schools have larger rugby playing populations and also normally field teams in all age-groups. Secondly, it was felt that reporting of injuries at these schools may be more reliable. Thus, although the 26 schools were not randomly selected and the selection may therefore have influenced the data obtained, the major consideration was obtaining reliable data from a large rugby playing population.

Two further considerations were taken into account at the selection of the 26 schools. Firstly, in order to determine whether any differences existed between the data obtained from schools monitored through different reporting systems, the schools were divided into two groups. The first group, consisting of 20 schools (Figure 3.1), were to be monitored through correspondence in conjunction with the Cape Education Department. The second group, consisting of six schools, were to be personally monitored by the research team during the first year of the study (1983). During the second year of the study (1984) close personal contact with these six schools was to be relaxed. Of particular interest was to determine whether under-reporting of injuries occurred in schools monitored only through correspondence. It was felt that by dividing the schools into the above-mentioned two groups, and by relaxing personal contact with the six personally monitored schools during the second year

of the study (1984), the aspect of under-reporting could be comprehensively examined.

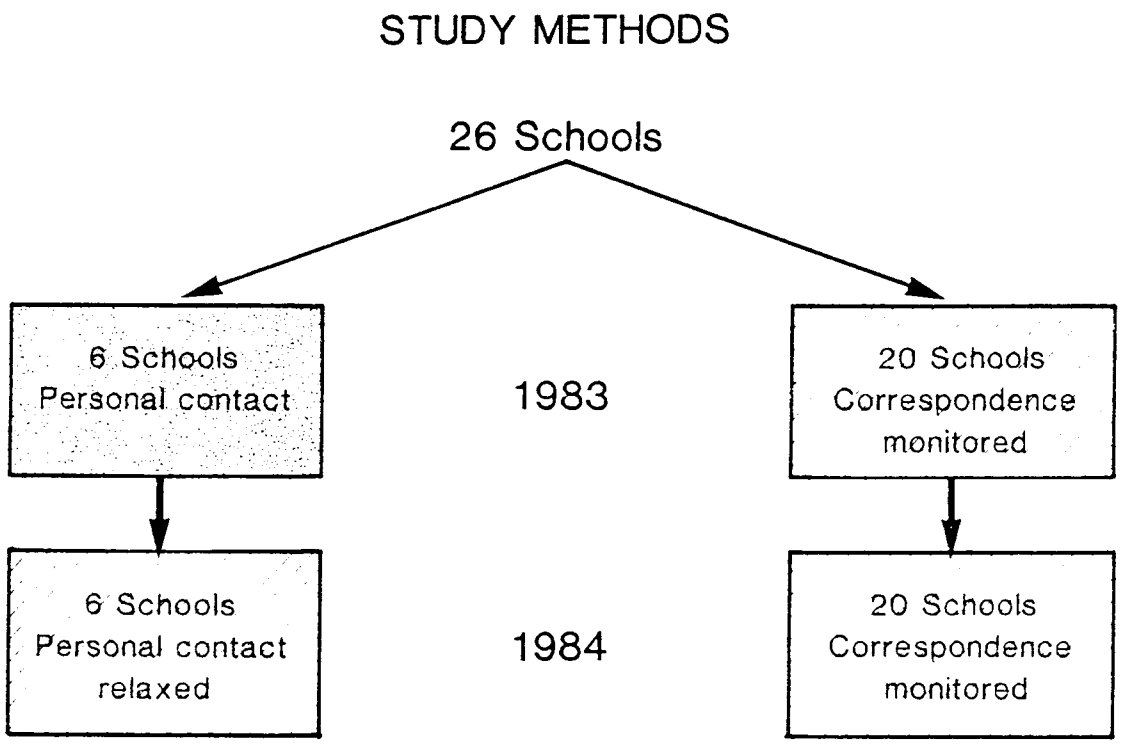

Figure 3.1 The different survey methods that were used in the two groups of schools during the 1983 and 1984 studies.

Secondly, in order to determine whether any differences existed between data obtained from schools in different geographical areas, the 20 correspondence monitored schools were divided into groups of four schools each from five geographical areas (Western Cape, Boland, Eastern Cape, South-Western Districts, and Northern Cape). These five regions were selected as they represent the larger school rugby unions in the Cape Province but differ markedly in terms of climate and total population e.g. Western Cape vs Northern Cape. It was felt that four schools from each region could provide an adequate sample to determine whether the above-mentioned factors (climate and population)

influence injury rates and patterns between different regions. It was also assumed that competitive levels would be similar for schools playing within each region but that the competitive levels may vary between the regions. This assumption was based on the fact that more schoolboys participate in rugby in larger, densely populated metropolitan areas (Western Cape, Eastern Cape) than in the more sparsely populated rural areas (Northern Cape, South-Western Districts).

3.2 **Data collection**

Instruction, weekly report, and injury questionnaire forms (Appendix) were sent to the 20 correspondence monitored schools. The teacher/coach of each team was instructed by the Cape Education Department to complete a weekly injury report form on the Monday following any rugby-playing week. The weekly report form contained the following data:

(a) the date of the preceding Saturday;
(b) controlling body;
(c) the number of boys playing rugby in the school (this data was required after the first week of each term);
(d) summary of players injured during the week (this data included the age-group and team-level of injured players as well as the number of players injured in each team).

The weekly report had to be completed for all teams each week, even by those teams that either did not play rugby or did not have an injury during that week. Completed weekly report forms had to be signed by both the teacher in charge of rugby at the school and the headmaster.

Injured players were instructed to complete a separate injury questionnaire containing the following data:

(a) personal particulars (name, date of birth, age, height, mass, name of school, team and playing position);

(b) injury data which included the site and type of injury, specific diagnosis of the injury, number of days out of rugby, the phase of play during which the player was injured, date of injury, an account of how the player was injured, medical treatment received, previous history of all rugby injuries, final score of match (for injuries sustained during matches), number of years the injured player has played rugby and designation of the injury as a match or practice event.

The injury questionnaire used during the first year of the study (1983) merely requested that the injured player state the type of injury sustained, whilst that of the second year (1984) included an additional injury listing from which the player had to select specific appropriate options.

The completed injury questionnaires were attached to the weekly report form and returned to the Cape Education Department. Each week the Cape Education Department immediately contacted schools which either failed to return a form after any week during the season or which returned inadequately completed forms. This practice ensured that all schools filed complete injury reports each week for the entire rugby season.

The six personally monitored schools (all from Western Cape region) received the identical forms which the other twenty schools had received and the data collection process was similar except that the schools were personally monitored by the research team. Two members of the research team were each allocated three schools. Before the start of the

season coaches were personally briefed on the objectives of the study and completed survey forms were collected by the two researchers on a regular weekly basis. During the second year of the study (1984) personal contact with the six schools was relaxed and the schools were only visited when the completed survey forms were collected at the end of the second and third school terms.

The personal monitoring survey technique, which had been chosen previously in 1982 (Nathan et al. 1983), was used again in 1983 and 1984 in order to evaluate the accuracy of the mail survey technique chosen for the other 20 schools. In particular, we wished to determine whether there was under-reporting of certain injuries in those twenty schools that were monitored only through the mail and that did not have regular weekly personal contact with the research team. Under-reporting would be especially likely for those injuries that, like concussion, require a high index of clinical suspicion before diagnosis.

Cognisance was taken of the fact that often players and coaches have limited anatomical knowledge and for this reason the injury questionnaire was drawn up to facilitate easy and speedy completion by injured players. In some cases vernacular terminology was used to describe injuries (e.g. bone-bruising) or injury sites (thigh vs hamstring - see 3.7 [g]). However, in retrospect, some aspects of the questionnaire appeared inconsistent and certain omissions were made. Most of these were addressed when the data were analysed and did not influence the results, particularly those of the major findings, negatively. The inconsistencies and omissions are briefly discussed.

(a) Bone bruising

Bone bruising was included as an injury type in the 1983 study but was omitted from the 1984 study. The reason for including bone bruises in the 1983 study was

that it was used as an injury type in the 1982 pilot study (Nathan et al. 1983). Bone bruising was omitted from the 1984 study as it was felt that such injuries cannot be clinically defined as an injury type and may have resulted in incorrect diagnosis.

(b) Laceration injuries

Laceration injuries were omitted as an injury type in the 1983 study but was included in the 1984 study. This omission was made as the 1983 study was based on the 1982 pilot study (Nathan et al. 1983), which did not report any laceration injuries. In 1984 lacerations were included as it was felt that such injuries could prevent a player from participation in rugby for a period of one week.

(c) Anatomical site

The questionnaire of the 1984 study incorrectly described the upper limb as the proximal parts of the arm and thigh and the lower limb as the distal parts of these separate limbs. This mistake was corrected when the data was analysed.

(d) Specific injuries

As it was not feasible to include all specific bones, muscles and ligaments in the specific injury section an attempt was made to include as many as possible of those commonly injured by rugby players. However, a number of specific injuries could have been benefically included, namely;

- forearm muscle injuries
- metacarpal fractures
- metatarsal fractures
- sternum fractures
- scapula fractures

Furthermore, it was also possible to record injuries not listed in the specific injury section. A section, which players who sustained such injuries had to complete, was included in the questionnaire. Through this section it would have been possible to record organ injuries as well as other injuries not commonly sustained by rugby players. Finally, to ensure that the correct information was obtained each injured player had to describe his injury in a few words, stating what the doctor said his injury was (if seen by a doctor).

3.3 Definition of an injury

The reasons for selecting the following definition of an injury was discussed in Chapter 1.3. Thus, for the purposes of this study (1983/84) an injury was defined as previously (Nathan et al. 1983): an injury which was severe enough to prevent a player from returning to rugby for at least seven days after the injury. All concussion injuries had to be reported even if the player remained on the field or played again within seven days. Concussion was defined as a loss of consciousness irrespective of how short the time interval might be; even one second was considered long enough.

3.4 Analysis of survey forms

All the results were computerised using programmes specifically designed for the project. At the end of the rugby season, the complete data were made available on computer printouts which were further analysed (see next section) to determine:

(a) the overall number and incidence of injured players;
(b) the age-group and playing level (team) of the injured players;

(c) the incidence of injured players during different four-week periods of the rugby season;
(d) the injured player's position and the phase of play at the time when the player was injured;
(e) the incidence of players injured during match play and during practices;
(f) the nature and anatomical site of injuries;
(g) specific diagnoses of injuries;
(h) the medical treatment that injured players received;
(i) the number of days out of rugby.

Possible relationships between age, team, playing position, phase of play, anatomical site, type of injury, specific injury, medical treatment and days out of rugby were also studied. Finally, data from the two different groups of schools were compared to determine whether injury reporting was the same for both groups of schools.

3.5 **Data analysis**

The data received from the Cape Education Department for the 1983 study were analysed manually to determine the different statistical relationships as discussed above.

In the 1984 study, the data were entered into a spread sheet package (Lotus 1-2-3). The reason for doing so was that the additional specific injury analysis section, which was included in this study (1984), complicated the manual analysis of data. It was found that Lotus 1-2-3 greatly facilitated the analysis of large quantities of data.

3.6 **Statistical analysis**

The statistical testing methods applied in this study (1983/84) were chosen with the intention of detecting any evidence in the data of non-random association between

factors such as age-group, team-level, time of the season, playing position, year and frequencies of injured players. The test chosen to determine the above was the chi-square test.

The chi-square test is a test for evidence of association between factors affecting the frequency of injury events. A large chi-square value indicates that the corresponding factor is associated with statistically significant differences in the relative frequencies, or equivalently in the incidences.

Data on certain issues was best summarized in multiway tables. Thus it was of interest to examine the three and four-dimensional tables for:

(a) injured player x school (*) x year;
(b) concussion x school (*) x year;
(c) injured player x position x year;
(d) injured player x level x age x year;

(*) Closely monitored or correspondence monitored

These multiway tables reflect the issues of possible under-reporting of injured players or of concussion in the second year at the six closely monitored schools; possible changes in annual injured player reporting grades generally; likely higher injured player rates at A-team levels of each age-group; differences between injured player rates across age-groups; and differences in injured player rates across playing positions.

Multiway tables can be analysed by log-linear models. These models are chosen to mimic as economically as possible the observed frequencies of the data tables. However, the primary focus of attention in this study (1983/84) is the isolation of factors that affect the injured player rates. In the language of log-linear models one is seeking the

factors which are associated with changes in the frequency of injured players.

Such factors can be identified by using BMDP 4F statistical software. In the output of the 4F programs they appear as interaction terms, and the statistical importance of these interaction terms is conveyed by (likelihood-ratio) chi-square values and their corresponding p-values.

The effect (on the frequencies of injury) of these factors is conveyed by an estimated multiplicative ratio that is required to mimic the change in frequencies caused by the factor between the injured and non-injured groups.

3.7 **Assumptions**

The following assumptions were made:

(a) That all players were male high school rugby players aged between twelve and nineteen.

(b) That all matches were inter-high school matches played according to the rules of the International Rugby Board.

(c) That each match lasted for a period of one hour and was controlled by a referee.

(d) That all players practised for a period of three hours per week during one 18-week season.

(e) That the exposure time to injury risk during matches and practices was equal for players in different playing positions.

3.8 Definition of terminology used

Most of the terminology used throughout the thesis is self explanatory. However, the following terms need additional clarification:

(a) Match play incidence of injury

The incidence of injury during match play was determined by multiplying the number of matches played during the season by 15 (players per team) and then dividing this product (total hours of match play) by the number of players injured during match play during the season. An average match was considered to last for sixty minutes and the incidence was expressed as one injured player per boy-hours of match play.

(b) Practice incidence of injury

The incidence of injury during practice was determined by taking the product of the number of teams, weeks per season, hours of practice per week and players per team and dividing this product (total hours of practice) by the number of players injured during practices during the season. The total hours of practice was calculated by multiplying the practice hours per week (three hours) by the number of weeks during the rugby season (18 weeks). The incidence was expressed as one injured player per boy-hours of practice play.

(c) Overall incidence of injury

The overall injury incidence was determined by adding the total number of match play hours, as determined in (a) above, to the total number of practice hours, as determined in (b) above, and then dividing this sum by the total number of players injured during the season.

The incidence was expressed as one injured player per boy-hours of rugby.

(d) Playing positions

The 15 players in a rugby team play in ten different positions. Of these positions, five have two players and the other five one player per team. In some previous studies (Sparks 1985; Addley and Farren 1988), a distinction was made between positions which have two players per team e.g. tight and loose-head props, left and right wings. In this study (1983/84) no distinction between these playing positions was made.

(e) Injury risk to players in different playing positions.

As five of the ten different playing positions in a rugby team have two players per team and the other five only one player per team, the risk of injury to players in different playing positions was calculated through the use of two different methods. Firstly, " actual percentages" were calculated by considering only the ten different playing positions, irrespective of the number of players in each position. This method of calculation represents the true risk of injury for the ten different playing positions (total number of injured players per position).

The second method, "corrected percentages", took into account that five of the ten different playing positions have only one player per team. Percentages were only calculated after the total number of injured players for positions in which there is only one player per team were doubled. Although this method of calculation has an in-built bias in that a new and hypothetical total was obtained, the method was used so that comparisons could be made between the two studies (1983 and 1984) reported in this thesis, the

1982 study (Nathan et al. 1983), as well as several other schoolboy studies which used the same method to calculate the risk of injury to players in different playing positions.

(f) Anatomical site of injury

Injuries sustained at different parts of the body were divided into four main anatomical sites; the head and neck, trunk (chest, abdomen and back), upper limb (shoulder, arm, elbow, forearm, wrist and hand), and lower limb (hip, buttock, thigh, knee, lower-leg, ankle and foot).

(g) Nature of injuries

The nature of injuries was classified as follows: (i) type of injury e.g. muscle, ligament, fracture etc.; and (ii) specific injuries e.g. neck muscle injury, clavicle fracture etc.

In some cases vernacular terms were used to describe particular injuries. Firstly, a distinction was made between "thigh muscle injuries" and "hamstring muscle injuries", although, strictly speaking, the hamstring muscles are thigh muscles. Thigh muscle injuries were therefore regarded as injuries of the quadriceps and adductors only.

CHAPTER 4

THE 1983 STUDY: RESULTS AND DISCUSSION

4.1 Overall risk and incidence of injury

The 26 high schools fielded 315 teams, which played 3 350 rugby matches. A total of 495 players were injured. Of these players, 354 (71.5%) were injured during match play and 141 (28.5%) during practices. This corresponds with the findings of the previous study (1982), in which 63.3% of all injured players sustained injuries during matches and 36.7% during practices (Nathan et al. 1983).

The overall incidence of injury was one injured player for every 617 boy-hours of rugby, considerably lower than that of one injured player for every 243 boy-hours of rugby in the 1982 study (Nathan et al. 1983). Considering matches separately, the incidence of injury was one injured player for every 142 boy-hours of match play, compared with an incidence of one injured player for every 84 boy-hours of match play in the 1982 study (Nathan et al. 1983). The incidence of injury for practices was one injured player for every 1810 boy-hours of practice, also considerably lower than the incidence of one injured player for every 506 boy-hours of practice found in the 1982 study (Nathan et al. 1983).

These data suggest that the incidence of injured players was lower in this study (1983) than in the 1982 study. However, when the results of the 1983 study were separated into those for the six schools monitored through personal contact and those for the 20 schools monitored only through correspondence, there was a clear difference in the reported incidence of injured players (Figure 4.1); the incidence of injured players in the six closely monitored schools was one

injured player for every 417 boy-hours of rugby, compared with a reported incidence of one injured player for every 736 boy-hours of rugby in the 20 schools monitored through correspondence, or of one injured player for every 243 boy-hours of rugby in the single school monitored in 1982 (Nathan et al. 1983). It seems probable that these differences are due to under-reporting, particularly of certain injuries (see later), by the 20 schools monitored through correspondence. It would also seem that close monitoring of even a single school results in the most accurate injury reporting (Figure 4.1).

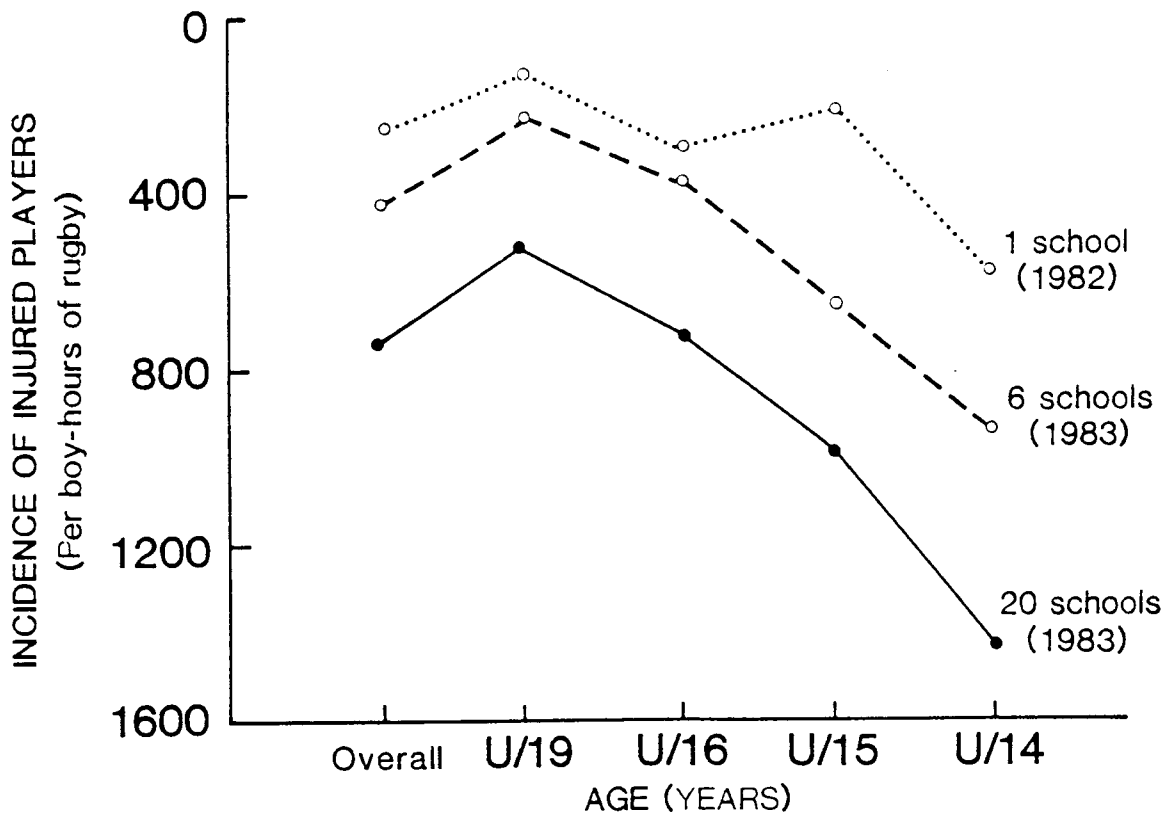

Figure 4.1 The incidence of injured players in different age-groups compared between the one school studied in 1982 (Nathan et al. 1983), the six closely monitored schools (1983), and the 20 correspondence-monitored schools (1983). Note that the incidence of injured players was highest in the school monitored by two researchers in 1982 and lowest in the 20 schools monitored by correspondence in 1983.

4.2 Incidence of injury during different periods of the season

Figure 4.2 shows that the incidence for players injured during match play was highest during the four-week period at the beginning of the season, and again after the winter (four-week) vacation. This observation was also made in the 1982 study (Nathan et al. 1983) and suggests that a lack of "match fitness" at the start of the season and after the winter vacation may predispose players to injury.

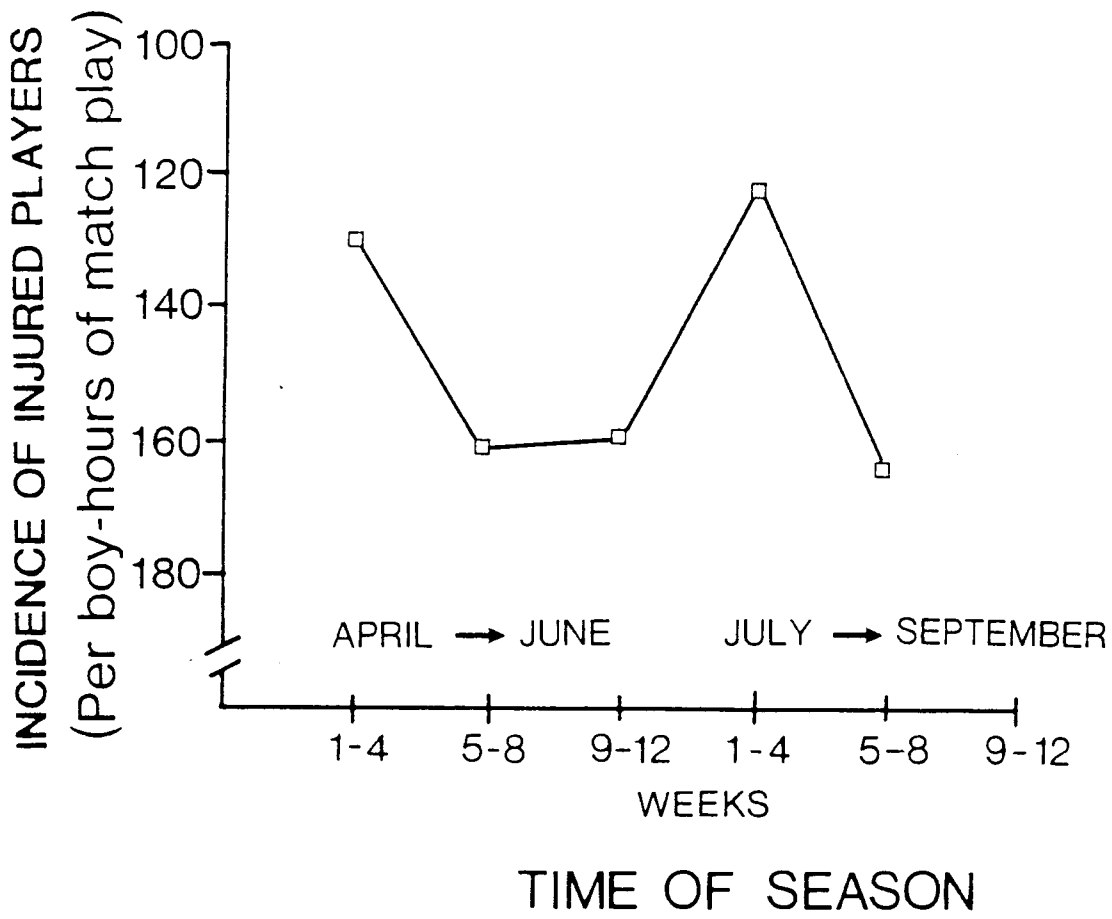

Figure 4.2 The match play incidence for players injured during different four-week periods of the 1983 season.

4.3 Risk and incidence of injury at different ages and levels of play

The injury risk and incidence in the different age-groups was essentially the same as in the 1982 study (Nathan et al. 1983). The incidence of injured players was low in the under-14 age-group, but increased in the under-15 and under-16 and especially the under-19 age-groups (Figure 4.3 and Table 4.1). The clear difference between injury risk in matches and practices is also shown. Overall, players were 13.3 times more likely to be injured during an hour of match play than during an hour of practice. The risk of injury during practices increased dramatically in the under-16 and under-19 age-groups (Figure 4.3), whereas no such steep increase with age was seen in the incidence during matches.

Table 4.1 The match, practice and overall incidence of injured players for different age-groups in the 1983 study.

AGE GROUP	INCIDENCE OF INJURED PLAYERS *		
	MATCH (a)	PRACTICE (b)	RUGBY (c)
Under-19	88	1266	386
Under-16	156	1312	631
Under-15	199	2623	897
Under-14	319	3605	1362
OVERALL #	142	1810	617

* One injured player per boy-hours of: (a) matchplay; (b) practice; (c) rugby.

\# n = 495 injured players.

Of all injured players, 56.6% were under-19 players (Table 4.2). This percentage is 21.4% higher than the 35.2% that

under-19 players represented of all players and again shows the greater injury risk which under-19 players are exposed to when compared with players in the other age-groups. In contrast, only 12.7% of all injured players were under-14 players, 15.6% less than the 28.3% that under-14 players represented of all players. When the risk of injury for individual players was calculated the following emerged. Overall, one out of every 9.5 players was likely to be injured (Table 4.2). The relative risk of injury for under-19 players (one injured under-19 player for every 5.9 under-19 players) was 3.6 times greater than the relative risk of injury for under-14 players (one injured under-14 player for every 21.2 under-14 players).

Table 4.2 The overall and age-group risk of injury for players in the 1983 study.

AGE GROUP	PLAYERS NUMBER	(%)	INJURED PLAYERS NUMBER	(%)	RISK *
Under-19	1665	35.2	280	56.6	5.9
Under-16	705	14.9	79	16.0	8.9
Under-15	1020	21.6	73	14.7	14.0
Under-14	1335	28.3	63	12.7	21.2
OVERALL	4725	100.0	495	100.0	9.5

* Number of players per injured player.

The chi-square test for association of probability of injured players with age, in Table 4.2 yields chi-square = 130.9, df = 3, $p < 10^{-6}$; thus there is overwhelming statistical evidence of the differences in risk for differing age-groups.

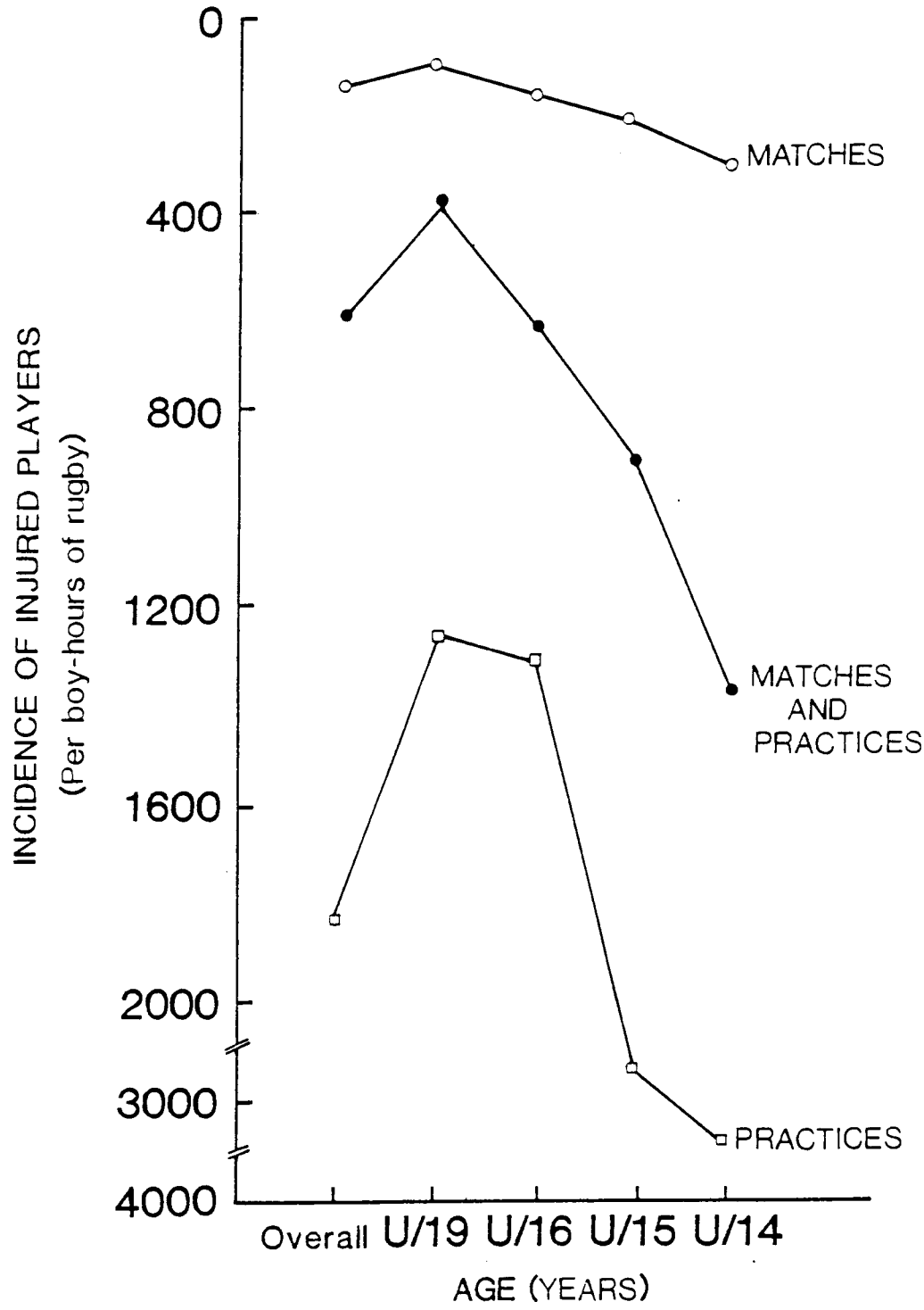

Figure 4.3 The incidence of injured players for matches, matches and practices, and practices only for different age-groups in the 1983 study. Note that the incidence increased with age and was considerably higher during matches than during practices.

At all ages, A-team players were most frequently injured (chi-square = 52.1, df = 1, $p < 10^{-6}$), and of these players, a larger percentage was injured during matches when compared with lower level players injured during matches. Under-19 A-team players were especially injury-prone (Figure 4.4) and accounted for 20.6% of all injured players, almost identical with the 20.3% found in the 1982 study (Nathan et al. 1983). Figure 4.4 also shows that under-19 A-team players were more frequently injured in matches alone than the total number of players injured in each of the other age-groups.

As Figure 4.4 shows only the relative number of injured players for age-groups and team levels, further analysis was conducted to show the greater risk of injury to A-team players, particularly under-19 A-team players. The percentage that A-team players represented of all players within an age-group was compared with the percentage that injured A-team players represented of all injured players within an age-group.

Overall, A-team players accounted for 30.2% of all players, compared with 44.2% that injured A-team players represented of all injured players, a difference of 14%. In Table 4.3 the compared percentages are also shown for the different age-groups. When compared, the greatest differences occurred in the under-16 and under-15 age-groups (19.5% and 22.1% respectively). The difference in the under-19 age-group was only 13% and from this it could be deduced that players in the under-16 and under-15 A-teams were more at risk of being injured than under-19 A-team players. However, when the relative risk of injury for A-team players in the different age-groups was calculated it showed that one out of every 3.8 under-19 A-team players was likely to be injured, compared with one out of every 5.8 and 8.9 for under-16 and under-15 A-team players respectively. The relative risk of injury for under-19 A-team players was 3.5 times greater than the relative risk of injury for under-14 A-team

players, almost identical with the overall risk pattern found for the respective age-groups.

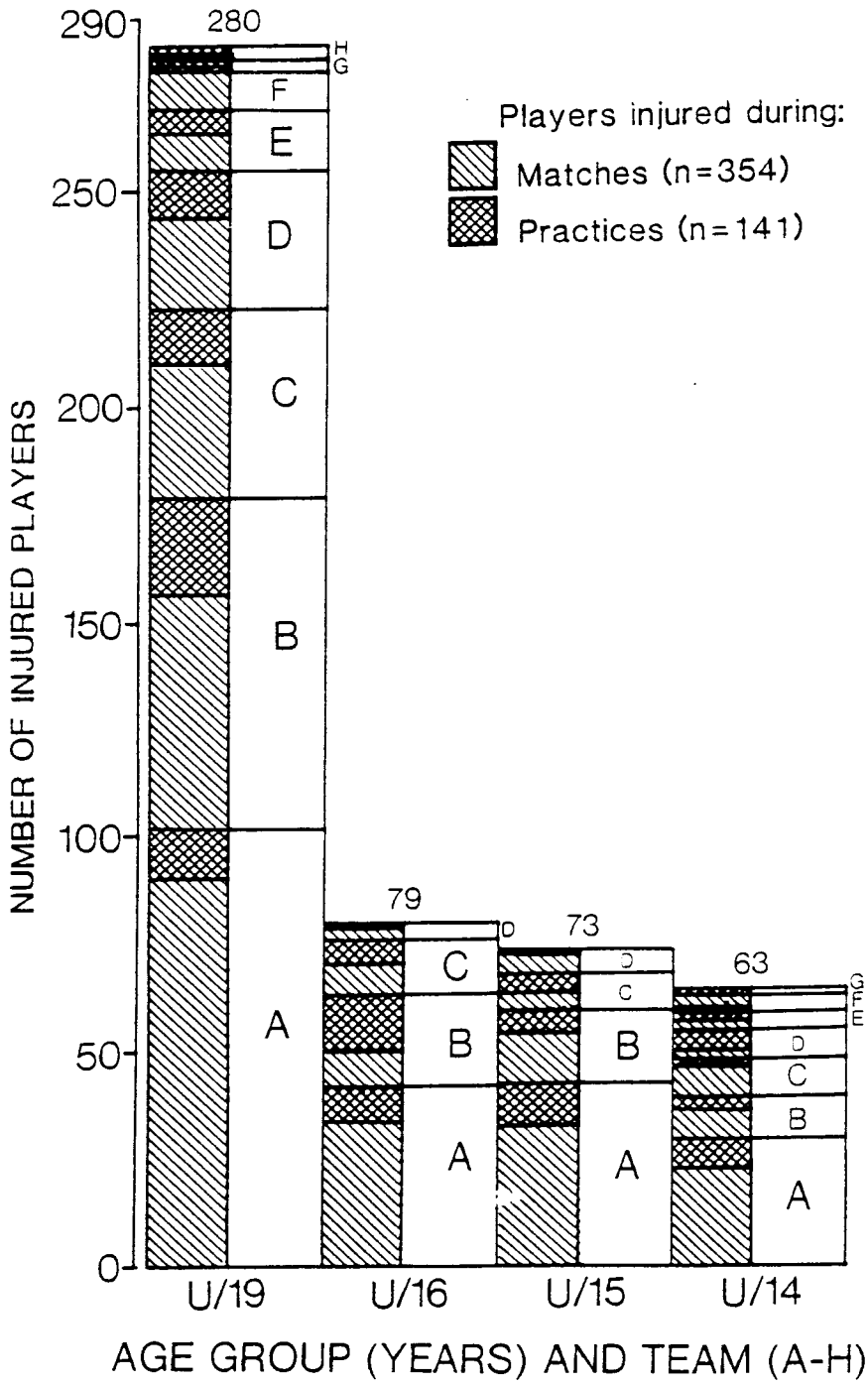

Figure 4.4 The relative number of injured players for the different age-groups, team levels (A-H) and for matches and practices in the 1983 study.

Table 4.3 The overall and age-group risk of injury for A-team players in the 1983 study.

AGE-GROUP AND TEAM	PLAYERS NUMBER	(%) #	INJURED PLAYERS NUMBER	(%) #	RISK *
Under-19A	390	23.4	102	36.4	3.8
Under-16A	255	36.2	44	55.7	5.8
Under-15A	390	38.2	44	60.3	8.9
Under-14A	390	29.2	29	46.0	13.4
OVERALL	1425	30.2	219	44.2	6.5

\# Expressed as a percentage of all players, and of all injured players, within an age-group.

* Number of A-team players per injured A-team player.

Furthermore, when the incidences for injured A-team and non A-team players in the different age-groups were calculated, under-19 A-team players were most at risk (one injured under-19 A-team player for every 254 boy-hours of rugby) (Table 4.4). The incidence pattern for injured A-team and non A-team players in the different age-groups was essentially the same as that of the overall incidences for injured players in the different age-groups.

The injury patterns associated with age and team level suggest that more competitive and aggressive play in higher age-groups and team levels may have been the cause of a large percentage of the injuries sustained by these players. Also, the game becomes faster and the players more powerful with increasing age and team level, which most probably results in an increase in the number of injured players, particularly during contact phases of play such as the two tackling phases of play.

Table 4.4 The incidence of injured players for A-teams and non A-teams (other teams) in the different age-groups during the 1983 study.

AGE GROUP	INCIDENCE OF INJURED PLAYERS *	
	A-TEAMS	OTHER TEAMS
Under-19	254	463
Under-16	382	830
Under-15	572	1389
Under-14	871	1825
OVERALL #	425	775

* One injured player per boy-hours of rugby.

\# n = 495 injured players.

4.4 Risk of injury for players in different playing positions, including the effect of age

Two methods were used to calculate the risk of injury for players in the different playing positions (see Chapter 3.8 [e]). Firstly, "actual percentages" were calculated by considering only the ten different playing positions, irrespective of the number of players in each position (Table 4.5). This method of calculation represents the true risk of injury for the ten different playing positions (total number of injured players per position).

By further use of this method it was also possible to calculate the risk of injury for individual players per team. This was done by halving the percentages for positions in which there are two players per team (Table 4.5).

Using the above method of calculation, players in the wing (16.4%), centre (14.1%), flanker (13.1%) and prop (10.9%)

positions were most likely to be injured (Table 4.5). Players in the hooker (5.7%), scrum-half (6.5%) and full-back (7.9%) positions were least likely to sustain injury. However, when the risk to individual players per team was determined through this method, eighthmen (8.9%), and wings and fly-halves (each 8.2%) were most likely to be injured (Table 4.5). Locks (4.1%), props (5.5%) and hookers (5.7%) were least likely to sustain injury.

Table 4.5 The "actual" percentage risk of injury for different playing positions and individual players per team in the 1983 study.

POSITION	NUMBER OF INJURED PLAYERS	INJURY RISK (%) POSITION	PLAYER	*
Wing	81	16.4	8.2	(2)
Centre	70	14.1	7.1	(4)
Flanker	65	13.1	6.6	(5)
Prop	54	10.9	5.5	(8)
Eighthman	44	8.9	8.9	(1)
Lock	41	8.2	4.1	(9)
Fly-half	41	8.2	8.2	(2)
Full-back	39	7.9	7.9	(3)
Scrum-half	32	6.5	6.5	(6)
Hooker	28	5.7	5.7	(7)
TOTAL	495	99.9	68.7	

* Ranking of player positions after the actual percentages for positions in which there are two players per position per team were halved.

The second method, "corrected percentages", took into account that five of the ten different playing positions

have only one player per team and the other five positions two players per team. Percentages were only calculated after the total number of injured players for positions in which there are one player per team were doubled. Although this method of calculation has an in-built bias in that a new and hypothetical total number of injured players was obtained, the method was used so that comparisons could be made between the two studies reported in this thesis (1983 and 1984), the 1982 study (Nathan et al. 1983), as well as several other schoolboy studies which used the same method to calculate the risk of injury for players in different playing positions. For this reason, further analysis, comparisons and discussion with regard to playing position is based on the "corrected percentages" method of calculation.

Using the above method of calculation, players in the eighthman (13%), fly-half (12.1%), wing (11.9%) and full-back (11.5%) positions were the most commonly injured players (Table 4.6). Players in the lock (6%), prop (7.6%) and hooker (8.2%) positions were least likely to be injured. In the 1982 study hookers (31.6%), full-backs (14.7%), eighthmen (12.6%) and scrum-halves (10.5%) were the most frequently injured players (Nathan et al. 1983). Props (2.1%) and locks (4.2%) were least likely to be injured.

Two observations regarding individual player risk and playing position can be made. Firstly, the tight-forwards (hookers, props and locks) were the least frequently injured players and, of the backline positions, the scrum-half position was the safest. In contrast, players in positions involved in those phases of the game in which play was fast and open, namely all backline players (except the scrum-half) and eighthmen and flankers were most likely to be injured. This finding suggests that speed of play predisposes to injury, as has been suggested by Lingard et al. (1976).

Table 4.6 The "corrected" percentage risk of injury for players in the different playing positions in the 1983 study.

POSITION	NUMBER OF INJURED PLAYERS		INJURY RISK
	ACTUAL	CORRECTED *	CORRECTED (%)
Eighthman	44	88	13.0
Fly-half	41	82	12.1
Wing	81	81	11.9
Full-back	39	78	11.5
Centre	70	70	10.3
Flanker	65	65	9.6
Scrum-half	32	64	9.4
Hooker	28	56	8.2
Prop	54	54	7.6
Lock	41	41	6.0
TOTAL	495	679	99.6

* Corrected for positions which have only one player per team (see discussion above).

Secondly, there was a clear pattern of injury when different playing positions were compared with age. Figure 4.5 (left panel) shows that at all ages the relative risk of injury amongst eighthmen, centres and locks remained relatively constant. In contrast, the relative risk of injury to props falls with increasing age, whereas that of the full-back rises, so that at under-19 level the full-back was the player who sustained most injuries (Figure 4.5 - right panel).

The most likely explanations for these findings are that at a young age the full-back participates only occasionally in the game, whereas at under-19 level he is involved in

collisions that usually occur at speed (catching the up-and-under; joining the line at speed; tackling opposing backs at speed). Also, that younger props are not physically developed enough, or adequately prepared, for the pressures associated with scrummaging.

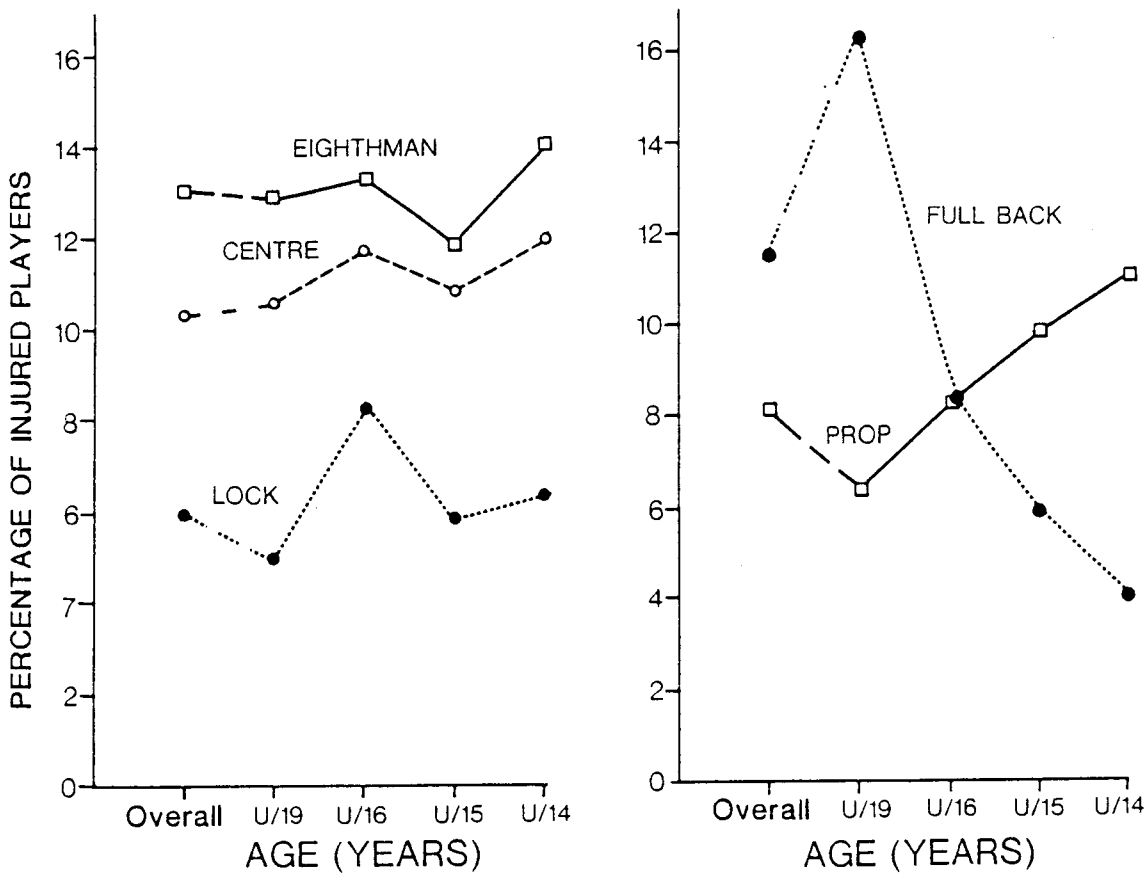

Figure 4.5 The percentage of injured locks, centres and eighthmen (left panel) remained relatively constant at all ages, whereas the percentage of injured full-backs and props (right panel) rose and fell respectively with increasing age in the 1983 study.

4.5 Injury risk and type at the different anatomical sites

Most players sustained injuries to the lower limb (37.4%), followed by the head and neck (29.9%) and the upper limb (20.2%) (Table 4.7). As in the 1982 study (Nathan et al. 1983), players sustaining trunk injuries were least common (7.6% vs 12.5% in the respective studies). In general, the trends for injuries sustained at different anatomical sites were similar for both studies, with the exception that the reported percentage for players sustaining lower limb injuries was lower in the 1982 study.

Table 4.7 The percentage risk for players sustaining injuries at different anatomical sites in the 1983 study.

ANATOMICAL SITE	NUMBER OF INJURED PLAYERS	INJURY RISK (%)
Lower limb	185	37.4
Head and neck	148	29.9
Upper limb	100	20.2
Trunk	62	12.5
TOTAL	495	100.0

The type of injury most commonly reported was fractures (26.7%), followed by ligament (25.1%) and muscle injuries (16.7%) (Table 4.8). In contrast to the findings of the 1982 study (Nathan et al. 1983), concussion accounted for only 12.3% of all injuries (compared with 21.5% in the 1982 study). This difference was most probably due to the different reporting systems used. In the 1982 study two researchers monitored the injuries of a single school,

whilst in this study (1983) two researchers monitored 6 schools through personal contact, and 20 schools through correspondence.

Table 4.8 The percentage risk for different types of injury sustained in the 1983 study.

TYPE OF INJURY	NUMBER OF INJURIES	INJURY RISK (%)
Fracture	132	26.7
Ligament	124	25.1
Muscle	83	16.7
Concussion	61	12.3
Dislocation	48	9.7
Bone bruising	31	6.3
Other	16	3.2
TOTAL	495	100.0

To determine whether under-reporting of concussion by some schools could possibly explain this anomalous finding, the percentage of players sustaining head and neck injuries due to concussion, as reported by the two groups of schools monitored either by personal contact (six schools) or by correspondence (20 schools), were compared. All schools were informed what the definition for a concussion injury was (see Chapter 3.3). However, through continual personal contact with the coaches at the six schools, the researchers emphasised the importance of identifying and reporting concussion injuries. Figure 4.6 shows that a smaller percentage of players sustained head and neck injuries (25.5% vs 37.3% in the six schools) in the 20 schools but, more significantly, that only 8.7% of players injured at

these schools sustained concussion injuries, compared with 18.4% reported by players from the six closely monitored schools. This latter figure is closer to the 21.5% of all players who reported concussion injuries in the 1982 study (Nathan et al. 1983).

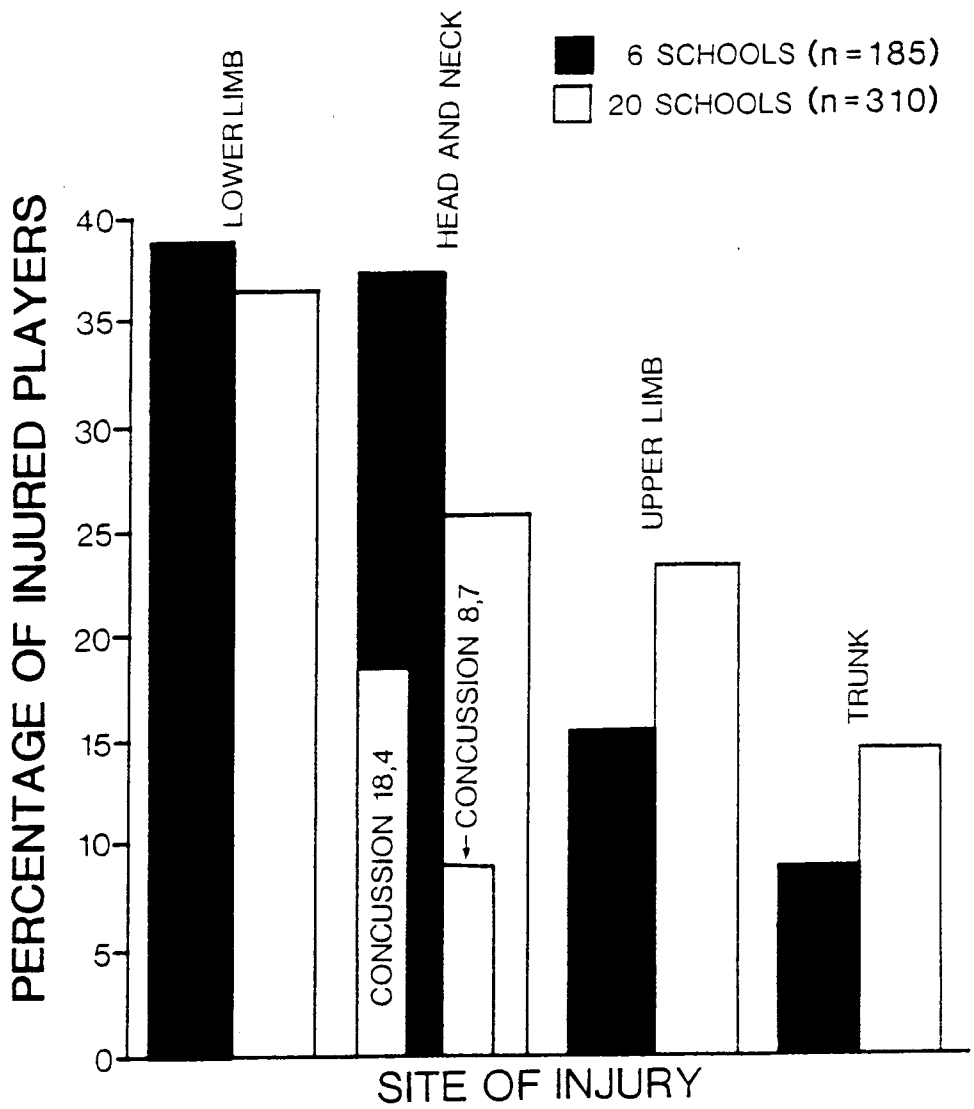

Figure 4.6 The percentage risk of injury at different anatomical sites, as reported by the six closely monitored schools and the twenty schools monitored by correspondence in the 1983 study. Note that injured players at the twenty schools monitored only by correspondence reported a low percentage of concussion injuries.

Further analysis revealed that of the 20 schools, six did not report a single case of concussion during the entire rugby season and nine reported only one case each. Thus the twenty schools reported a total of only 27 cases of concussion, whereas the six schools reported 34 such injuries. It is therefore highly probable that there was marked under-reporting of concussion injuries by the schools monitored only by correspondence, probably because a degree of ignorance about the nature of the injury existed. This under-reporting also negated attempts to define geographical trends in injury risk.

4.6 Injury risk and nature during different phases of play

The risk of injury during different phases of play is shown in Figure 4.7, which also includes data from the 1982 study (Nathan et al. 1983). Of all injured players, 54.3% sustained injuries while tackling (24.8%) or while being tackled (29.5%), a figure not very different from that of the 1982 study (46.8%).

The line-out (1.2%) was again the safest phase of play (vs 4% in the 1982 study). Only 7.7% of injured players sustained injuries during scrummaging (vs 18% in the 1982 study) and 18.2% during the loose-scrum/maul (vs 6% in the 1982 study). That the majority of players were injured when either tackling or being tackled further suggests that speed of play was an important component of injury risk. Figure 4.7 also shows that 72.5% of all injured players sustained injuries while either tackling, being tackled or during the loose-scrum/maul.

When different types of injury were considered individually, fractures (85.6%) in particular, but also bone bruising (77.4%) and concussion (73.7%), occurred more frequently during the two tackling or in the loose-scrum/maul phases of play. Ligament (70.1%), muscle (67.5%) and especially

other injuries (50%) were less frequently reported during these phases of play (Table 4.9).

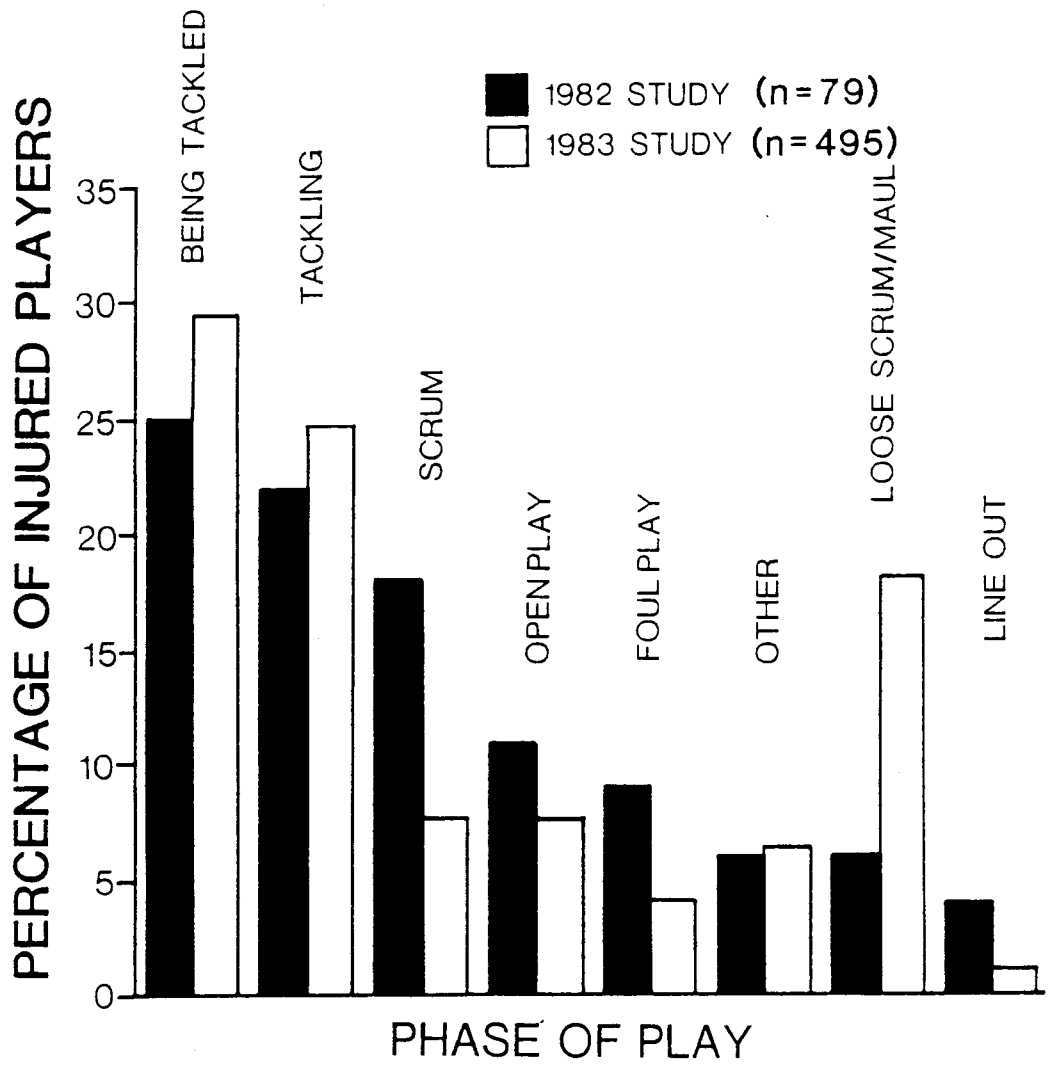

Figure 4.7 The percentage risk of injury during different phases of play for the 1982 (Nathan et al. 1983) and 1983 studies. Note that both studies reported high percentages for players injured during the two tackling phases of play.

Table 4.9 The percentage risk for different injury types which occurred during the two tackling and loose-scrum/maul phases of play in the 1983 study.

INJURY TYPE (n = 495)	PHASE OF PLAY (%) *		TOTAL (%) *
	TACKLING	LOOSE SCRUM/MAUL	
Fractures	66.7	18.9	85.6
Bone bruising	61.3	16.1	77.4
Concussion	47.5	26.2	73.7
Ligament	53.2	16.9	70.1
Muscle	50.6	16.9	67.5
Other	37.5	12.5	50.0

* Expressed as a percentage of the total number of injuries sustained for each injury type.

The most common types of injury which occurred during different phases of play are shown in Table 4.10. Of interest is the finding that 42.1% of all injuries sustained during scrums were dislocations, and that 33.3% of all foul play resulted in concussion injuries.

Fractures occurred more commonly during the two tackling and line-out phases of play, and ligament injuries during open play. Muscle injuries were most likely to occur during open play and scrums. Overall, fracture and ligament injuries were commonly sustained during most phases of play.

Table 4.10 The percentage risk for the most common types of injury sustained during different phases of play in the 1983 study.

PHASE OF PLAY	INJURY TYPE (%) *		TOTAL (%) *
Tackling (n = 123)	Muscle	21.1	
	Ligament	17.9	
	Fracture	30.9	69.9
Scrum (n = 38)	Muscle	26.3	
	Dislocation	42.1	68.4
Line-out (n = 6)	Ligament	33.0	
	Fracture	33.0	66.0
Being-tackled (n = 146)	Ligament	30.1	
	Fracture	32.8	62.9
Open play (n = 38)	Muscle	23.7	
	Ligament	36.8	60.5
Loose-scrum/maul (n = 90)	Ligament	24.4	
	Fracture	26.7	50.1
Foul play (n = 21)	Concussion	33.3	33.3

* Expressed as a percentage of the total number of injuries sustained during different phases of play.

4.7 Interrelationships between playing position, phase of play, and nature of injury

Tables 4.10 (reads horizontally) and 4.11 (reads vertically) have been drawn up to establish possible interrelationships that may exist between playing position, type of injury and phase of play. Table 4.11-A shows that concussion and

ligament injuries were most common amongst eighthmen and full-backs; that muscle injuries and fractures were fairly evenly distributed across all playing positions; that other injuries were most frequent amongst scrum-halves (38%), but were also common in fly-halves and full-backs (each 15%); and that bone bruises were most frequent amongst fly-halves, centres (each 15%) and wings (18%), whereas dislocations were most common amongst hookers (24%) and props (12%).

Table 4.11 Interrelationships between type of injury and phase of play for different playing positions in the 1983 study.

(A) TYPE OF INJURY #	PLAYING POSITION *									
(B) PHASE OF PLAY #	HK	PP	LK	FK	EM	SH	FH	CN	WG	FB
(A) Concussion	7	10	7	13	16	7	12	7	7	16
Muscle	8	11	9	11	10	10	15	12	14	4
Ligament	6	6	6	7	18	9	13	12	9	15
Fracture	7	5	5	12	14	11	10	9	18	10
Other	8	4	4	0	0	38	15	8	8	15
Bone bruising	5	5	5	13	5	10	15	15	18	10
Dislocation	24	17	8	6	9	3	6	9	6	12
(B) Being-tackled	4	3	7	7	10	9	16	14	21	11
Tackling	6	3	4	9	14	11	14	13	12	14
Scrum	40	32	10	10	4	4	0	0	0	0
Open play	0	5	5	4	14	4	21	14	7	25
Foul play	13	0	6	9	0	19	19	9	13	13
Lse-scrm/maul	9	15	7	21	21	9	5	5	4	5
Line-out	0	13	25	13	50	0	0	0	0	0
Other	9	11	7	7	13	13	4	4	13	18

* Corrected percentages # Table reads horizontally to 100%

Table 4.11-B shows that wings (21%) were especially prone to injuries caused while being tackled; that tackling injuries were relatively evenly distributed amongst loose-forward and backline players; that scrumming injuries were predominant amongst hookers (40%) and props (32%); and that fly-halves (21%) and full-backs (25%) were most at risk during open play, whereas fly-halves and scrum-halves (each 19%) were especially prone to injuries caused by foul play. Flanks and eighthmen (each 21%) were at risk during the loose-scrum/maul, whereas 50% of all line-out injuries were sustained by eighthmen, with locks (25%) the next most frequently injured players in the line-out.

Table 4.12-A shows that 50% of all injuries that occurred to hookers were dislocations or fractures, that 62% of injuries to props were either dislocation, muscle or ligament injuries, and that 69% of injuries to locks were either fracture, muscle or ligament injuries. Of all injuries to the remaining players, between 50% (flankers) and 63% (eighthmen) were either ligament injuries or fractures.

Table 4.12-B shows that 54% of all injuries to hookers, and 63% of all injuries to props occurred in the scrum or loose-scrum/maul, that 47% of all injuries to locks occurred when they were either being tackled or were in the loose-scrum/maul, and that flankers (79%), eighthmen (77%) and scrum-halves (75%) sustained the majority of their injuries either when tackling, whilst being tackled or in the loose-scrum/maul. With regard to injuries to the other backline players, between 58% (full-backs) and 81% (wings) of their injuries occurred when they were either tackling or being tackled.

Table 4.12 Interrelationships between playing position, type of injury and phase of play in the 1983 study.

(A) TYPE OF INJURY # / (B) PHASE OF PLAY #	PLAYING POSITION *									
	HK	PP	LK	FK	EM	SH	FH	CN	WG	FB
(A) Concussion	11	17	12	17	16	9	12	9	6	18
Muscle	14	22	22	18	11	9	20	19	19	5
Ligament	18	20	27	18	36	25	29	30	20	33
Fracture	21	15	20	32	27	31	22	23	40	23
Other	4	2	2	0	0	16	5	3	2	5
Bone bruising	4	4	5	8	2	6	7	9	9	5
Dislocation	29	20	12	6	7	3	5	9	5	10
(B) Being-tackled	14	9	27	17	23	28	39	40	51	28
Tackling	18	11	17	25	27	31	29	33	30	30
Scrum	36	30	12	8	2	3	0	0	0	0
Open play	0	6	7	3	9	3	15	11	5	18
Foul play	6	0	5	5	0	9	7	4	5	5
Lse-scrm/maul	18	33	20	37	27	16	7	9	6	8
Line-out	0	2	5	2	5	0	0	0	0	0
Other	6	9	7	5	7	9	2	3	7	10

* Corrected percentages # Table reads vertically to 100%

CHAPTER 5

THE 1984 STUDY: RESULTS AND DISCUSSION

5.1 Overall risk and incidence of injury

The 26 high schools fielded 312 teams which played 3416 matches. There were 410 injured players who sustained a total of 508 injuries. Of these players, 265 (64.6%) were injured during match play and 145 (35.4%) during practices, figures similar to those found in 1982 (Nathan et al. 1983) and 1983. Thus, fewer players were injured in 1984 when compared with the 495 players injured in 1983, a decrease of 17.2%.

The decrease in the number of injured players during 1984 may suggest that there had also been a corresponding decrease in the incidence of injured players. However, it should be noted that during 1984 personal contact with the six Western Cape schools was relaxed, resulting in 79 (42.7%) fewer players being injured in these schools. To put the above in perspective it is necessary to examine the results of the 20 schools monitored only through correspondence. In 1983 and 1984 these 20 schools reported a total of 310 and 304 injured players for each respective year, a decrease of only 1.9%.

The overall 1984 incidence of injury was one injured player for every 741 boy-hours of rugby (Figure 5.1). This incidence, which was calculated using the same formula as in the 1982 (Nathan et al. 1983) and 1983 studies, was slightly lower than the one injured player for every 617 boy-hours of rugby found in 1983. Considering matches separately, the incidence of injury was one injured player for every 193 boy-hours of match play. The practice incidence was one injured player for every 1742 boy-hours of practice.

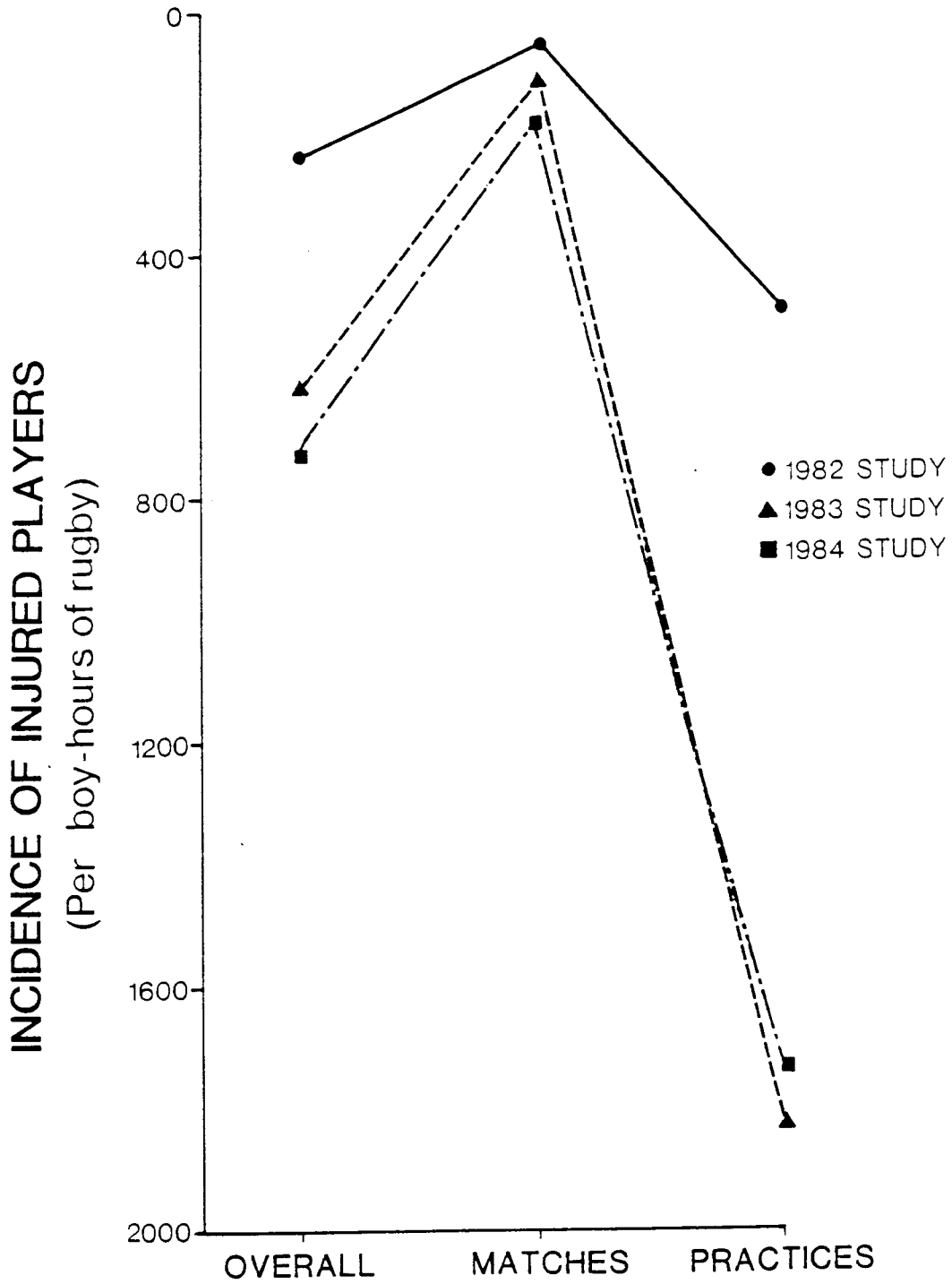

Figure 5.1 The overall, match, and practice incidences for players injured in the 1982 (Nathan et al. 1983), 1983 and 1984 studies.

Thus the overall, match and practice incidences found in the 1983 and 1984 studies were similar, but all were lower than those of the 1982 study (Nathan et al. 1983) (Figure 5.1). However, as already reported in Chapter 4, the 1982 study was conducted at one school and was closely monitored by the authors, whilst the 1983 and 1984 studies were conducted at 26 schools, of which 20 were monitored only through correspondence.

When the results of this study (1984) were separated into those for the six schools monitored by the author and those for the 20 schools monitored through correspondence only, the overall incidence of injury for the closely monitored schools was one injured player for every 723 boy-hours of rugby, and that of the 20 correspondence monitored schools one injured player for every 748 boy-hours of rugby. The difference is not as marked as found in 1983 (one injured player for every 417 boy-hours of rugby for the closely monitored schools and one injured player for every 736 boy-hours of rugby for the schools monitored by correspondence). This may be due to less contact by the author with the closely monitored schools during 1984. The above figures show that whilst the incidence of injured players for the 20 correspondence monitored schools was almost identical in 1983 and 1984, the incidence of injured players for the closely monitored schools was lower in 1984 after personal contact with the schools had been relaxed.

5.2 Incidence of injury during different periods of the season

The incidence of injured players was higher in the first four-week periods at the beginning of the season and again after the winter vacation (Figure 5.2). When the match and practice incidences are studied separately, an interesting pattern emerges; the match play incidence remained the same (one injured player for every 169 boy-hours of match play) during the first two four-week periods of the season, but

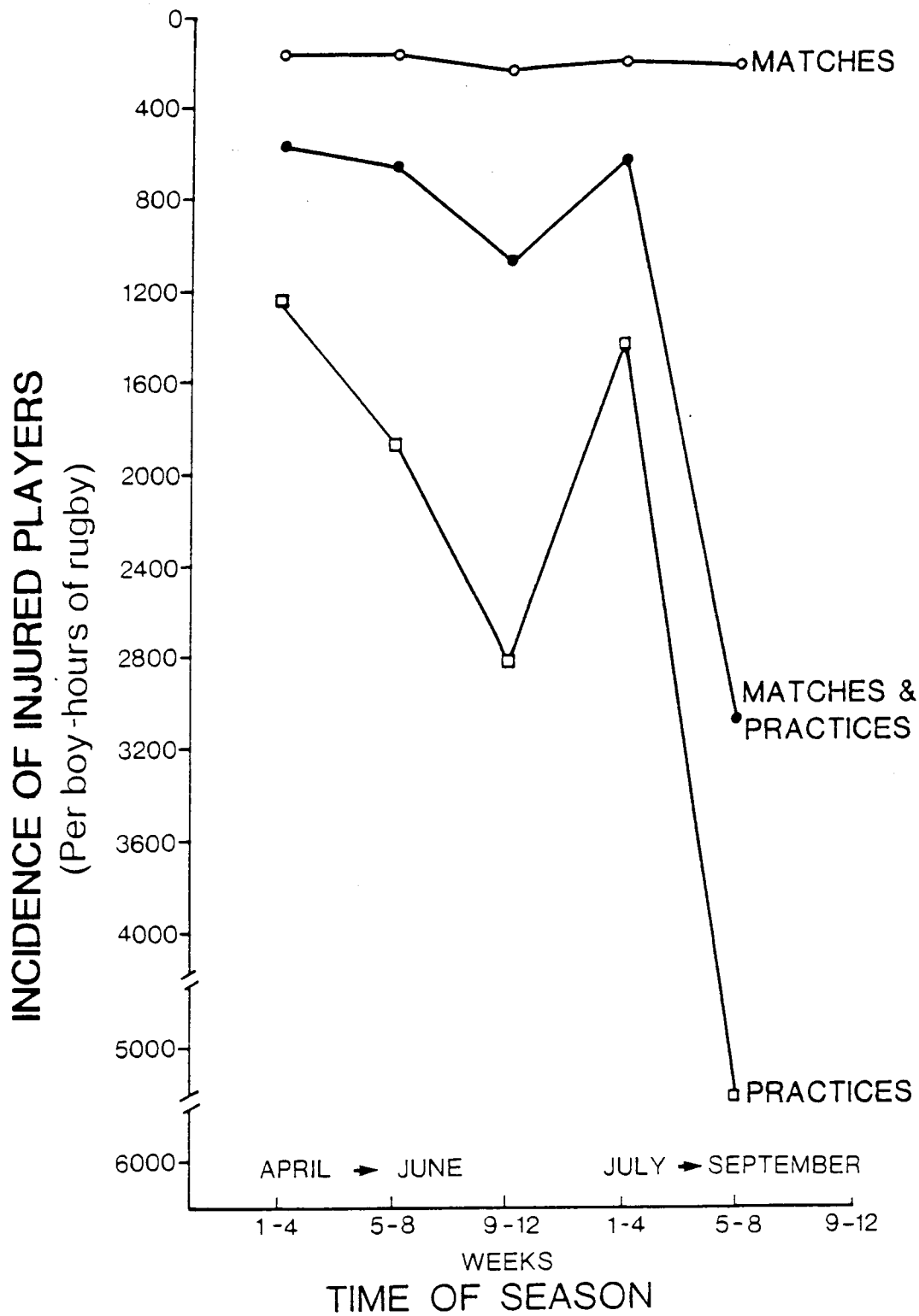

Figure 5.2 The incidence of injured players during different four-week periods of the 1984 season.

then decreased during the third four-week period (one injured player for every 255 boy-hours of match play). It increased again during the first four-week period following the July vacation (one injured player for every 203 boy-hours of match play), before once again decreasing slightly (one injured player for every 215 boy-hours of match play).

The practice incidence was at its highest during the first four-week period of the season (one injured player for every 1256 boy-hours of practice), but then decreased during each of the following two four-week periods (one injured player for every 1884 and 2826 boy-hours of practice respectively). Following the July vacation, the practice incidence increased sharply during the first four-week period (one injured player for every 1449 boy-hours of practice) and then decreased dramatically during the final four-week period of the season (one injured player for every 5652 boy-hours of practice). A possible explanation for the sharp decrease in the practice incidence at the end of the season may be that less time is spent practising, thereby lessening the risk of injury. Also, some of the lower league teams complete their league programmes earlier and this could also have contributed to the decreased risk of injury at the end of the season. The above trends are similar to those found in the 1983 study, the only difference being that all incidences were slightly higher in 1983.

5.3 Risk and incidence of injury at different ages and levels of play

Similar to the results of the 1982 (Nathan et al. 1983) and 1983 studies, the overall incidence of injured players was low in the under-14 age-group, but increased in the under-15 to under-19 age-groups (Figure 5.3).

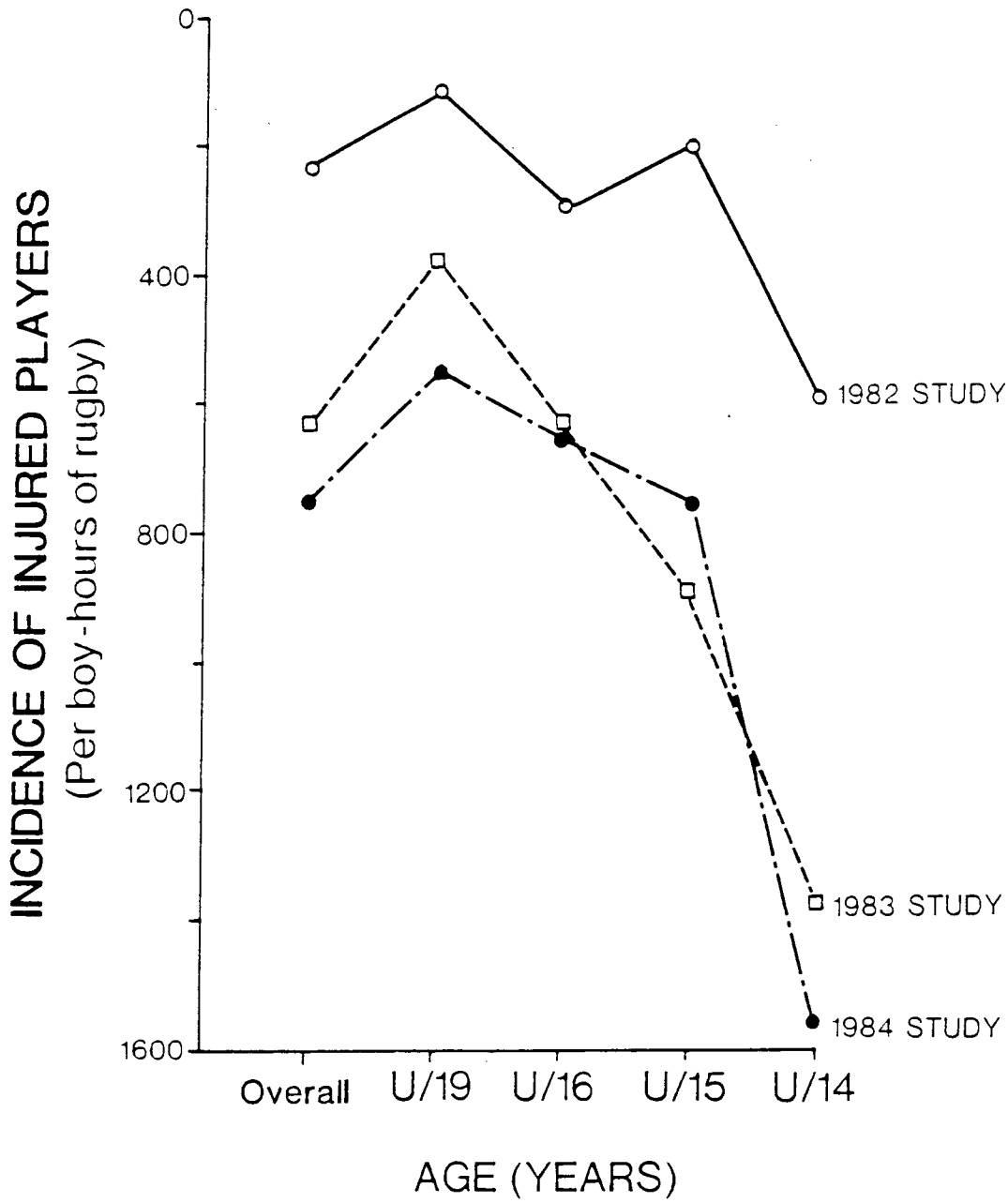

Figure 5.3 The overall incidence of injured players for different age-groups compared in the school studied in 1982 (Nathan et al. 1983) and the 26 schools studied in 1983 and 1984.

In this study (1984) the practice incidence of the under-16 age-group was higher (one injured player for every 1229 boy-hours of practice) than the under-19 practice incidence (one injured player for every 1409 boy-hours of practice) and the match incidence (one injured player for every 192 boy-hours of match play) lower than that of the under-15 match incidence (one injured player for every 177 boy-hours of match play) (Table 5.1 and Figure 5.4). The overall under-16 incidence was, however, higher than the overall under-15 incidence and lower than the overall under-19 incidence.

Table 5.1 The match, practice and overall incidence of injured players for different age-groups in the 1984 study.

AGE GROUP	INCIDENCE OF INJURED PLAYERS *		
	MATCH (a)	PRACTICE (b)	RUGBY (c)
Under-19	145	1409	568
Under-16	192	1229	648
Under-15	177	2056	739
Under-14	448	3162	1566
OVERALL #	193	1742	741

* One injured player per boy-hours of: (a) matchplay; (b) practice; (c) rugby.

\# n = 410 injured players.

Two hundred and six or 50.2% of the 410 injured players were under-19 players (Figure 5.5). At all ages, A-team players, who represented 30.4% of the total number of players, were most commonly injured and accounted for 161 (36.8%) of all players injured during 1984. Two hundred and sixty-five or 64.6% of all injured players sustained injuries during match play.

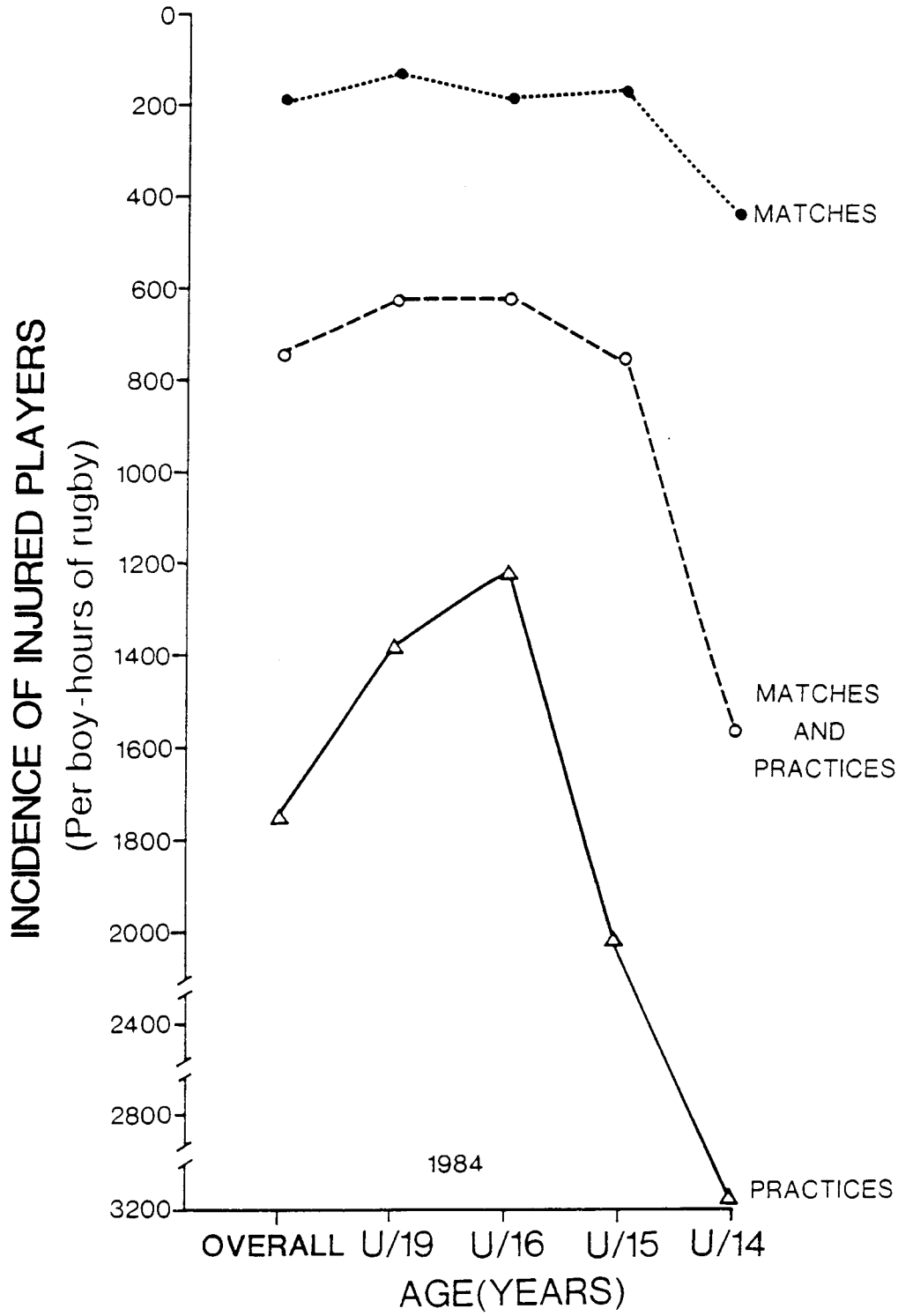

Figure 5.4 The incidence of players injured during matches, matches and practices, and practices only for different age-groups in the 1984 study.

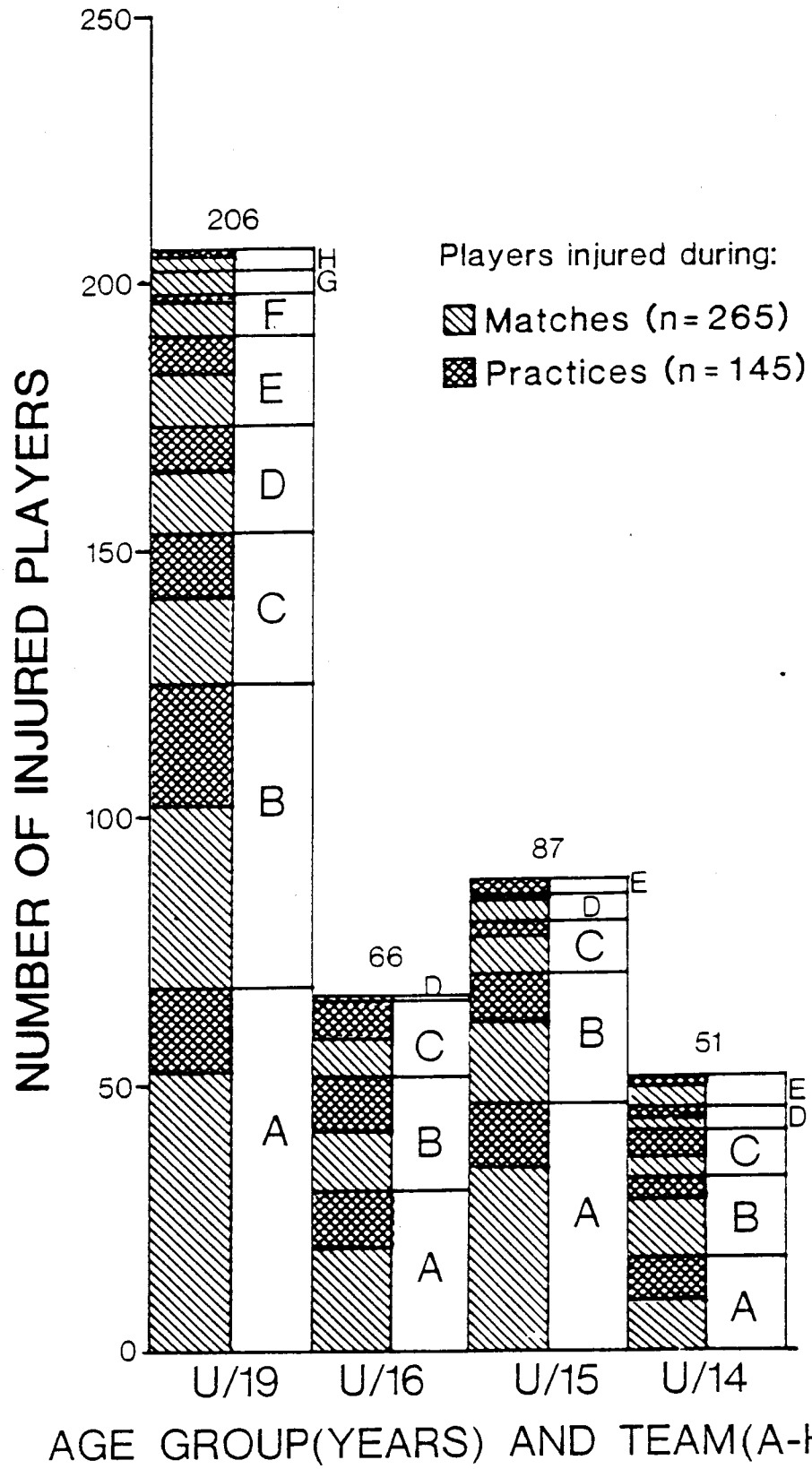

Figure 5.5 The relative number of injured players in the different age-groups and team levels during matches and practices in the 1984 study.

Closer examination of the age-groups and A-teams within the age-groups showed some interesting trends. Firstly, when the percentage of injured players in each age-group was compared with the percentage of players in each age-group, the following emerged. The percentage of injured under-19 players was 11.7% higher, and that of injured under-14 players 13.9% lower, than the respective percentages that players in these age-groups represented of all players (Table 5.2). In the other two age-groups the compared percentages were remarkably similar. This again shows the greater relative risk of injury at under-19 level, as was shown earlier when incidences for the age-groups were calculated (see Table 5.1). Overall, one out of every 11.4 players was likely to be injured (Table 5.2). The relative risk of injury was almost three times greater for under-19 players (one injured under-19 player for every 8.7 under-19 players) than for under-14 players (one injured under-14 player for every 24.1 under-14 players).

Table 5.2 The overall and age-group risk of injury for players in the 1984 study.

AGE GROUP	PLAYERS NUMBER	(%)	INJURED PLAYERS NUMBER	(%)	RISK *
Under-19	1800	38.5	206	50.2	8.7
Under-16	660	14.1	66	16.1	10.0
Under-15	990	21.2	87	21.2	11.4
Under-14	1230	26.3	51	12.4	24.1
OVERALL	4680	100.1	410	99.9	11.4

* Number of players per injured player.

The chi-square test for association of probability of

injured players with age, in Table 5.2 yields chi-square = 50.3, df = 3, $p < 10^{-6}$; thus there is highly significant statistical evidence of the differences in risk for differing age-groups.

Secondly, when the percentage of injured A-team players in each age-group was compared with the percentage of A-team players in each age-group, the following emerged. At each age level, the percentage of injured A-team players was higher than the percentage that A-team players represented of each age-group (Table 5.3). The difference in the compared percentages was small at under-14 level (1.6%) but far greater at under-15 and under-19 level (13.5 and 11.3% respectively). This shows that at all ages, but particularly at under-15 and under-19 level, A-team players were more at risk of sustaining injuries (chi-square = 15.2, df = 1, $p < 10^{-4}$). Overall, A-team players represented 30.8% of all players, and injured A-team players 39.5% of all injured players, a difference of 8.7%.

Table 5.3 The overall and age-group risk of injury for A-team players in the 1984 study.

AGE-GROUP AND TEAM	PLAYERS NUMBER	(%) #	INJURED PLAYERS NUMBER	(%) #	RISK *
Under-19A	390	21.7	68	33.0	5.7
Under-16A	270	40.9	30	45.5	9.0
Under-15A	390	39.4	46	52.9	8.5
Under-14A	390	31.7	17	33.3	22.9
OVERALL	1440	30.8	161	39.5	8.9

Expressed as a percentage of all players, and of all injured players, within an age-group.

* Number of A-team players per injured A-team player.

Overall, one out of every 8.9 A-team players was likely to be injured. The relative risk of injury for under-19 A-team players (one injured under-19 A-team player for every 5.7 under-19 A-team players) was four times greater than the relative risk of injury for under-14 A-team players (one injured under-14 A-team player for every 22.9 under-14 A-team players).

There are several possible reasons which may explain the above findings. The most likely is that at A-team level competition is more vigorous. Also, in general, A-team players are bigger, stronger and faster than players in the lower level teams, thereby increasing their risk of injury during contact play such as the tackling phases of play.

The above findings correspond with those of both the 1982 and 1983 studies. In all three studies, injured under-14 players never accounted for more than 13% of all injured players. Injured under-15 and under-16 players never accounted for more than 22% of all injured players, whilst the lowest percentage reported for injured under-19 players was 46.9% in 1982 (Nathan et al. 1983). Also, in all three studies A-team players were more commonly injured than players in the lower level teams.

5.4 Risk of injury for players in different playing positions

The same two methods of calculation, as used in the 1983 study, were used to calculate the risk of injury to players in the different playing positions (see Chapter 3.8 [e]). Table 5.4 lists the actual positional and player risks of injury. Players in the wing (16.3%), centre (15.1%), flanker and prop (each 13%) positions were most likely to be injured, whilst players in the hooker (4.4%), fly-half (5.4%) and scrum-half (6.6%) positions were least likely to sustain injury. However, when the risk to individual players per team was calculated through this method, eighthmen

(8.5%), wings (8.2%) and centres (7.6%) were the most likely to be injured (Table 5.4). Hookers (4.4%) and fly-halves (5.4%) were the individual players least likely to sustain injury.

Table 5.4 The "actual" percentage risk of injury for different playing positions and individual players per team in the 1984 study.

POSITION	NUMBER OF INJURED PLAYERS	INJURY RISK (%) POSITION	PLAYER	*
Wing	67	16.3	8.2	(2)
Centre	62	15.1	7.6	(3)
Flanker	53	13.0	6.5	(6)
Prop	53	13.0	6.5	(6)
Lock	45	11.0	5.5	(7)
Eighthman	35	8.5	8.5	(1)
Full-back	28	6.8	6.8	(4)
Scrum-half	27	6.6	6.6	(5)
Fly-half	22	5.4	5.4	(8)
Hooker	18	4.4	4.4	(9)
TOTAL	410	100.1	66	

* Ranking of player positions after the actual percentages for positions in which there are two players per position per team were halved.

Using the "corrected percentages" method of calculation, players in the eighthman (13%), wing (12.4%), centre (11.5%) and full-back (10.4%) positions were most commonly injured (Table 5.5). Players in the hooker (6.7%), fly-half (8.1%) and lock (8.3%) positions were least likely to sustain injury. In the under-15 and under-19 age-groups eighthmen

were the most commonly injured players (15.5% and 13.7% respectively), whilst hookers and fly-halves reported the fewest injuries. Centres were amongst the most, and hookers amongst the least commonly injured players in all age-groups.

Table 5.5 The "corrected" percentage risk of injury for players in the different playing positions in the 1984 study.

POSITION	NUMBER OF INJURED PLAYERS		INJURY RISK
	ACTUAL	CORRECTED *	CORRECTED (%)
Eighthman	35	70	13.0
Wing	67	67	12.4
Centre	62	62	11.5
Full-back	28	56	10.4
Scrum-half	27	54	10.0
Flanker	53	53	9.8
Prop	53	53	9.8
Lock	45	45	8.3
Fly-half	22	44	8.1
Hooker	18	36	6.7
TOTAL	410	540	100

* Corrected for positions which have only one player per team (see Chapter 3.8 [e]).

The positional percentages shown in Table 5.5 are similar to those found in the 1983 study and confirms the finding that players involved in the fast, open phases of play (backline players and loose-forwards) were more likely to sustain injuries than were the tight forwards. The only position at which a marked difference occurred was that of the fly-half

(12.1% and 8.1% respectively in the 1983 and 1984 studies).

(a) Props

Fifty-three of the 410 injured players were props (9.8% corrected) (Table 5.5). Of all injured props, 66% were injured during match play, 47.2% were under-19 players and 60.4% A and B-team players from all age-groups. Nineteen (35.8%) of the injured props sustained head and neck, and 28.3% upper limb injuries.

The phases of play during which props were most likely to be injured were during scrums (41.5%), while being tackled and while tackling (24.5%), and during loose-scrums and mauls (18.9%). Props sustained 66.7% of all scrum injuries.

The 53 injured props reported 70 specific injuries. Of these injuries, 41.4% were ligament and 24.3% fracture injuries. The fractures included four neck and trunk vertebral fractures (5.7% of all injuries sustained by props and 44.4% of all neck and trunk vertebral fractures). The most common ligament injuries sustained by props were neck ligament injuries (34.5%) and knee and ankle ligament injuries (34.5%). Seven of the 12 muscle injuries reported by props were neck muscle injuries.

Thirty percent of all injuries sustained by props were neck injuries. This figure is 21.5% higher than the 8.5% that neck injuries represented of all injuries sustained by other injured players and shows that props were particularly at risk of sustaining neck injuries.

Fifteen (28.3%) of the 53 injured props reported more than one specific injury and ten (18.9%) were referred to medical specialists, the highest percentage reported amongst all playing positions.

(b) Hookers

Eighteen of the 410 injured players were hookers (6.7% corrected) (Table 5.5), the lowest percentage reported amongst all playing positions. Of all injured hookers, 50% were injured during match play, 61.1% were under-19 players and 61.1% A and B-team players from all age-groups. Seven (38.8%) of the injured hookers sustained head and neck injuries, a figure similar to the 35.8% of injured props who sustained head and neck injuries. Eight (44.4%) sustained upper and lower limb injuries.

The phases of play during which hookers were most likely to be injured were during loose-scrums and mauls (33.3%) and during scrums (27.8%). Hookers and props were the only players not to report any foul play injuries.

The 18 injured hookers reported 19 specific injuries, indicating that only one hooker (5.6%) sustained more than one specific injury. Eight (42.1%) of the injuries reported by these players were fractures and five (26.3%) were muscle injuries. Three (16.7%) of the 18 injured hookers were referred to medical specialists.

(c) Locks

Forty-five of the 410 injured players were locks (8.3% corrected) (Table 5.5). Of all injured locks, 62.2% were injured during match play, 51.1% were under-19 players and 60% A and B-team players from all age-groups.

Fourteen (31.1%) of the injured locks sustained head and neck injuries and the phase of play during which locks were most likely to be injured was the loose-scrum/maul (46.7%). Locks were the players who were most frequently injured during loose-scrums and mauls

(23.1%) and only 8.8% of locks were injured during scrums.

The 45 injured locks reported a total of 55 specific injuries. Of these injuries, 38.2% were ligament, 23.6% muscle, 20% fracture and 14.5% concussion injuries. Ten locks (22.2%) reported more than one specific injury and only five (11.1%) of the 45 injured locks were referred to medical specialists.

(d) Flankers

Fifty-three of the 410 injured players were flankers (9.8% corrected) (Table 5.5). Of all injured flankers, 66% were injured during match play, 45.3% were under-19 players and 73.5% A and B-team players from all age-groups. Twenty (37.8%) of the injured flankers sustained head and neck, and 17 upper limb injuries.

The phases of play during which flankers were most likely to be injured were during loose-scrums and mauls (33.9%), while tackling (26.4%) and while being tackled (22.6%). The scrum, line-out and foul play phases of play together contributed to only 5.6% of all flanker injuries.

The 53 injured flankers reported a total of 64 specific injuries. Ten players (18.7%) reported more than one specific injury. Concussion (23.4%) and fracture injuries (25%) accounted for 48.4% of all flanker injuries. Seven (10.9%) laceration injuries were sustained by flankers and these players sustained 28% of all laceration injuries. Muscle and ligament injuries accounted for only 32.8% of injuries to flankers, compared with 62.8 and 61.8% sustained by props and locks respectively. Five (9.4%) of the 53 injured flankers were referred to medical specialists.

(e) Eighthmen

Thirty-five of the 410 injured players were eighthmen (13% corrected). This was the highest percentage reported amongst all playing positions (Table 5.5). A very high percentage of the injured eighthmen (77.1%) were injured during match play. Of all injured eighthmen, 54.3% were under-19 players and 62.9% A and B-team players from all age-groups. Sixteen (45.7%) of the injured eighthmen sustained head and neck, and 12 (34.3%) upper limb injuries.

The phases of play during which eighthmen were most likely to be injured were during loose-scrums and mauls (40%) and while being tackled (28.6%). Eighthmen reported no scrum or line-out injuries.

The 35 injured eighthmen reported 40 specific injuries. Of these injuries, 27.5% were concussion injuries and 25% each ligament and fracture injuries. The most common ligament injuries reported were shoulder ligament injuries (10%), and the most common fracture injury was clavicle fractures (10%). Eighthmen sustained 16.4% of all concussion injuries and together with flankers, 38.8% of all concussion, and 33.3 of all dislocation injuries. Only two (5.7%) of the 35 injured eighthmen were referred to medical specialists.

(f) Scrum-halves

Twenty-seven of the 410 injured players were scrum-halves (10% corrected) (Table 5.5). Of all injured scrum-halves, 55.6% were injured during match play, 63% were under-19 players and 66.7% A and B-team players from all age-groups. Eighteen (66.7%) of the injured scrumhalves sustained upper and lower limb injuries.

The phases of play during which scrum-halves were most

likely to be injured were while tackling (33.3%), during loose-scrums and mauls (25.9%) and while being tackled (22.2%). Scrum-halves, flankers and props were the only players who were more frequently injured while tackling than while being-tackled. The percentage of scrum-halves injured during loose-scrums and mauls was the highest percentage reported for backline players injured during this phase of play.

The 27 injured scrum-halves reported 31 specific injuries. Most common amongst these were fracture and ligament injuries (29% each). Scrum-halves sustained only 3% of all concussion injuries. Six (22.2%) of the 27 injured scrum-halves were referred to medical specialists.

(g) Fly-halves

Twenty-two of the 410 injured players were fly-halves (8.1% corrected) (Table 5.5). Of all injured fly-halves, 59.1% were injured during match play, 45.5% were under-19 players and 81.8% A and B-team players from all age-groups. This is the only position where A and B-team players sustained more than 80% of the respective injuries. Nine (41%) of the injured fly-halves sustained upper limb, and seven (31.8%) lower limb injuries.

The phases of play during which fly-halves were most likely to be injured were while being tackled (36.4%) and during open play (27.3%). Only 13.6% were injured during the tackling phase of play, whilst 18.2% were injured during loose-scrums and mauls. Fly-halves and scrum-halves reported 39.3% of all loose-scrum/maul injuries sustained by backline players.

The 22 injured fly-halves reported 28 specific injuries. As found with scrum-halves, most were

fracture (35.7%) and ligament (32.1%) injuries. Three of the 15 finger fracture, and two of the three hip dislocation injuries were sustained by fly-halves. As was the case with scrum-halves, fly-halves sustained only two (3%) of the 67 concussion injuries. Two (9.1%) of the 22 injured fly-halves were referred to medical specialists.

(h) Centres

Sixty-two of the 410 injured players were centres (11.5% corrected) (Table 5.5). Of all injured centres, 67.8% were injured during match play, 46.8% were under-19 players and 69.4% A and B-team players from all age-groups. Twenty-four (38.7%) of the injured centres sustained upper limb, and 17 (27.4%) lower limb injuries.

The phases of play during which centres were most likely to be injured were while being tackled (43.5%) and while tackling (32.3%). Thus 75.8% of injured centres sustained injuries during the two tackling phases of play, the highest percentage reported amongst all positions.

The 62 injured centres reported 75 specific injuries. Most common amongst these were fracture and ligament injuries (each 30.7%), muscle injuries (17.3%) and concussion injuries (13.3%). Centres reported 25.6% of all clavicle fractures and 23.8% of all knee ligament injuries. These two specific injuries constituted 26.7% of all injuries to these players. Three of the four humerus fractures reported by all players were sustained by centres. Shoulder muscle and ligament injuries were also common amongst centres, accounting for 14.7% of all injuries to these players. Seven (11.3%) of the 62 injured centres were referred to medical specialists.

(i) Wings

Sixty-seven of the 410 injured players were wings (12.4% corrected) (Table 5.5). Of all injured wings, 58.2% were injured during match play, 50.7% were under-19 players and 71.6% A and B-team players from all age-groups. Fifty-one (76.1%) of the injured wings sustained upper and lower limb injuries (upper limb 40.3% and lower limb 35.8%).

The phases of play during which wings were most likely to be injured were while being tackled (44.8%), while tackling (25.4%) and during open play (19.4%). Wings sustained 25% of all being tackled injuries and 28.9% of all open play injuries.

The 67 injured wings reported a total of 82 specific injuries. Of these injuries, 35.4% were ligament, 26.8% fracture and 15.9% muscle injuries. The most common fracture injury reported by wings were clavicle fractures (40.9%), whilst ankle and knee ligament injuries accounted for 62.1% of all ligament injuries reported by these players. Seven (46.7%) of the 15 muscle injuries reported by wings were shoulder muscle injuries. Nine (13.4%) of the 67 injured wings were referred to medical specialists.

(j) Full-backs

Twenty-eight of the 410 injured players were full-backs (10.4% corrected) (Table 5.5). Of all injured full-backs, 78.6% were injured during match play, 50% were under-19 players and 67.9% A and B-team players from all age-groups. Ten (35.7%) of the injured full-backs sustained head and neck, 32.1% lower limb, and 25% upper limb injuries. Full-backs were the only backline players to report a higher percentage of head and neck injuries than upper or lower limb injuries.

The phases of play during which full-backs were most likely to be injured were while being tackled (39.3%), while tackling (28.6%) and during open play (17.9%). The above figures are similar to those found for wings.

The 28 injured full-backs reported a total of 42 specific injuries. Most common amongst these were fracture and ligament (26.2% each) and muscle injuries (21.4%). Four of the eight ligament injuries reported by full-backs were ankle and knee ligament injuries. Only three (10.7%) of 28 injured full-backs were referred to medical specialists.

5.5 Risk of injury during different phases of play, including the effect of age

The risk of injury for different phases of play is shown in Figure 5.6, which also includes data from the 1983 study. The phase of play during which most players were injured was while being tackled (29.3%). This figure is almost identical with that of the 1983 study (29.5%) and, when added to the 21.5% of players injured while tackling, confirms the findings of the 1983 study that more than 50% of all players were injured during the two tackling phases of play. Finally, when the percentage for players injured during the loose-scrum/maul (22.2%) is added to those of the above two phases, these three phases of play accounted for 73.2% of all players injured during the 1984 study, almost identical with the 72.5% of all players injured during these three phases of play in the 1983 study. The line-out (1.7%) was again the safest phase of play.

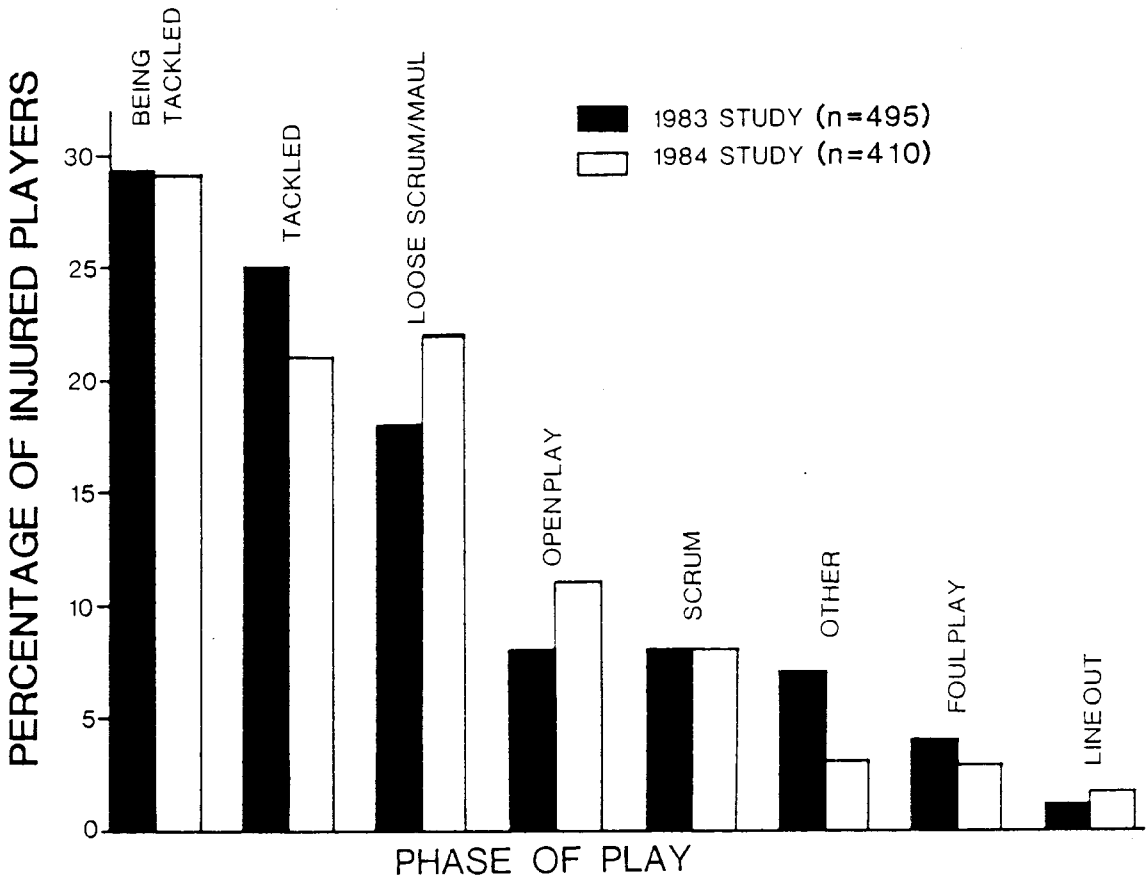

Figure 5.6 The percentage risk for players injured during different phases of play in the 1983 and 1984 studies. Note that during each season more than 70% of all injured players sustained injuries while being tackled, while tackling or during loose-scrums and mauls.

When the phase of play is reflected as a percentage of the players injured within an age-group, two interesting patterns emerge. At under-14 level, 9.8% of the injured players sustained injuries during the loose-scrum/maul phase of play. The percentages for players who sustained injuries during this phase of play then rises through the other age-groups to 29.1% at under-19 level (Figure 5.7-A). The opposite occurred with the being-tackled phase of play. At

under-14 level, 41.2% of the injured players were injured while being tackled. The percentages then decrease through the other age-groups to 21.3% at under-19 injuries level. In contrast, the percentages for players injured during the tackling phase of play varies between 20% and 25% within all age-groups and that for players injured in the scrum between 5% and 12% (Figure 5.7-B). The percentages for players injured during the line-out, foul play and "other" phases of play do not rise above 5% in any of the four age-groups.

Figure 5.7 - A

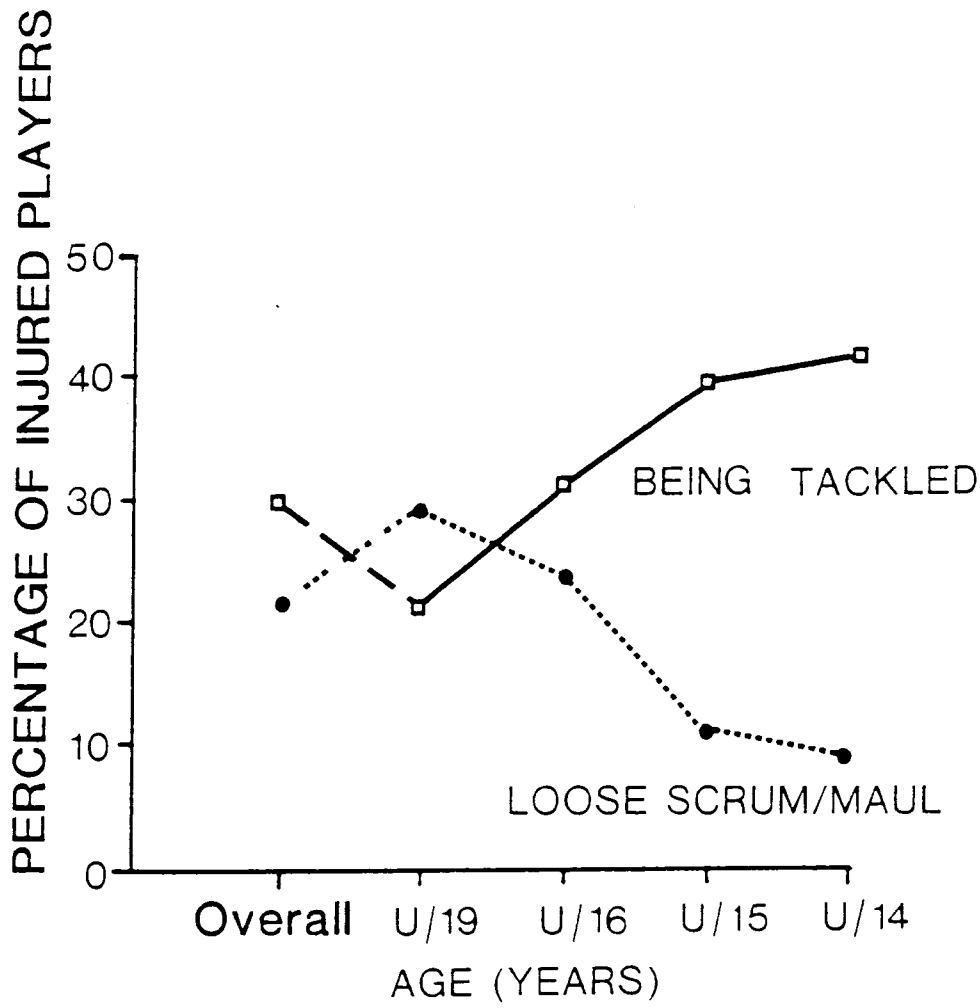

Figure 5.7 - B

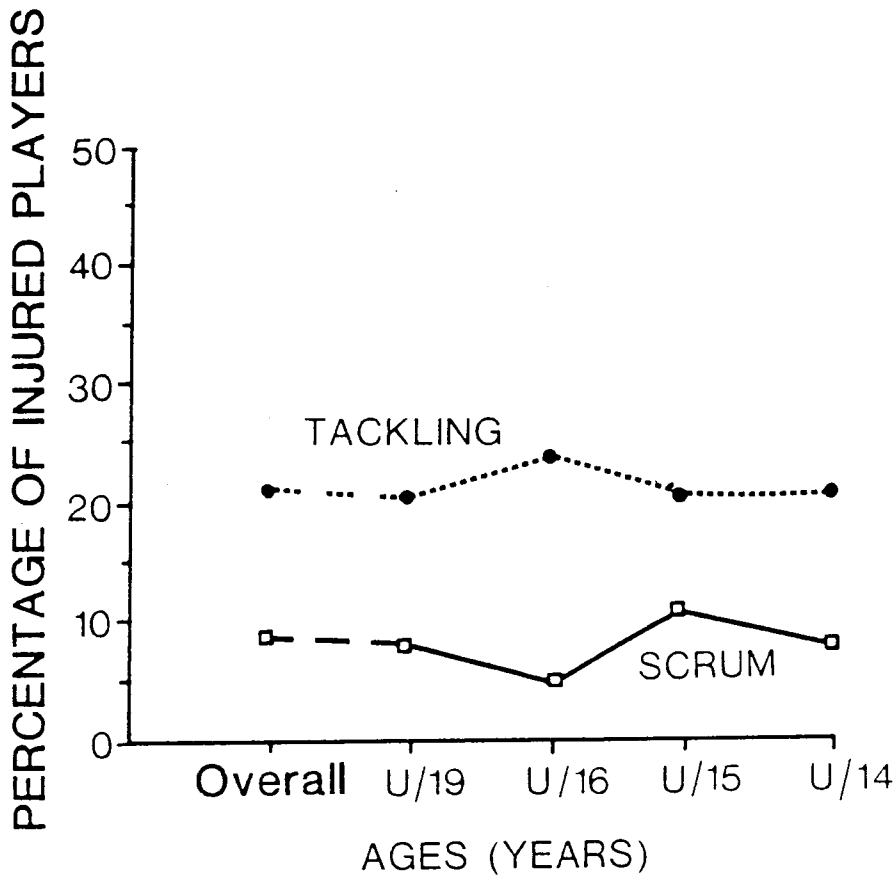

Figure 5.7 The relative age-group risk of injury for players injured while being tackled and during the loose-scrum/maul rises or falls with age (Figure 5.7 - A), whilst the relative age-group risk of injury for players injured during the tackling and scrum phases of play remains constant at all ages in the 1984 study (Figure 5.7 -B).

(a) Being-tackled

One hundred and twenty (29.3%) of the 410 injured players were injured while being tackled (Figure 5.6). Of these players, 36.7% were under-19 players, a percentage 19.2% lower than the 55.9% of under-19 players injured during other phases of play. Of all players injured while being tackled 69.2% were A and B-team players from all age-groups and 68.3% backline

players. Centres and wings (47.5%) were the backline players, and flankers and eighthmen (18.3%) the forward players most likely to be injured.

Fifty-five (45.8%) of the 120 players injured while being tackled sustained upper limb, 29.2% lower limb and 23.3% head and neck injuries. These injuries, particularly those to the upper limb, were most probably sustained as a result of the tackled player striking the ground after being tackled. Of all players injured while being-tackled, 61.7% were injured during match play.

The 120 players injured while being-tackled reported 142 specific injuries. Of these injuries, 40.8% were fractures, 16.3% more than the 24.5% that fractures represented of all injuries sustained during other phases of play. Clavicle fractures (18.3%), concussion (13.4%) and knee ligament injuries (11.3%) were the most commonly reported specific injuries. Three of the eight neck dislocation injuries (37.5%) were sustained during this phase of play and were most probably caused by illegal high tackles.

(b) Tackling

Eighty-eight (21.5%) of the 410 injured players were injured while tackling (Figure 5.6). Of these players, 48.9% were under-19 players and 68.2% A and B-team players from all age-groups. Fifty-seven (64.8%) of the players injured during this phase of play were back-line players, and most at risk amongst these were centres (22.7%) and wings (19.3%). Flankers (15.9%) were the forward players most likely to sustain tackling injuries. Forty-two percent of the players injured while tackling sustained upper limb, 31.8% head and neck and 19.3% lower limb injuries, whilst 62.5% were injured during match play.

The 88 players injured while tackling reported 106 specific injuries. Of these injuries, 25.5% were fractures, compared with 40.8% fractures sustained during the being-tackled phase of play. Most common amongst the specific injuries were concussion (14.2%) and shoulder ligament injuries (13.2%). Four of the five shoulder dislocation injuries were sustained during this phase of play and clavicle fractures accounted for only 14.2% of tackling injuries, 4.1% less than the 18.3% clavicle fractures sustained during the being-tackled phase of play. Players injured during the tackling phases of play sustained 50.7% of all clavicle fractures.

The above findings suggest that a tackled player, falling to the ground with an outstretched arm, is more likely to sustain a clavicle fracture, and the tackling player a shoulder dislocation injury.

(c) Loose-scrum/maul

Ninety-one (22.2%) of the 410 injured players were injured during the loose-scrum/maul phase of play (Figure 5.6). Of these players, 65.9% were under-19 players, a figure 20.1% higher than the 45.8% of all injuries sustained by this age-group during other phases of play. Sixty-seven percent of the players injured during this phase of play were A and B-team players, and of these players, 60% were under-19 A and B-team players.

Sixty-nine (75.8%) of the players injured during the loose-scrum/maul were forward players, and most at risk were locks (23.1%), flankers (19.8%) and eighthmen (15.9%). Thirty-five (38.5%) of 91 injured players sustained head and neck, 24.2% upper limb, and 23.1% lower limb injuries. The high percentage of injured players who sustained head and neck injuries suggests

that illegal play such as raking had occurred during this phase of play. Sixty-five (71.4%) of the players injured during the loose-scrum/maul were injured during match play.

The 91 players injured during the loose-scrum/maul phase of play reported 113 specific injuries. Most common amongst these injuries were concussion (15.9%), head and face lacerations (8%) and trunk muscle injuries (7.1%). Thirty-six percent of all laceration and 26.9% of all concussion injuries occurred during the loose-scrum/maul. Two hip dislocation, two neck vertebral dislocation, and two neck vertebral fracture injuries also occurred during this phase of play.

(d) Open play

Forty-five (11%) of the 410 injured players were injured during open play (Figure 5.6). Of these players, 53.3% were under-19 players and 71.1% A and B-team players from all age-groups. Thirty (66.7%) of players injured during this phase of play were backline players and most at risk were wings (28.9%), fly-halves (13.3%) and centres and full-backs (each 11.1%). Flankers and props (each 11.1%) were the forward players most likely to be injured during open play. Twenty-three (51.1%) of the players injured during this phase of play sustained lower limb, and 26.7% upper limb injuries, whilst 64.4% were injured during match play.

The 45 players injured during open play reported 57 specific injuries. Of these injuries, ankle (17.5%) and knee (12.3%) ligament injuries were most commonly reported. Ten (29.4%) of the 34 ankle ligament injuries occurred during this phase of play. Eight (57.1%) of the 14 upper limb injuries sustained during this phase of play were finger injuries. Four of the seven finger

ligament, and four of the 15 finger fracture injuries reported in this study (1984), were sustained during open play. Six (54.5%) of the 11 muscle injuries which were sustained during open play were either thigh or hamstring muscle injuries.

(e) Scrum

Thirty-three (8%) of the 410 injured players were injured during the scrum phase of play (Figure 5.6). Of these players, 45.5% were under-19 players and 57.6% A and B-team players from all age-groups. Twenty-two (66.7%) of the injured players were props and when combined with the percentage of hookers injured during scrums, 81.8% of all players injured during this phase of play were front-row players. No eighthmen were injured during scrums. Fourteen (42.4%) of the players injured during scrums sustained head and neck, and 39.4% trunk injuries. Thus only 18.2% of players injured during this phase of play sustained upper and lower limb injuries. Sixty percent of players injured during scrums were injured during match play.

The 33 players injured during the scrum phase of play reported 50 specific injuries. Of these injuries, 38% were either neck ligament or neck muscle injuries and 26% either trunk ligament or trunk muscle injuries. Two neck vertebral dislocations, two neck vertebral fractures and one trunk vertebral fracture were reported. Thus 46% of injuries sustained during scrums were neck injuries, whilst all fractures sustained during scrums were either neck vertebral fractures, rib fractures, or trunk vertebral fractures.

(f) Foul play

Only twelve (2.9%) of the 410 injured players were injured as a result of foul play (Figure 5.6). Of these

players, six (50%) were under-19 players and eight (66.7%) A and B-team players from all age-groups. Four (33.3%) of the 12 injured players were forward players, a percentage 17% lower than the 50.3% of all forward players injured during other phases of play. Amongst backline players, wings and full-backs (41.7%) were most likely to be injured. All 12 players were injured during match play.

The twelve players injured as a result of foul play reported 14 specific injuries. Of these injuries, five (35,7%) were concussion, three ligament (21.4%), and three fracture injuries.

(g) Line-out

The phase of play during which the fewest players (1.7%) were injured was the line-out (Figure 5.6). Five (71.4%) of the seven players injured during line-outs were under-19 players and the remaining two, under-15 players. Thus no under-14 and under-16 players were injured during this phase of play. Five players were A and B-team players and the same number of players sustained injuries during match play. Four of the seven players were locks and two props. Four players sustained head and neck, and two lower limb injuries

The seven players injured during line-outs reported nine specific injuries. Of these injuries, four were ligament injuries and no fractures were reported during this phase of play.

(h) Other phases of play

Fourteen (3.4%) of the 410 injured players were injured during other phases of play (Figure 5.6). Of these players, ten (71.4%) were under-19 players and 11 (78.6%) A and B-team players from all age-groups. Four

of the 14 injured players were eighthmen. Nine (64.3%) players were injured during practices.

The 14 players injured during other phases of play reported 15 specific injuries. Of these injuries, six (40%) were ligament injuries, and interestingly, one a trunk vertebral fracture. It was, regrettably, not possible to establish how this injury had occurred.

5.6 **Risk of injury at different anatomical sites**

Thirty-one percent of the 410 injured players sustained head and neck, 32.7% upper limb, 26.6% lower limb and 9.8% trunk injuries (Figure 5.8). Figure 5.8, which also includes the figures of the 1983 study, shows that the percentage of players who sustained head and neck injuries was high in both studies, whilst the percentage of players who sustained trunk injuries was low. This confirms the findings of the 1982 study (Nathan et al. 1983) in which players who sustained trunk injuries were the least common.

(a) Head and neck injuries

One hundred and twenty seven (31%) of the 410 injured players sustained head and neck injuries (Figure 5.8). Of these players, 52.7% were under-19 players and 66.1% A and B-team from all age-groups. Both percentages are consistent with overall injury figures for the two groups. Of the players who sustained head and neck injuries, 59.8% were forward players and particularly at risk were flankers (15.7%) and props (15%). Amongst the backline players, centres (12.6%) and wings (11.8%) were the players most likely to sustain head and neck injuries. Hookers (5.5%) and scrum-halves (2.4%) were least likely to sustain these injuries.

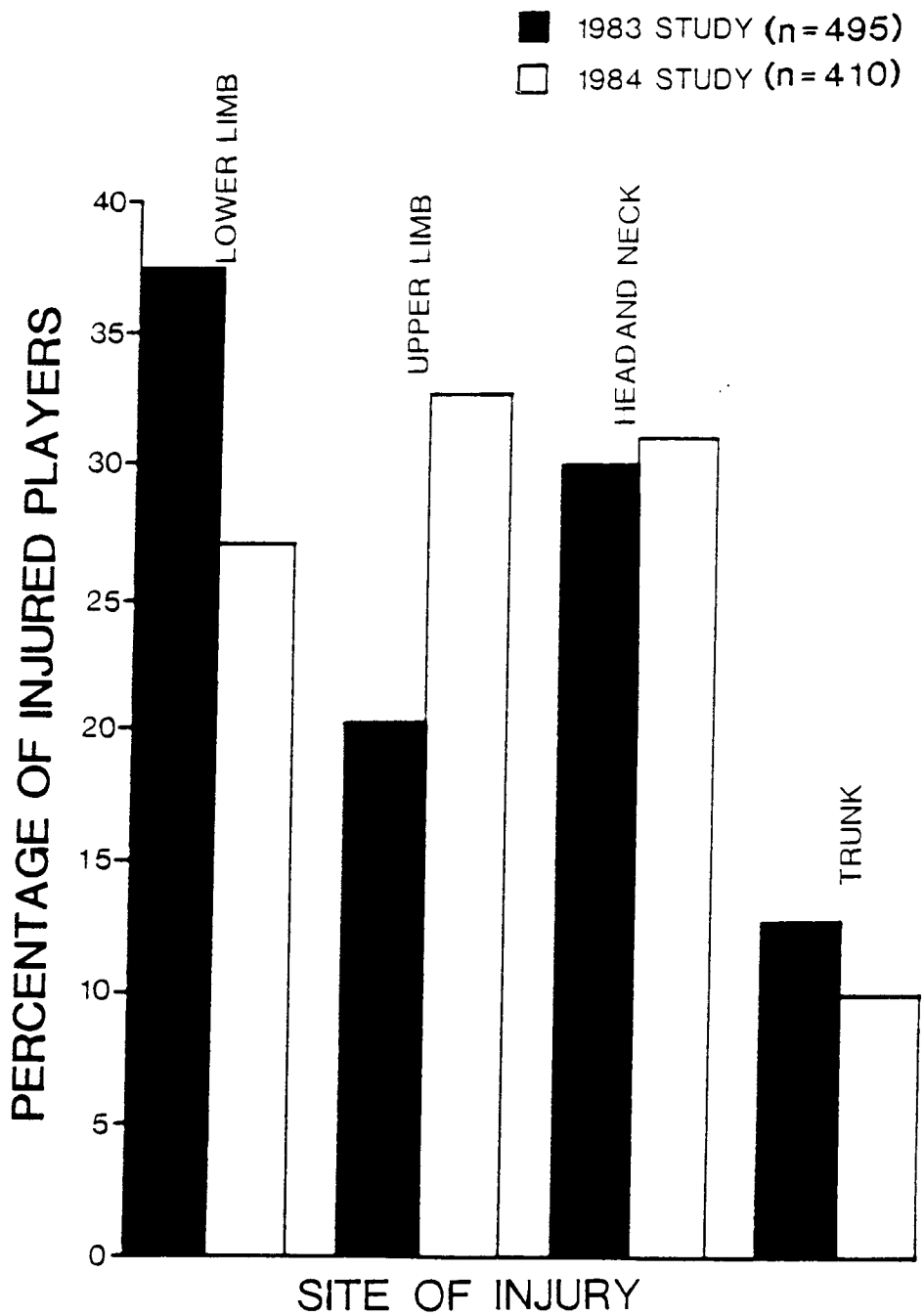

Figure 5.8 The percentage risk of injury at different anatomical sites during the 1983 and 1984 studies.

Players who sustained head and neck injuries were most likely to be injured during loose-scrums and mauls (27.6%), while being tackled and while tackling (each 22%). Only 11% of the players were injured during the scrum. One hundred and one (79.5%) of the players who sustained head and neck injuries were injured during match play, a percentage 21.5% higher than the 58% that players injured at other anatomical sites sustained during match play. Furthermore, players who sustained head and neck injuries during match play represented 38.1% of all players injured during match play, compared with the only 17.9% that players who sustained head and neck injuries during practices represented of all players injured during practices.

The 127 players who sustained head and neck injuries reported 159 specific injuries. Most common amongst these were concussion (42.1%), neck muscle (16.4%) and neck ligament injuries (11.9%).

(b) Upper limb injuries

One hundred and thirty four (32.7%) of the 410 injured players sustained upper limb injuries (Figure 5.8). Of these players, 44.8% were under-19 players and 67.1% A and B-team players from all age-groups. Seventy-six (56.7%) of the players who sustained upper limb injuries were backline players and particularly at risk were wings (20.1%) and centres (17.9%). Amongst the forward players, flankers (12.7%) and props (11.2%) were most frequently injured.

Players who sustained upper limb injuries were most likely to be injured while being tackled (41%), while tackling (27.6%) and during the loose-scrum/maul (16.4%). Seventy-eight (58.2%) of the 134 players were injured during match play.

The 134 players who sustained upper limb injuries reported 168 specific injuries. Most common amongst these were clavicle fractures (23.2%), shoulder ligament (19%) and shoulder muscle injuries (13.1%).

(c) Lower limb injuries

One hundred and nine (26.6%) of the 410 injured players sustained lower limb injuries (Figure 5.8). Of these players, 55% were under-19 players, 60.6% backline players and 68.8% A and B-team players from all age-groups. Wings (22%) and centres (15.6%) were the backline players, and locks, props and flankers (each 10.1%) the forward players most likely to sustain lower limb injuries.

Players who sustained lower limb injuries were likely to be injured while being tackled (32.1%), during open play (21.1%) and during the loose-scrum/maul (19.3%). Fifty-five percent of the players were injured during match play.

The 109 players who sustained lower limb injuries reported 128 specific injuries. Most common amongst these were knee (32.8%) and ankle ligament injuries (26.6%). Thigh, hamstring and calf muscle injuries together accounted for only 12.5% of all lower limb injuries.

(d) Trunk injuries

Forty (9.8%) of the 410 injured players sustained trunk injuries (Figure 5.8) Of these players, 50% were under-19 players and 72.5% A and B-team players from all age-groups. Twenty-seven (67.5%) were sustained by forward players, and particularly at risk were locks (25%). Centres (12.5%) were the backline players who were most likely to sustain trunk injuries.

Players who sustained trunk injuries were likely to be injured during the scrum and loose-scrum/maul phases of play (each 32.5%). Only 20% of the players who sustained trunk injuries were injured during the two tackling phases of play, compared with respectively 44.1%, 47.7% and 68.6% for players sustaining head and neck, lower limb and upper limb injuries during the two tackling phases of play. Twenty-five (62.5%) of the players who sustained trunk injuries were injured during match play.

The 40 players who sustained trunk injuries reported 51 specific injuries. Most common amongst these were muscle (43.1%), ligament (21.6%) and rib fracture (17.6%) injuries.

5.7 **Specific diagnoses of injuries**

A total of 506 specific injuries were reported by the 410 injured players, indicating that some players (20.5%) sustained more than one specific injury during one injury incident. Ten players reported three specific injuries, and two players four specific injuries. The most common types of injury were ligament (30%), fracture (29.1%) and muscle injuries (18.6%) (Table 5.6). Thus almost 60% of all injuries were ligament and fracture injuries. Concussion accounted for 13.2% of all injuries. The above percentages are similar to those of the 1983 study.

The percentages for concussion were almost identical in the 1983 and 1984 studies and contrast with the finding of the 1982 study (Nathan et al. 1983), in which concussion injuries accounted for 21.5% of all injuries. However, as previously stated in Chapter 3, it seems highly probable that concussion injuries were under-reported. The 1982 finding is therefore likely to be more realistic.

Table 5.6 The percentage risk and average number of days out of rugby for different injury types in the 1984 study.

INJURY TYPE	NUMBER OF INJURIES	RISK (%)	AVERAGE DAYS OUT #
Ligament	152	30.0	22.6
Fracture	147	29.1	34.8
Muscle	94	18.6	10.3
Concussion	67	13.2	15.0
Laceration	25	4.9	12.2
Dislocation	18	3.6	25.3
Other	3	0.6	*
OVERALL	506	99.9	22.7

\# Calculated only for cases where a player sustained only one specific injury during one injury incident, and for which the number of days out of rugby could be determined (except in the case of dislocations - see text below).

* Sample too small or varied to furnish reliable data.

Table 5.6 also shows the average number of days out of rugby for the different types of injury. These figures were calculated only for cases where a player sustained only one specific injury during one injury incident and the number of days out of rugby could be determined. It stands to reason that cases where more than one specific injury was sustained could not be included, as in such cases it was impossible to determine the number of days out of rugby for each specific injury sustained. However, in the case of dislocations an exception was made. In the two studies (1983 and 1984) reported in this thesis, a distinction was made between dislocation and ligament injuries, although, strictly speaking, dislocations are also ligament injuries. As almost all dislocations reported in this study (1984) were

sustained with associated ligament and/or muscle injuries, it was not possible to calculate the average number of days out of rugby for dislocation injuries only. Thus, for dislocation injuries the average number of days out of rugby was calculated for all cases where the number of days out of rugby could be determined (see 5.7.1).

Of the 410 injured players, a total of 326 (79.5%) players reported only one specific injury. In 17 of these cases it was not possible to determine the exact number of days out of rugby as some of these players were out of rugby for either the rest of the season or forever. The remaining 309 players who reported only one specific injury and for who the number of days out of rugby could be determined, were out of rugby for a total of 7014 days (average 22.7 days). Players who sustained only one specific fracture were out of rugby for an average of 34.8 days, which is, on average, 24.5 days more than for players who sustained only one specific muscle injury. Thus, fracture injuries kept injured players out of rugby for the longest average period of time (34.8 days) and muscle injuries for the shortest average period of time (10.3 days).

Interestingly, players who sustained only one specific ligament injury were out of rugby for an average period more than twice as long as that for players who sustained only one specific muscle injury. Eighty-four (20.5%) of the 410 injured players sustained more than one specific injury. Almost all players who reported dislocations (94.4%) sustained more than one specific injury, compared respectively with only 20.9% and 24% for players who sustained concussion and laceration injuries.

5.7.1 **Dislocation injuries**

Eighteen dislocation injuries were reported (3.6% of all injuries) (Table 5.6). With the exception of one, all players who reported dislocation injuries sustained more

than one specific injury. Eight players (44.4%) sustained vertebral dislocations. Five shoulder (27.8%), three hip (16.7%) and two finger (11.1%) dislocations were also reported.

Ten (55.6%) of the 18 dislocations were sustained during match play, 72.2% by A and B-team players from all age-groups and 44.4% by under-14 and under-15 players. This last figure is 11.2% higher than the 33.2% of all other injuries sustained by players in these age-groups and possibly indicates that younger players are more prone to dislocation injuries.

Five of the eight vertebral dislocations were sustained by forward players. Three of the seven neck vertebral dislocations were sustained when the player was tackled, two in the scrum and two in the loose-scrum/maul. Four of the five shoulder dislocations were sustained by the player executing the tackle. Two of the three hip dislocations were sustained by fly-halves.

Sixteen of the seventeen players who reported dislocations with other injuries sustained associated muscle and/or ligament injuries (five reported both muscle and ligament injuries). Two of these players also sustained fractures (femur, humerus).

One of the players who sustained a neck vertebral dislocation injury may never play rugby again and five of the players who reported dislocation injuries were out of rugby for the remainder of the season (two hip, two neck and one shoulder). The other twelve players were out of rugby for a total of 304 days (average 25.3 days) (Table 5.6). Of these players, five reported neck or back-vertebral dislocations and were out of rugby for an average of 29 days. This finding must be treated with some suspicion and may indicate that these injuries were possibly not true neck dislocation injuries, as such

injuries would almost certainly have prevented these players from participation for a much longer period, if not forever. The players who reported shoulder dislocation injuries were out of rugby for an average of 22.2 days.

Seven of the players who reported dislocation injuries were treated at hospitals, twelve by family practitioners and seven (38.9%) were referred to medical specialists. Only five of the eight players who reported vertebral dislocation injuries were referred to medical specialists, which also indicates that some vertebral dislocation injuries were most probably incorrectly diagnosed or reported.

5.7.2 Concussion injuries

Sixty-seven concussion injuries were reported (13.2% of all injuries) (Table 5.6). Of these injuries, 53 (79.1%) were reported as concussion injuries only. The remaining 14 concussion injuries were most commonly reported with neck muscle and/or neck ligament injuries (35.7%), with facial fractures (28.6%) and with facial lacerations (28.6%).

Fifty-six (83.6%) of the 67 concussion injuries were sustained during match play, a figure 22.7% higher than the 60.9% of all other injuries that occurred during match play. Of all concussion injuries, 70.1% were sustained by A and B-team players from all age-groups, 43.3% by under-19 players and 61.2% by forward players. Flankers (22.4%), eighthmen (16.4%) and locks (11.9%) were the forward players most likely to sustain concussion injuries, whilst amongst backline players centres (14.9%) and wings (13.4%) sustained most. Hookers, scrum-halves and fly-halves (each 3%) sustained the fewest concussion injuries.

The phases of play during which most concussion injuries occurred were while being tackled (28.4%), the loose-

scrum/maul (26.9%) and while tackling (22.4%). Together these three phases of play accounted for 77.7% of all concussion injuries reported. Concussion injuries were least likely to occur during the scrum and line-out phases of play (each 3%).

Of the 53 players who reported concussion injuries only, four (7.5%) were out of rugby for the rest of the season. The 46 players for who the number of days out of rugby could be determined were out of rugby for a total of 690 days (average 15 days) (Table 5.6). Three players continued playing rugby directly after being injured, 8 played again within the first seven days, 16 within fourteen days and a further 13 within 21 days of being injured. Thus 75.5% of the players who reported only concussion ignored recommendations by medical and rugby authorities and participated in rugby within three weeks following their concussion injuries. Seven players received no medical treatment, whilst most were treated by family practitioners (35.8%) or at hospitals (26.8%). Only three players (4.5%) were referred to medical specialists.

5.7.3 **Laceration injuries**

Twenty-five laceration injuries were reported (4.9% of all injuries (Table 5.6). Nineteen of these were reported as laceration injuries only. Four of the remaining six were reported with concussion injuries. Eighteen (72%) of the 25 laceration injuries occurred during match play and 20 (80%) were head and face lacerations. The injuries were evenly spread between forward (52%) and backline players (48%). Flankers (28%) and wings and full-backs (each 20%) sustained 68% of all laceration injuries, whilst 72% of these injuries occurred during the tackling and loose-scrum/maul phases of play. No laceration injuries were reported during the scrum and line-out phases of play and foul play accounted for only 4% of laceration injuries.

Seventy-two percent of all laceration injuries were sustained by under-16 and under-19 players, and of these injuries, 56% were sustained by under-19 A and B-team players. The 19 players who reported laceration injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 232 days (average 12.2 days) (Table 5.6). Five players received no medical treatment, 14 (56%) were treated at hospitals and six by family practitioners.

5.7.4 **Muscle injuries**

Ninety-four muscle injuries were reported (18.6% of all injuries) (Table 5.6). Fifty were reported with other injuries, and of these, 56% were reported with associated ligament injuries, 26% with fracture injuries and 16% with dislocation injuries.

Muscle injuries were evenly spread among the different anatomical sites. Most were sustained to the head and neck and upper limb (each 27.7%). Trunk and lower limb muscle injuries respectively accounted for 24.5% and 20.4% of all muscle injuries. Table 5.7 lists the different muscles injuries. Neck (27.7%), shoulder and trunk muscle injuries (each 24.5%) were most commonly reported. Hamstring and calf muscle injuries (each 4.3%) were collectively fewer than thigh muscle injuries (9.6%). The least commonly reported muscle injuries were arm (3.2%) and groin muscle injuries (2.2%).

Sixty-six (70.2%) of the 94 muscle injuries occurred during match play and 43.6% to under-19 players. This figure is slightly lower than the 49.3% of all other injuries reported by under-19 players. Muscle injuries were evenly spread between forward (47.9%) and backline players (52.1%). These figures are similar to the 44.4% and 55.6% of other all injuries sustained by forward and backline players respectively. Wings and props (each

16%), centres (14.9%) and locks (12.8%) reported the most muscle injuries and hookers, eighthmen and fly-halves (each 5.3%) the fewest.

Table 5.7 The percentage risk and average number of days out of rugby for different muscle injuries in the 1984 study.

MUSCLE TYPE	NUMBER OF INJURIES	RISK (%)	AVERAGE DAYS OUT #
Neck	26	27.7	15.3
Shoulder	23	24.5	22.8
Trunk	23	24.5	13.7
Thigh	9	9.6	9.0
Hamstring	4	4.3	18.4
Calf	4	4.3	10.8
Arm	3	3.2	9.4
Groin	2	2.2	25.7
	—	———	———
OVERALL	94	100.3	10.3

Calculated only for cases where a player sustained only one specific injury during one injury incident, and for which the number of days out of rugby could be determined.

Sixty-seven percent of all muscle injuries were sustained by A and B-team players, a figure similar to the 68.1% of all other injuries sustained by A and B-team players. Most muscle injuries were sustained during the tackling and loose-scrum/maul phases of play (each 21.3%), followed by the scrum (20.2%) and while being tackled (19.1%) phases of play.

The 46 players who reported one muscle injury only and for who the number of days out of rugby could be determined, were out of rugby for a total of 473 days (average 10.3 days) (Table 5.6). The specific muscle injuries that kept players out of rugby for the longest average number of days were groin (25.7 days) and shoulder muscle injuries (22.8 days) (Table 5.7). Players who sustained arm or thigh muscle injuries were back playing rugby again after an average of 9.1 days out of rugby. Thirteen (13.8%) of the players who reported muscle injuries were referred to medical specialists.

(a) Neck muscle injuries

Twelve (46.2%) of the 26 neck muscle injuries were reported as neck muscle injuries only. Eight of the 14 neck muscle injuries sustained with other injuries were reported with associated ligament injuries, and four with concussion injuries.

A and B-team players sustained 61.5% and under-19 players 53.8% of all neck muscle injuries. Nineteen (73.1%) of the injuries were sustained by forward players. Props (26.9%) and locks (19.2%) reported the highest percentages. The phases of play during which most neck muscle injuries occurred were the scrum (34.6%), followed by players injured while being tackled (19.2%) and during the loose-scrum/maul (15.4%). Foul play, open play and the line-out contributed collectively to only 19.2% of these injuries.

Twenty-three (88.5%) of the 26 neck muscle injuries occurred during match play, a percentage 23.8% higher than the 64.7% reported for all other muscle injuries sustained during match play, and 25.5% higher than the 63% reported for all other injuries sustained during match play.

The 12 players who reported neck muscle injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 183 days (average 15.3 days) (Table 5.7). Six the 26 players who sustained neck muscle injuries received no medical treatment, whilst 16 of the 20 players who received medical treatment were treated by family practitioners and/or at hospitals. Of these players, six were referred to medical specialists. It should be noted that five of the last mentioned six players sustained more than one specific injury. In all five cases, a neck muscle injury was reported with either a concussion, a neck vertebral fracture or a neck vertebral dislocation.

(b) Shoulder muscle injuries

Nineteen (82.6%) of the 23 players who sustained shoulder muscle injuries reported more than one specific injury. Of these players, 13 (68.4%) reported shoulder muscle injuries with associated shoulder ligament injuries and five (26%) with fractures (three clavicle and two humerus).

Of all shoulder muscle injuries, 82.6% were sustained by A and B-team players from all age-groups and 73.9% by under-16 and 19 players. In direct contrast with neck muscle injuries, of which 73.1% were sustained by forward players, 78.3% of the shoulder muscle injuries were sustained by backline players, particularly by wings (30.4%) and centres (21.7%).

The phases of play during which most of these injuries occurred were while tackling (39.1%) and while being tackled (30.4%). Seventeen (71.9%) of shoulder muscle injuries occurred during match play.

All the players who reported the above injuries were

treated by family practitioners and three players were referred to medical specialists. The four players who reported shoulder muscle injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 91 days (average 22.8 days) (Table 5.7). The 13 players who reported shoulder muscle and ligament injuries were out of rugby for an average period of 26.4 days.

(c) Trunk muscle injuries

Twelve (52.2%) of the 23 players who reported trunk muscle injuries reported more than one specific injury. Of these players, six (50%) reported trunk muscle injuries with associated trunk ligament injuries. In two cases (16.7%) trunk muscle injuries were reported with rib fractures.

The players most likely to sustain trunk muscle injuries were almost identical with those likely to sustain neck muscle injuries. Seventeen (73.9%) of the players who sustained trunk muscle injuries were forwards (73.1% in the case of neck muscle injuries) and, of these players, 43.5% were props and locks. This percentage is similar to the 46.1% of props and locks who sustained neck muscle injuries.

Most trunk muscle injuries occurred during the scrum and loose-scrum/maul phases of play (each 34.8%), a figure identical with that of neck muscle injuries occurring during scrums. No trunk muscle injuries were reported by under-14 players, but under-15 and under-16 players sustained 69.6% of these injuries. Thus under-19 players sustained only 30.4% of trunk muscle injuries. This percentage is 18.9% lower than the 49.3% of all other muscle injuries, and 18.7% lower than the 49.1% of all other injuries sustained by players in this age-group.

Sixteen (69.6%) of the 23 trunk muscle injuries were sustained by A and B-team players and 60.8% occurred during match play. The eleven players who reported trunk muscle injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 151 days (average 13.7 days) (Table 5.7). Five players received no medical treatment and most (56.5%) were treated by family practitioners.

(d) Thigh muscle injuries

Seven of the nine thigh muscle injuries were reported as thigh muscle injuries only. One of the two reported with other injuries was reported with a hip dislocation injury.

Various similarities between thigh and shoulder muscle injuries were found. Eight (88.9%) were sustained by backline players and more particularly by wings (33.3%). In the case of shoulder muscle injuries these figures were 78.3% and 30.4% respectively. The open play and loose-scrum/maul phases of play each accounted for 33.3% of thigh muscle injuries and 55.6% occurred during match play. Of the nine thigh muscle injuries reported, five (55.6%) each were sustained by under-19 players and A and B-team players from all age-groups.

The seven players who reported thigh muscle injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 63 days (average 9 days) (Table 5.7). All nine players who sustained thigh muscle injuries were treated by family practitioners.

(e) Arm, groin, hamstring and calf muscle injuries

Ten (76.9%) of the above muscle injuries were reported as muscle injuries only. One arm muscle injury was reported with a wrist and radius fracture, one calf muscle injury with a knee ligament injury and another with an ankle ligament injury.

All three arm muscle injuries occurred in the two tackling phases of play and the two players who reported arm muscle injuries only, were out of rugby for an average of nine days (Table 5.7). Seven of the eight (87.5%) hamstring and calf muscle injuries were sustained by backline players (75% by centres, wings and full-backs). Four (50%) occurred during the open play phase of play and six (75%) during match play.

Players who reported arm, calf, hamstring and groin muscle injuries only and for who the number of days out of rugby could be determined, were out of rugby for an average of 9.4, 10.8, 18.4 and 25.7 days respectively (Table 5.7).

5.7.5 **Ligament injuries**

Ligament injuries were the most common type of injury reported (Table 5.6), accounting for 30% of all injuries. Of the 152 reported, 65.8% were reported as ligament injuries only. Those reported with other injuries were most commonly reported with associated muscle (51.9%), fracture (26.9%) and dislocation injuries (17.3%). The most common ligament injuries reported were knee (27.6%), ankle (22.4%), shoulder (21.1%) and neck ligament injuries (12.5%) (Table 5.8). When the anatomical site is considered, lower limb ligament injuries accounted for 51.3% and upper limb ligament injuries for 28.9% of all ligament injuries (80.2% when combined).

Ligament injuries were evenly distributed between forward and backline players (50% each). The players most likely to sustain ligament injuries were props and wings (19.1% each), centres (14.5%) and locks (13.8%). Hookers (2%), and full-backs and fly-halves (5.3% each) were least likely to sustain ligament injuries. Eighty-seven (57.2%) of the 152 ligament injuries were sustained by under-19 players, a percentage 12.8% higher than the 44.4% of all other injuries sustained by under-19 players.

Table 5.8 The percentage risk and average number of days out of rugby for different ligament injuries in the 1984 study.

LIGAMENT TYPE	NUMBER OF INJURIES	RISK (%)	AVERAGE DAYS OUT #
Knee	42	27.6	22.0
Ankle	34	22.4	20.2
Shoulder	32	21.1	29.3
Neck	19	12.5	37.0
Trunk	11	7.2	21.0
Finger	7	4.6	10.2
Wrist	4	2.6	19.5
Foot	2	1.3	9.7
Elbow	1	0.7	*
OVERALL	152	100	22.6

\# Calculated only for cases where a player sustained only one specific injury during one injury incident, and for which the number of days out of rugby could be determined.

* Sample too small to furnish reliable data.

A and B-team players sustained 67.8% of all ligament injuries. This figure is almost identical with the 68.2% of all other injuries sustained by A and B-team players and the 67% of all muscle injuries sustained by A and B-team players.

Ninety-two (60.5%) of the 152 ligament injuries occurred during match play. Thirty-nine (25.7%) were sustained by players during the being-tackled phase of play, 20.4% while tackling, 17.1% in the loose-scrum/maul and 15.1% during open play. The line-out and foul play phases together accounted for only 4.6% of ligament injuries.

The 95 players who reported ligament injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 2148 days (average 22.6 days). This last figure is more double the average of 10.3 days reported by players who sustained muscle injuries only (Table 5.6). The specific ligament injuries that kept players out of rugby for the longest average number of days were neck ligament injuries (37 days) and shoulder ligament injuries (29.3 days) (Table 5.8). Thus players sustaining neck ligament injuries were out of rugby for an average period 21.7 days longer than players sustaining neck muscle injuries. Players who sustained finger and foot ligament injuries were playing again after an average period of ten days out of rugby. Twenty-one percent of players who reported ligament injuries were referred to medical specialists.

(a) Knee ligament injuries

Forty-two or 8.3% of all injuries reported were knee ligament injuries. This figure was the second highest, after concussion (13.2%), for a specific injury reported. Knee ligament injuries accounted for 27.6% of all ligament injuries reported (Table 5.8) and, of these injuries, 36 (85.7%) were reported

as knee ligament injuries only. Those reported with other injuries included knee ligament injuries reported with patella fractures (two cases).

Twenty-seven (64.3%) of the knee ligament injuries were reported during match play. Under-19 players sustained 50% of all knee ligament injuries and the percentage reported by under-19 A-team players (26%) was particularly high, representing 16.2% of all under-19 A-team injuries, compared with only 8.8% that knee ligament injuries represented of all injuries to under-19 players. Seven (70%) of the ten under-14 players who reported ligament injuries sustained knee ligament injuries.

Twenty-six (61.9%) of knee ligament injuries were sustained by backline players and more particularly by centres and wings (23.8% each). Amongst forward players, props (14.3%) were the most likely to sustain knee ligament injuries, whilst no such injuries were reported by hookers.

The phases of play during which knee ligament injuries were most likely to occur were while being tackled (38.1%), while tackling (21.4%) and during open play (16.7%). Surprisingly, only one (2.4%) of these injuries occurred during the scrum and line-out phases of play.

Five players (11.9%) received no medical treatment, 66.7% were treated by family practitioners and six (14.3%) were referred to medical specialists. The 34 players who reported knee ligament injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 748 days (average 22 days) (Table 5.8).

(b) Ankle ligament injuries

The 34 ankle ligament injuries accounted for 22.4% of all ligament injuries reported (Table 5.8). Thirty (88.2%) of these were reported as ankle ligament injuries only. The remaining four were all reported with associated ankle fractures (one of the four players also sustained a tibia and fibula fracture).

Nineteen (55.9%) of the 34 ankle ligament injuries occurred during practices, one of the very few instances where more injuries occurred during practices than during matches. Twenty-one (61.8%) of the ankle ligament injuries were sustained by under-19 players, a figure 14.6% higher than the 47.2% of all other injuries sustained by this age-group, whilst 76.5% were sustained by A and B-team players from all age-groups, also higher than the 68.1% of all other injuries reported by A and B-team players from all age-groups.

Nineteen (55.9%) of the 34 ankle ligament injuries occurred to backline players. Wings (23.5%) were most prone to this type of injury whilst amongst the forward players props, locks and flankers each reported 11.6% of these injuries. Only one ankle ligament injury was reported by hookers. The occurrence of these injuries, particularly those occurring to players in high risk positions (backline players), may largely be avoided by using preventive ankle strapping techniques.

The phases of play during which most ankle ligament injuries occurred were during open play (29.4%), while being tackled (26.5%) and during the loose-scrum/maul (20.6%). Similar to knee ligament injuries, only two of these injuries (5.9%) occurred during the scrum and line-out phases of play.

Eight players received no medical treatment, 47.1% were treated by family practitioners and three were referred to medical specialists. The 29 players who reported ankle ligament injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 585 days (average 20.2 days) (Table 5.8).

(c) Shoulder ligament injuries

The 32 shoulder ligament injuries accounted for 21.1% of all ligament injuries reported (Table 5.8). Sixteen (50%) of these injuries were reported as shoulder ligament injuries only. Of the 16 shoulder ligament injuries reported with other injuries, ten (62.5%) were reported with associated shoulder muscle injuries, three with shoulder dislocation and muscle injuries and three with fractures (two humerus and one clavicle).

Twenty-one (65.6%) of these injuries occurred during match play and 53.1% to backline players. Centres and wings (each 15.6%) were the players most likely to sustain shoulder ligament injuries, followed by locks, flankers and eighthmen (each 12.5%), whilst hookers reported no shoulder ligament injuries. The phases of play during which most occurred were while tackling (43.8%), while being tackled (21.9%) and during loose-scrums and mauls (18.8%). Only 15.5% of shoulder ligament injuries occurred during the scrum, open play, foul play and line-out phases of play.

Under-19 players reported 68.8% of all shoulder ligament injuries, a figure 13% higher than the 55.8% of all other ligament injuries, and 22% higher than the 46.8% of all other injuries reported by this age-group. This figure is also much higher than the 44.7% shoulder muscle injuries sustained by under-19

players. In contrast, the 28.1% of shoulder ligament injuries sustained by under-16 players (under-16 and under-19 combined = 96.9%) approximates the 34.8% of all shoulder muscle injuries sustained by the same age-group. None of these injuries were reported by under-14 players and only one by an under-15 player. Twenty-three (71.9%) were sustained by A and B-team players, 10.7% fewer than the 82.6% of shoulder muscle injuries reported by A and B-team players.

Four players received no medical treatment and most were treated by family practitioners (59.4%) or at hospitals (25%). Four players were referred to medical specialists. The 15 players who reported shoulder ligament injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 440 days (average 29.3 days) (Table 5.8).

(d) Neck ligament injuries

The 19 neck ligament injuries accounted for 12.5% of all ligament injuries reported (Table 5.8). Only five (26.3%) of these injuries were reported as neck ligament injuries only. Those reported with other injuries were most commonly reported with associated neck muscle injuries (57.1%) and with neck vertebral dislocations (35.7%).

Sixteen (84.2%) of the 19 neck ligament injuries were sustained by forward players, a figure 39.1% higher than the 45.1% of all other ligament injuries, and 36.1% higher than the 48.1% of all other injuries sustained by forward players. The players most prone to neck ligament injuries were props (52.6%) and locks (15.8%). The 52.6% sustained by props was the highest percentage reported for a specific injury by players in a specific playing position.

The phases of play during which most neck ligament injuries occurred were the scrum (52.6%), during the loose-scrum/maul (15.7%) and while being tackled (15.7%). Fifteen or 78.9% of these injuries were sustained during match play, 21% higher than the 57.9% of all other ligament injuries that occurred during match play. Both the figure for under-19 players (52.6%) and that for all A and B-team players (68.4%) who sustained neck ligament injuries, correspond with the respective figures of 50.2% and 67.8% for all other injuries reported by the above-mentioned two groups of players.

All the players who sustained neck ligament injuries received medical treatment. The players who reported neck ligament injuries only were all treated by family practitioners and were out of rugby for a total of 185 days (average 37 days) (Table 5.8). This was the longest average number of days out of rugby for a specific ligament injury (7.7 days longer than for shoulder ligament injuries and 21.7 days longer than for neck muscle injuries). Seven (50%) of the 14 players who reported neck ligament injuries with other injuries were treated by medical specialists. It should be noted, however, that all these players also reported either neck vertebral fractures or neck vertebral dislocations.

(e) Trunk ligament injuries (intervertebral ligaments)

The 11 trunk ligament injuries accounted for 7.2% of all ligament injuries reported (Table 5.8). Three were reported with accompanying trunk muscle injuries, one with a hip dislocation and one with a trunk vertebral fracture.

Five (45.5%) trunk ligament injuries were sustained by under-19 players and none were reported by under-

14 players. Eight (72.7%) of these injuries were sustained by A and B-team players and six (54.5%) by forward players. Props sustained four of the 11 trunk ligament injuries (36.4%). Hookers, flankers, eighthmen and scrum-halves reported no trunk ligament injuries. Seven trunk ligament injuries (63.6%) were sustained during match play and five (45.5%) during the scrum phase of play.

The three players who reported trunk ligament injuries only were out of rugby for a total of 63 days (average 21 days) (Table 5.8). Ten of the 11 players who reported trunk ligament injuries were treated by family practitioners.

(f) Elbow, wrist, finger and foot ligament injuries

One elbow, four wrist, seven finger and two foot ligament injuries were reported by 11 players. Nine of these injuries (64.3%) were reported as ligament injuries only. Those reported with other injuries were most commonly reported with associated finger fracture or dislocation injuries.

The injuries were evenly spread across age-groups, levels of play, matches and practices, phases of play and playing positions. The eight players who reported the above ligament injuries as ligament injuries only and for who the number of days out of rugby could be determined, were out of rugby for the following average number of days: 19.5 days for players with wrist ligament injuries, 10.2 days for players with finger ligament injuries, and 9.7 days for players with foot ligament injuries (Table 5.8). Ten players (90.9%) who sustained the above ligament injuries were treated by family practitioners.

5.7.6 **Fractures**

Fractures were the second most common type of injury reported, accounting for 29.1% of all injuries (Table 5.6). Of the 147 fractures reported, 65.3% were reported as fractures only. Those reported with other injuries were most commonly reported with associated ligament (30.4%), muscle (26.1%), fracture (15.2%) and concussion injuries (8.7%).

The most common fracture injuries reported were clavicle fractures (26.5%), more than double that of facial and finger fractures (each 10.2%) (Table 5.9). Radius and wrist fractures (each 7.5%) were also amongst the most common fractures reported. No cranium fractures and only a few each of the sternum, scapula, femur, patella, ulna and toe (6.3% in total) were reported.

When the anatomical site is considered, most fracture injuries occurred to the upper limb (60.5%), followed by the lower limb (16.3%) and head and neck (13.6%). This contrasts with ligament injuries where the majority (51.3%) occurred to the lower limb and only 28.9% to the upper limb. However, when the figures for the upper and lower limb are combined they represent 76.8% of all fractures, similar to the 80.2% that upper and lower limb injuries represent of all ligament injuries.

Sixty-five (44.2%) of the 147 fractures were sustained by under-14 and under-15 players, a figure 14.1% higher than the 30.1% of all other injuries sustained by these age-groups. This figure corresponds closely with the 44.4% of all dislocation injuries sustained by the above age-groups. Of all fracture injuries, 60.5% were sustained during match play and 67.3% by A and B-team players from all age-groups.

Table 5.9 The percentage risk and average number of days out of rugby for different fracture injuries in the 1984 study.

FRACTURE TYPE	NUMBER OF INJURIES	RISK (%)	AVERAGE DAYS OUT #
Clavicle	39	26.5	34.3
Facial bones	15	10.2	18.3
Finger	15	10.2	18.3
Radius	11	7.5	35.1
Wrist	11	7.5	37.7
Ankle	10	6.8	49.7
Rib	9	6.2	25.7
Metacarpal	6	4.1	26.8
Neck vertebra	5	3.4	+
Fibula	5	3.4	62.0
Trunk vertebra	4	2.7	+
Tibia	4	2.7	62.0
Humerus	4	2.7	40.3
Ulna	2	1.4	*
Toe	2	1.4	*
Patella	2	1.4	*
Sternum	1	0.7	*
Scapula	1	0.7	*
Femur	1	0.7	*
OVERALL	147	100.1	34.8

\# Calculated only for cases where a player sustained only one specific injury during one injury incident, and for which the number of days out of rugby could be determined.

* Sample too small or varied to furnish reliable data.

\+ See Tables 5.10 and 5.11.

The phases of play during which fractures were most likely to occur were while being tackled (39.4%), while tackling (23.8%) and during loose-scrums and mauls (18.4%). The above three phases of play therefore contributed to 81.6% of all fractures, compared with the scrum, foul play and line-out phases of play, which collectively contributed only 8.8% to all fracture injuries.

Eighty-one (55.1%) of the 147 fractures were sustained by backline players, a percentage similar to that of all other injuries sustained by backline players. The players who were most likely to sustain fractures were centres (18.3%) and wings (17.0%). Amongst forward players, fractures were most commonly reported by props (12.9%) and flankers (12.2%). Hookers and full-backs (each 6.1%) were least at risk of sustaining fractures.

The 91 players who sustained fractures only and for who the number of days out of rugby could be determined, were out of rugby for a total of 3167 days (average 34.8 days) (Table 5.9). Of these players, those who sustained fibula or tibia fractures were out for an average of 62 days, those with ankle fractures for an average of 49.7 days, whilst the fractures that prevented players from playing for the shortest average period were finger and facial fractures (each 18.3 days) (Table 5.9).

(a) Facial fractures

Nine (60%) of the 15 facial fractures were nose fractures, four were tooth fractures (26.7%) and two jaw fractures (13.3%). Eleven (73.3%) were reported as facial fractures only and two of the four reported with other injuries were reported with concussion injuries. Eighty percent of the facial fractures were sustained during match play, a percentage 15.2% higher than the 64.8% of all other injuries sustained during match play. Of all facial fractures, A and B-

team players reported 60% and under-19 players 53.3%.

Eleven (73.3%) were sustained by backline players, particularly by centres (33.3%). The 73.3% sustained by backline players is 20.3% higher than the 53% of all other fractures sustained by this group of players, and the 33.3% sustained by centres is 16.6% higher than the 16.7% of all other fractures sustained by centres.

The phases of play during which most facial fractures occurred were while tackling (60%), during the loose-scrum/maul (20%) and while being tackled (13.3%). None of the above injuries occurred during the scrums, open play, or as a result of foul play.

Only one player received no medical treatment, 40% were treated by family practitioners and 40% at hospitals. One player was referred to a specialist. The 11 players who reported facial fracture injuries only and for who the number of days out of rugby could be determined, were out of rugby for a total of 201 days (average 18.3 days) (Table 5.9).

(b) Vertebral fractures

Five neck and four trunk vertebral fractures were reported. Thus 6.1% of the 147 fractures or 1.8% of the 506 specific injuries were vertebral fractures. When the nine neck and trunk vertebral fractures were added to the eight neck and trunk vertebral dislocation injuries, these serious injuries accounted for 3.4% of all injuries reported. When neck ligament and muscle injuries were also added to the above, then 12.3% of all injuries occurred to the neck area.

(i) Neck vertebral fractures

Four of the five neck vertebral fractures were reported with accompanying muscle, ligament or concussion injuries. Due to the seriousness of these injuries all five cases are presented in the table which follows.

Table 5.10 Classification of neck vertebral fractures in the 1984 study.

AGE & TEAM	POSITION	MECHANISM	MATCH PRACTICE	DAYS OFF
U/15 A	Hooker	Scrum	Match	45
U/15 A	Prop	Tackling	Match	Ever
U/16 A	Flank	Loose-scrum	Match	Ever
U/16 A	Prop	Scrum	Match	Ever
U/19 E	Prop	Loose-scrum	Prac	Ever

Thus in summary: Four (80%) of these injuries were sustained by under-15 and 16 A-team players and occurred during matches. All five were sustained by forward players, and of these, three (60%) were props. Four (80%) occurred during the scrum or loose-scrum/maul phases of play. Four of the players were referred to medical specialists and all four were advised not to play rugby ever again.

(ii) Trunk vertebral fractures

Two of the four trunk vertebral fractures were reported with associated muscle or ligament injuries. No A and B-team players sustained trunk vertebral

fractures. This differs sharply from neck vertebral fractures where four of the five injuries (80%) were sustained by A-team players. Three (75%) of the trunk vertebral fractures were sustained by forward players (Table 5.11) and when added to neck vertebral fractures, eight of the nine or 88.9% of vertebral fractures were sustained by forward players (seven of the eight players were tight forwards, and of these, four were props).

Table 5.11 Classification of trunk vertebral fractures in the 1984 study.

AGE & TEAM	POSITION	MECHANISM	MATCH/ PRACTICE	DAYS OFF
U/14 C	Prop	Scrum	Practice	Season
U/19 C	Full-back	Loose-scrum	Match	75
U/19 D	Lock	Other	Practice	Ever
U/19 E	Lock	Loose-scrum	Match	44

Three (75%) trunk vertebral fractures occurred during the scrum or loose-scrum/maul phases of play, consistent with neck vertebral fractures where four of the five (80%) occurred during these two phases of play.

All four players who sustained trunk vertebral fractures were treated by family practitioners and three were referred to medical specialists. Only one of the players was advised not to play rugby ever again. Once again, this differs greatly from neck vertebral fractures where four of the players (80%) were out of rugby for ever.

When the nine neck and trunk vertebral fractures were compared with the eight neck and trunk vertebral dislocations some interesting differences were found. Eight (88.9%) and four (50%) of these injuries were respectively sustained by forward players, whilst seven (77.8%) and four (50%) were respectively sustained during the scrum and loose-scrum/maul phases of play. Seven (77.8%) of the nine players who sustained neck or trunk vertebral fractures were referred to medical specialists and five (55.6%) were advised not to play rugby ever again. Only four (50%) of the eight players who sustained neck or trunk vertebral dislocations were referred to medical specialists and only one player (12.5%) was advised not to play rugby ever again.

The reason for the differences found between neck and trunk vertebral fracture and dislocation injuries was most probably, as was discussed earlier (see Chapter 5.7.1), that some neck and trunk vertebral dislocation injuries had been incorrectly diagnosed or reported. The data must therefore be treated with suspicion. It is most unlikely that this would have been the case with any of the reported neck or trunk vertebral fractures.

(c) Rib fractures

Nine players sustained rib fracture injuries and these injuries accounted for 6.1% of all fractures reported (Table 5.9). Six (66.7%) were reported as rib fractures only. Three players reported rib fractures with other injuries and all three sustained either muscle and or ligament injuries. One of the three players also sustained a sternum fracture.

Six (66.7%) of the rib fracture injuries were each sustained by under-19 players, by forward players,

and during matches. All the injuries were sustained by A and B-team players. Four (44.4%) of the nine rib fractures occurred during scrums and two each during the loose-scrum/maul and as a result of foul play.

All injured players received medical treatment (77.8% by family practitioners). Two players were referred to medical specialists. The six players who reported rib fractures only were out of rugby for a total of 154 days (average 25.7 days) (Table 5.9).

(d) Sternum and scapula fractures

Only one each of the above injuries was reported and each is detailed in Table 5.12. Both injuries were sustained during match play.

Table 5.12 Sternum and scapula fractures in the 1984 study.

INJURY	AGE & TEAM	POSITION	MECHANISM	MEDICAL TREATMENT	DAYS OFF
Sternum	14 A	Prop	Scrum	Specialist	36
Scapula	19 A	Wing	Tackling	Specialist	30

(e) Clavicle fractures

Clavicle fractures were the third most common of all specific injuries reported. Thirty-nine or 7.7% of all injuries were clavicle fractures and clavicle fractures accounted for 26.5% of all fracture injuries (Table 5.9). Thirty-six (92.3%) were reported as clavicle fractures only. The remaining

three were reported with shoulder muscle or ligament injuries.

Nineteen or 48.7% of the 39 clavicle fractures were sustained during practices, a percentage 13.8% higher than the 34.9% of all other injuries sustained during practices. Nineteen of the clavicle fractures also occurred to under-14 and under-15 players, a percentage which is also much higher than the 33% of all other injuries sustained by these two age-groups.

Twenty-seven (69.2%) of these injuries were sustained by A and B-team players. Backline players (59%), particularly centres (25.6%) and wings (23.1%), were more likely to sustain clavicle fractures. Amongst forward players, flankers (12.8%), and eighthmen and props (each 10.3%) were most frequently injured.

Twenty-six (66.7%) of the 39 clavicle fractures occurred during the being-tackled phase of play. When the percentages for clavicle fractures which occurred during the tackling and loose-scrum/maul phases of play were added to the 66.7% of clavicle fractures which occurred during the being tackled phase of play, the figure rose to 84.6%. No clavicle fractures were sustained during scrums, line-outs, or as a result of foul play.

All players who sustained clavicle fractures received medical treatment, 50% at hospitals and 50% from family practitioners. Five (12.8%) of the players were referred to medical specialists. The 35 players who reported clavicle fractures only and for who the number of days out of rugby could be determined, were out of rugby for a total of 1202 days (average 34.3 days) (Table 5.9).

(f) Humerus, ulna and radius fractures

The 17 arm and forearm fractures represented 11.6% of all fractures reported (radius 7.5%, humerus 2.7% and ulna 1.4%) (Table 5.9). Of these, 13 (76.5%) were reported as a fracture injury only. The four reported with other injuries were reported with associated muscle and/or ligament or dislocation injuries.

Under-19 players sustained only four (23.5%) of the arm and forearm fractures and all four were radius fractures. This percentage was 25.6% lower than the 49.1% of all other injuries sustained by under-19 players. Thirteen (76.5%) of the 17 arm and forearm fractures were reported by A and B-team players (17.6% by under-14 A and B-team players and 29.4% by under-15 A and B-team players).

Of the 17 arm and forearm fractures, 16 (94.1%) were sustained during the tackling phases of play (while being tackled 64.7%; tackling 29.4%), and 10 (58.8%) were sustained during match play. Eleven (64.7%) of these fractures were sustained by backline players (centres 29.4% and wings 23.5%). All four humerus fractures were sustained by backline players.

All players who sustained arm and forearm fractures received medical attention, 64.7% at hospitals and 35.3% from family practitioners. Two players were referred to medical specialists. The 12 players who sustained arm and forearm fractures only and for who the number of days out of rugby could be determined, were out of rugby for a total 472 days (average 39.3 days).

(g) Wrist and hand fractures (excluding finger fractures)

Although carpal and metacarpal fractures were omitted from the "Fracture injuries" section of the questionnaire, it was possible, through Section E of the Addendum, to record such fractures. Eleven wrist, six metacarpal and no carpal fractures were reported.

The 17 wrist and metacarpal fractures accounted for 11.6% of all fractures reported (Table 5.9). Fourteen (82.4%) of the above injuries were reported as wrist and metacarpal fracture injuries only. All three reported with other injuries were reported with associated muscle or ligament injuries.

Six (35.3%) of the above injuries were sustained by under-19 players and nine (52.9%) by A and B-team players from all age-groups. Wrist and metacarpal fractures occurred more commonly to forward players (58.8%) and in particular to props (23.5%) and flankers (17.6%). Amongst backline players, wings (17.6%) were most likely to sustain these injuries. Ten (58.8%) of the wrist and metacarpal fractures were sustained during match play.

Ten (90.9%) of the 11 wrist fractures were sustained during the being-tackled and tackling phases of play and five (83.3%) of the six metacarpal fractures occurred during the loose-scrum/maul phase of play.

The ten players who reported wrist fractures only and for who the number of days out of rugby could be determined, were out of rugby for a total of 377 days (average 37.7 days), whilst the four who sustained metacarpal fractures only, were out of rugby for a total of 107 days (average 26.8 days) (Table 5.9).

(h) Finger fractures

The 15 finger fractures accounted for 10.2% of all fractures reported (Table 5.9). Twelve (80%) were reported as finger fractures only. Ten (66.7%) were sustained by backline players and these were evenly distributed among the different backline positions.

Amongst the forward players, four of the five finger fractures were sustained by loose-forward players. Seven (46.7%) of the 15 finger fractures occurred during the two tackling phases of play, whilst the rest were all sustained during the loose-scrum/maul or open play phases of play.

Eleven (73.3%) of the finger fractures occurred during matches and ten (66.7%) to A and B-team players. Under-19 players sustained six (40%) of the 15 finger fractures.

All except one of the 15 players who sustained finger fractures received medical treatment and two were referred to medical specialists (both sustained thumb fractures). The 12 players who sustained finger fractures only, were out of rugby for a total of 219 days (average 18.3 days) (Table 5.9).

(i) Femur and patella fractures

One femur and two patella fractures were reported and all three injuries were sustained by under-14 and under-15 players. Both patella fractures were reported with associated ligament injuries and the femur fracture with a hip dislocation injury. Two of the injuries were sustained by A and B-team players and both occurred during matches.

The player who sustained the femur fracture was

treated at a hospital, referred to a specialist and was out of rugby for the rest of the season. Both players who sustained patella fractures received medical treatment (one by a family practitioner and the other at a hospital). One of the two players was out of rugby for the rest of the season and the other for 42 days.

(j) Fibula and tibia fractures

The five fibula and four tibia fractures together accounted for 6.1% of all fractures reported (Table 5.9). Of these injuries, five (55.6%) were reported as fibula or tibia fractures only. Two players sustained fibula and tibia fractures.

Of the nine fibula and tibia fractures, only two were sustained by under-19 players and five (55.6%) by A and B-team players from all age-groups. Five were sustained during match play and eight (88.9%) during the two tackling phases of play. Players in all positions were likely to sustain fibula or tibia fractures and most occurred to forward players (55.6%).

All seven players received medical attention (four at hospitals and three by family practitioners). All the players treated by family practitioners were referred to medical specialists. Both players who sustained tibia and fibula fractures were out of rugby for the rest of the season. The five players who reported fibula or tibia fractures only, were out of rugby for a total of 310 days (average 62 days) (Table 5.9).

(k) Ankle and foot fractures

Ten ankle and two toe fractures were reported. No

tarsal or metatarsal fractures were reported. Although tarsal and metatarsal fractures were omitted from the "Fracture injuries" section of the questionnaire, it would have been possible, through Section E of the Addendum, to record any such fractures. In the case of metacarpal fractures which was also omitted from the questionnaire, six such fractures were recorded.

The 10 ankle fractures represented 6.8% of the 147 fractures reported (Table 5.9). Six (60%) were reported as ankle fractures only. Of the four reported with other injuries, one was reported with a tibia and fibula fracture and three with ankle ligament injuries.

Eighty percent of the ankle fractures were sustained by under-19 players, a percentage 32.2% higher than the 47.8% of all other injuries sustained by these players. Six (60%) of the ten ankle fractures were respectively sustained by A and B-team players, by backline players and during match play.

Most ankle fractures were sustained during the being tackled, loose-scrum/maul (each 30%) and tackling (20%) phases of play. No ankle fractures were sustained during scrums, line-outs or as a result of foul play. Hookers, scrum-halves and wings (each 20%) were the players most likely to sustain ankle fractures.

All players who sustained ankle fractures received medical treatment. Six were treated by family practitioners and the rest at hospitals. Three were referred to medical specialists and two of the four players who reported ankle fractures as more than one specific injury were out of rugby for the rest of the season. The six players who reported ankle fractures

only and for who the number of days out of rugby could be determined, were out of rugby for a total of 298 days (average 49.7 days) (Table 5.9).

Only two toe fractures were reported (Table 5.9). One was sustained by an under-15 A-team hooker during a practice and occurred during open play. This player also reported an ankle ligament injury. The other toe fracture was sustained by an under-16 C-team full-back while tackling and during match play. This player was out of rugby for 21 days.

5.7.7 **Other injuries**

Only three other injuries were reported (0.6% of all injuries) (Table 5.6). Of these three injuries the most serious was a kidney rupture sustained by an under-16 B-team lock during a loose-scrum/ maul. This player was advised not to play rugby ever again. The other two injuries were ruptured arteries. Both were sustained by A-team players (under-19 hooker and under-16 scrumhalf) and during practices. The hooker was injured during a loose-scrum/maul and the scrumhalf whilst being tackled.

CHAPTER 6

OVERALL RESULTS AND DISCUSSION

Note: In this Chapter the overall results of the two-year study are discussed and compared, where possible, with existing research. However, as new sections such as specific injuries were introduced to the study in 1984 and the design of the computed programme in 1983 was limited, some sections in this Chapter can be based only on the findings of the 1984 study. To avoid confusion the headings of all sections which are based on the results of the **1984 study only** will indicate this in brackets.

6.1 Overall, age-group and A-team risk of injury

During each of the two years that the study was conducted, the 26 high schools fielded an average of 314 teams involving approximately 4700 players. A total of 6766 matches were played over the two-year period and 905 players were injured. Thus with an average of 453 players being injured during each season, one out of every 10.4 players was likely to sustain an injury which prevented him from participating in rugby for at least one week (Table 6.1). The risk of injury for the two separate studies did not differ much. In 1983 one out of every 9.5 players, and in 1984 one out of every 11.4 players was likely to sustain an injury.

The relative risk of injury was more than three times greater for under-19 players (one injured under-19 player for every 7.1 under-19 players) than the relative risk of injury for under-14 players (one injured under-14 player for every 22.5 under-14 players) and almost double that for under-15 players (one injured under-15 player for every 12.6

under-15 players (Table 6.1).

Table 6.1 The overall and age-group risk of injury for players in the 1983/84 study.

AGE GROUP	NUMBER OF PLAYERS #	NUMBER OF INJURED PLAYERS #	RISK *
Under-19	1733	243	7.1
Under-16	683	73	9.4
Under-15	1005	80	12.6
Under-14	1283	57	22.5
OVERALL	4704	453	10.4

\# Averages calculated for each season over the two-year period. Figures rounded off to whole numbers.

* Number of players per injured player per season.

The chi-square test for association of probability of injured players with age, in Table 6.1 yields chi-square = 82.2, df = 3, $p < 10^{-6}$; thus there is overwhelming statistical evidence of the claimed differences in risk for differing age-groups. When the results for the two separate years (1983 and 1984) were compared there was significant change in the number of injured players in all age-groups except at under-15 level (chi-square = 8.0, df = 1, $p < .005$). The most significant change was a sharp decrease in the number of injured players at under-19 level during 1984. The relative risk of players sustaining injury during 1984, when compared with the risk of players sustaining injury during 1983, was 47.5% lower in the under-19 age-group, 12.4% lower in the under-16 age-group and 13.7% lower in the under-14 age-group. At under-15 level the relative risk of injury was 18.6% higher in 1984. Overall,

the risk of injury was 20% lower for players sustaining injury during 1984.

In Table 6.2 the overall and relative age-group risks of injury for A-team and non A-team players (other players) are shown. The players most at risk were under-19 A-team players (one injured under-19 A-team player for every 4.6 under-19 A-team players). These players were almost four times more likely to be injured than were under-14 A-team players (one injured under-14 A-team player for every 17 under-14 A-team players). The relative risk of injury for under-16 A-team players was identical with the relative risk for all under-19 players (one injured under-16 A-team player for every 7.1 under-16 A-team players). The overall A-team risk of injury was one injured A-team player for every 7.5 A-team players.

Table 6.2 The overall and relative age-group risks of injury for A-team and non A-team (other) players in the 1983/84 study.

AGE GROUP	NUMBER OF PLAYERS #		NUMBER OF INJURED PLAYERS #		RISK *	
	A-TEAM	OTHER	A-TEAM	OTHER	A-T	OTH.
Under-19	390	1343	85	158	4.6	8.5
Under-16	263	420	37	36	7.1	11.7
Under-15	390	615	45	35	8.7	17.6
Under-14	390	893	23	34	17.0	26.3
OVERALL	1433	3271	190	263	7.5	12.4

\# Averages calculated for each season over the two-year period. Figures rounded off to whole numbers.

* Number of players per injured player per season.

At all ages A-team players were at much greater risk of being injured than players in other teams. The chi-square test for association of probability of injured A-team players with age, in Table 6.2 yields chi-square = 80.1, df = 3, $p < 10^{-6}$, and that for injured non A-team players yields chi-square = 53.3, df = 3, $p < 10^{-6}$; thus there was more significant differences between the age-groups for injured A-team players when compared with non A-team players. The relative risk of injury was 84.8% greater at under-19 level, 64.8% greater at under-16 level, 102.3% greater at under-15 level and 54.7% greater at under-14 level. Overall, the risk was 65.3% greater for A-team players when compared with other players.

By using the same method of risk calculation, it can be shown that in both previous schoolboy studies which used similar injury definitions the risk of injury was much higher. In the study of Sparks (1985) each player was likely to sustain at least one injury which would prevent him from participation in rugby for at least one week during each season, whilst one out of every four high school players in the 1982 study (Nathan et al. 1983) was likely to suffer a similar fate.

The reasons for the higher injury risks found by Sparks (1985) and Nathan et al. (1983) will be discussed after the factor of under-reporting, which almost certainly influenced the injury risks found in this study (1983/84), has been examined in the next section. This will place the higher injury risks found in the other two studies in perspective.

(a) Under-reporting of injuries

In Chapters 4 and 5 it was shown that under-reporting of injuries had occurred during the two years of the study. From the results obtained in the two studies it is now possible to show to what extent under-reporting of injuries had occurred.

In 1983 the overall incidence of injury for the six closely monitored schools was one injured player for every 417 boy-hours of rugby and that of the 20 schools monitored through correspondence one injured player for every 736 boy-hours of rugby. The percentage difference between these two injury incidences is 43.4% (Figure 6.1). In the 1984 study it was shown that after personal contact with the six closely monitored schools had been relaxed, 43.8% fewer players were injured in those schools during 1984 when compared with the 1983 results of the same schools. Also, the percentage difference was now only 3.3% between the overall incidences of injury for the two groups of schools studied in 1984.

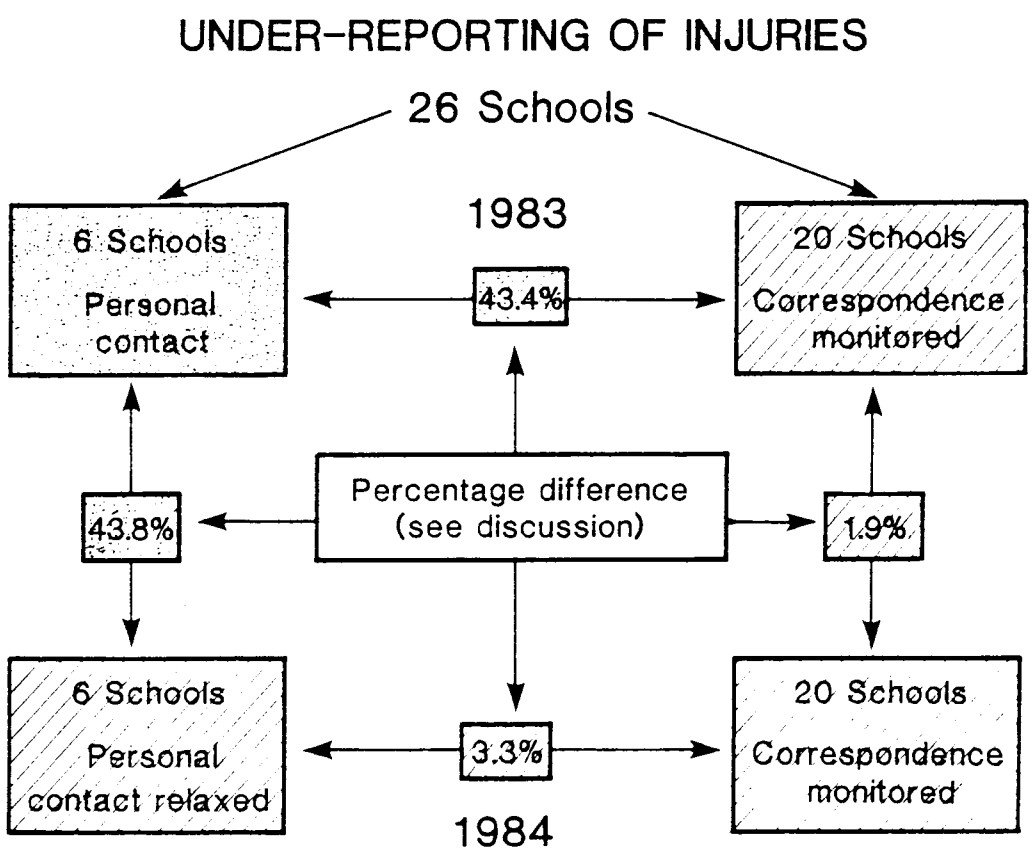

Figure 6.1 The percentage differences between the incidence or number of injured players which resulted through the use of different survey methods in the 1983 and 1984 studies.

Furthermore, in the 20 schools which were monitored through correspondence and for which the survey methods were identical during each of the two years, the percentage difference between the number of players injured during each year was only 1.9%.

This shows that under-reporting of more than 40% may have occurred. To confirm this finding the results of the school studied in 1982 by Nathan et al. (1983) must be examined. This school was also one of the six closely monitored schools which formed part of this study (1983/84). The overall injury incidence for this school in 1983 (the year following Nathan's study) was one injured player for every 265 boy-hours of rugby, only marginally lower than the 1982 overall injury incidence of one injured player for every 242 boy-hours of rugby (percentage difference 8.7%) (Figure 6.2), and much higher than the overall incidence of injured players reported for the other 25 schools (one injured player for every 673 boy-hours of rugby). There was no significant difference between the number of players injured during 1982 and 1983 (chi-square = 0.667).

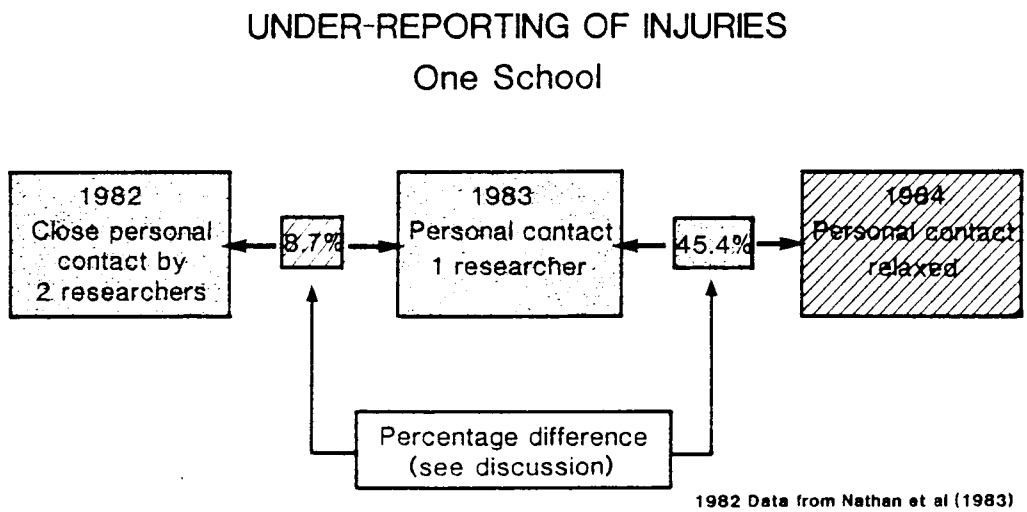

Figure 6.2 The percentage differences in the incidence of injured players which resulted through the use of different survey methods in the one school studied over a three year period.

In 1984 when personal contact with the school was relaxed the overall incidence of injury reported decreased to one injured player for every 485 boy-hours of rugby, a percentage difference of 45.4% when compared with the overall injury incidence for this school in 1983. This percentage difference is almost identical with the percentage differences found between the six closely and 20 correspondence monitored schools in 1983 (43.4%), and between the six closely monitored schools in 1983 and 1984 (43.8%). Thus there was a significant decrease in the number of injured players after personal contact with the school had been relaxed in 1984 (chi-square = 14.6, df = 2, $p < 10^{-3}$).

Thus it is finally possible to conclude that by using correspondence as a survey method and not maintaining close personal contact with the schools, between 40 and 50% of injuries were under-reported during the two-year period of the study. This finding is of significant importance and shows that the injury risk to players (discussed earlier) and the incidence of injured players (discussion follows) was most probably much higher than reported. It would seem that an incidence of more or less one injured player for every 250 boy-hours of rugby, as found in 1982 (Nathan et al. 1983), is a close estimate of the true injury risk to high school rugby players.

(b) Overall, age-group and match and practice incidences of injury

The overall injury incidence for the two-year period (1983/84), which was calculated as previously described in Chapter 3, was one injured player for every 673 boy-hours of rugby (Table 6.3). The incidence of injury for matches was one injured player for every 164 boy-hours of match play and that of practices one injured player for every 1776 boy-hours of practice. The incidence of

injury for players injured in the different age-groups is also shown in Table 6.3. These incidences follow the patterns already described in Chapters 4 and 5 and again show the greater risk of injury for under-19 players when compared with the other age-groups, particularly players in the under-14 age-group.

Table 6.3 The match, practice and overall incidence of injured players for different age-groups in the 1983/84 study.

AGE GROUP	INCIDENCE OF INJURED PLAYERS *		
	MATCH (a)	PRACTICE (b)	RUGBY (c)
Under-19	111	1337	463
Under-16	171	1271	610
Under-15	187	2309	810
Under-14	372	3378	1453
OVERALL #	164	1776	673

* One injured player per boy-hours of: (a) matchplay; (b) practice; (c) rugby per season.

\# n = 905 injured players.

The overall, match and practice incidences of injury found in this study (1983/84) are all markedly lower than those found in other schoolboy studies (Davidson et al. 1978; Sparks 1981, 1985; Nathan et al. 1983; Davidson 1987; Malan and Strydom 1987).

In the 1982 study of Nathan et al. (1983), which served as a pilot study for this study (1983/84) and was conducted at one school during one rugby season, an overall injury incidence of one injured player for

every 243 boy-hours of rugby, one injured player for every 84 boy-hours of matchplay and one injured player for every 506 boy-hours of practice was reported in high school players (Figure 6.3).

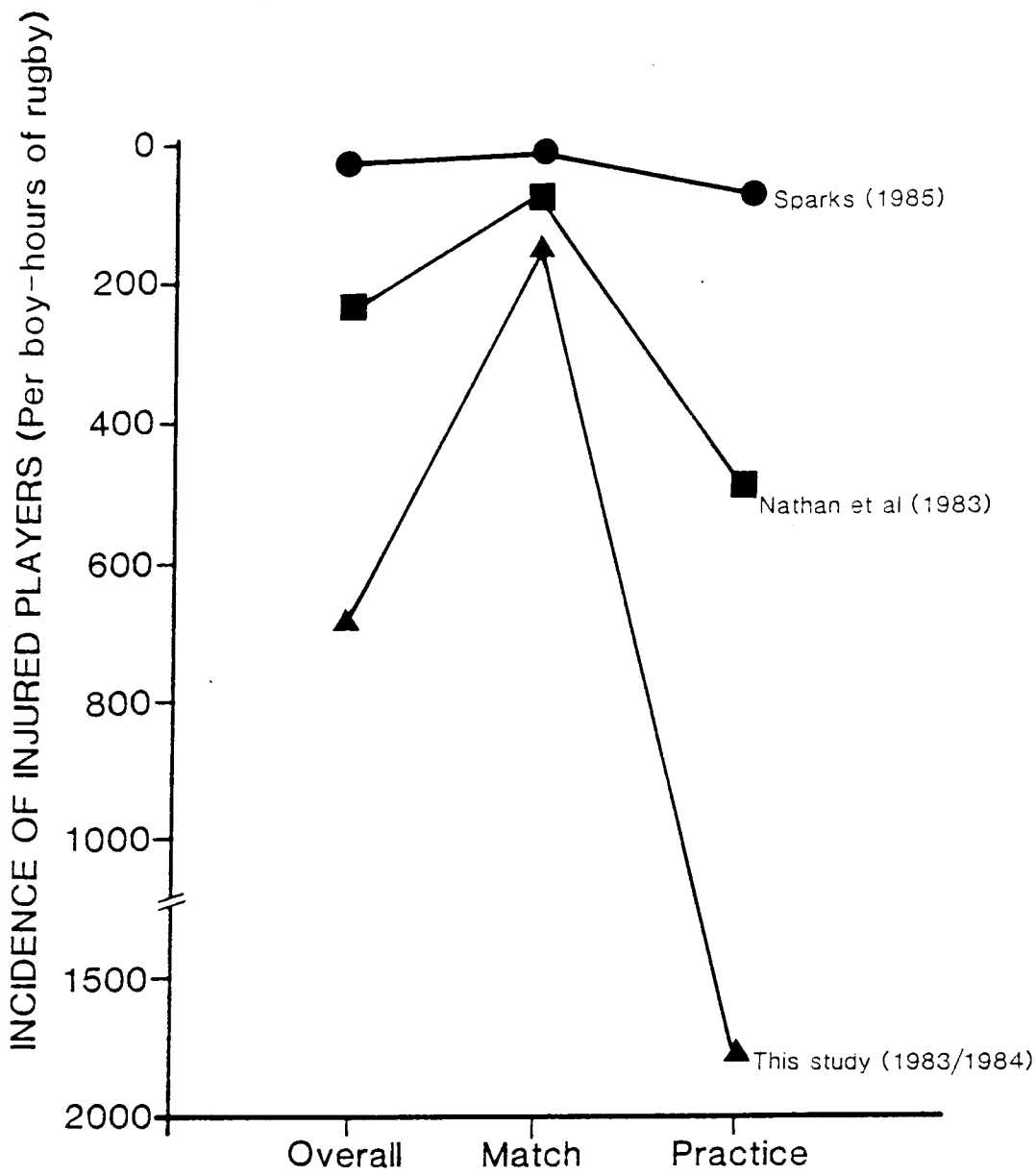

Figure 6.3 The overall, match and practice incidence of injured players for three schoolboy rugby injury studies which used a similar definition for an injury.

In two studies conducted at Rugby School (England), Sparks (1981, 1985) examined 10 657 rugby injuries which had occurred over a 34-year period (1950 -1984). The school fielded 10 teams, ranging in age from 13 to 18 years, for a 13-week season. Since Sparks used an injury definition in both his studies which was almost identical with that of this study (1983/84) and the 1982 pilot study (Nathan et al, 1983), and his age-groups were similar, a comparison between the three studies may be made. In his first study, which covered a period from 1950 to 1979, Sparks (1981) reported an overall injury incidence of one injury for every 51 boy-hours of rugby. In the second study (1985) he reported an even higher overall injury incidence of one injury for every 45 boy-hours of rugby (Figure 6.3). These incidences are more than thirteen times greater than that of the 1983/84 study and almost five times greater than that of the 1982 study (Nathan et al. 1983). However, it would appear that the data of Sparks are inaccurate as was suggested by Nathan et al. (1983).

The incidences reported by Sparks would mean that approximately 330 boys were injured per season in a school that fields only 10 teams (i.e. 150 players). This means that each player would sustain approximately two injuries each season and each injury would have to prevent him from playing rugby for at least a week. That Sparks was unaware of this error is evident from his concluding paragraph in which he states that the schoolboys who have passed through the school in the past 30 years would, on average, have suffered only two rugby injuries during their schooldays. In addition, a surprising difference between this study (1983/84) and those of Sparks (1981, 1985) is the stated number of hours (8.5) that each team played rugby per week - in this study (1983/84) each team played only four hours of rugby per week.

Davidson et al. (1978) and Davidson (1987) reported on all injuries seen at an Australian school's medical centre over an 18-year period. In the first study (Davidson et al. 1978), which covered the first eight years of the 18 year period (1969 - 1976), an injury incidence of one injured player for every 73 boy-hours of match play was reported. In the second study (Davidson 1987), which included the results of the full 18-year period (1969 - 1986), an injury incidence of one injured player for every 57 boy-hours of match play was reported. Through calculations it was possible to determine that the incidence of injury for the last ten years of the overall study had been one injured player for every 47 boy-hours of match play. This last incidence of injury is more than three times greater than the match play incidence established by this study (1983/84).

However, direct comparisons between the above-mentioned Australian schoolboy studies and this study (1983/84) cannot be made. In both the Australian studies all injuries, however trivial, were reported. According to the researchers 50% of all injuries were trivial and 8% severe. A breakdown of the severe injuries, which included 83% fractures, was given and no further differentiation was made. Also, their studies were conducted amongst players ranging in age from eleven to 18 years, whereas in this study (1983/84), the age range was 13 to 18 years. Finally, the conclusions of the second study (Davidson 1987), which includes the results of the full 18-year period, appear suspect. Davidson states that "there is no evidence that the game has been played more violently in recent years as the injury rate has varied little over the period of this study".

When the results of both periods are examined the following emerges: during the second ten-year period

the incidence of injury had increased by 55.3% when compared with the incidence of injury for the first eight-year period. Also, during the first eight-year period 556 schoolboys were injured and of these players 43 reported severe injuries. In the following ten years 888 players, of which 73 reported severe injuries, were injured. Thus the average number of injuries had risen from 69.5 per year in the first eight years to 88.8 per year in the following 10 years, an increase of 27.8%. The number of severe injuries had increased from 5.4 per year during the first period to 7.3 per year during the second period, an increase of 35.2%. In contrast, the annual number of player exposures decreased from 5074 player-hours per year during the first eight years to 4152 player-hours per year during the next ten years, a decrease of 18.2%. These findings contradict Davidson's statement and place a question mark behind his conclusions.

This study (1983/84) also shows that players were 10.8 times more likely to be injured during a match play hour than during a practice hour. This finding is similar to that of the 1982 study (Nathan et al. 1983), which found that high school players were eight times more likely to be injured during a match play hour. Nathan's study also found that junior school players were 6.75 times more likely to be injured during a match play hour. Clark et al. (1990) reported that senior first division rugby players were 13 times more likely to be injured during a match play hour. As all three of these studies used similar research methods and the same definition for an injury it is possible to conclude that the likelihood of sustaining an injury during match play increases with age.

Finally, it is interesting to note the very high incidence of match play injuries found by Malan and Strydom (1987). They studied injuries sustained by

players participating in the 1985 Craven Week Rugby Competition for high schools and only players who were forced to leave the field were considered for their study. As all the players who participate in this competition are top level under-19 players, the results found in the study of Malan and Strydom (1987) could be compared only to those of under-19 A-team players in other studies.

However, it must be stated that the Malan and Strydom (1987) study was limited in that it used a small select sample over a short period of time and under unusually highly competitive playing conditions. They reported an injury incidence of one injured player for every 23 boy-hours of match play. This figure is 2.5 times that of the corresponding incidence found for under-19 A-team players in this study (1983/84) (one injured player for every 57 boy-hours of match play). Even when the under-reporting of injuries in this study (1983/84) is taken into account the incidence found by Malan and Strydom (1987) is still much higher and this confirms the overall findings of this study (1983/84) that injuries occur more frequently to players playing at higher and more competitive levels.

In short, discussion in the above section has revealed that major differences exist between the injury incidences found in studies conducted amongst schoolboy rugby players. Similar variations in injury incidence were reported in studies conducted amongst adult rugby players and these differences were manifested by various factors such as under-reporting of injuries (this study - 1983/84), inaccurate data analysis (Sparks 1981, 1985), limited and/or specific studies (Nathan et al. 1983; Malan and Strydom 1987) and different definitions of injury (Davidson et al. 1978; Davidson 1987). It is essential that standardised research methods and samples be employed in order to

establish a true and reliable incidence of injury amongst rugby players.

(c) Percentage match and practice injuries

Of the 905 players who reported injuries in this study (1983/84), 619 (68.4%) were injured during match play and 286 (31.6%) during practices. In the 1982 study Nathan et al. (1983) reported that 63.3% of schoolboy players were injured during match play and 36.7% during practices. A similar trend was found by Sparks (1985), who reported 60.1% of all injuries as match injuries. Davidson (1987) did not include practice injuries in his research.

It is of interest to note that few epidemiological studies conducted amongst adult rugby players included practice injuries. Roy (1974) and Van Heerden (1976) both found that approximately one third of all rugby players injured at Stellenbosch University sustained injuries during practices, a percentage similar to that found in this study (1983/84). Clark et al. (1990), in a study which involved eight South African first-division senior teams, reported that 85.1% of all players were injured during match play and of these 88% were sustained injuries during league fixtures. Their research also showed that 58% of players injured during practices sustained injuries during match practices, 33% during skill training sessions and 8% during physical training sessions.

The above pattern of injury is not unique to rugby. Sullivan et al. (1980), Ekstrand and Gillquist (1983), Ekstrand et al. (1983) and Maehlum and Daljord (1984) all reported that more than two-thirds of all players injured whilst participating in soccer sustained injuries during match play. Several other studies have reported similar findings for other contact sports such

as American Football (Goldberg et al. 1988; Zemper 1989).

Finally, although the above findings show that schoolboy and adult rugby players are most likely to be injured during matches, the results of this study (1983/84) indicate, as will be discussed later, that differences between the specific types of injuries sustained during matches and practices exist. It is therefore important that future rugby injury studies, particularly those conducted amongst schoolboys, include data of players injured during practices. The findings of the 1982 study (Nathan et al. 1983), the study of Sparks (1985), and those of this study (1983/84), show that between 30 and 40% of all schoolboy players were injured during practices. This important aspect can therefore not be simply ignored, as was also suggested by Van Heerden (1976).

(d) Time of the season

This study (1983/84) shows that players were more likely to sustain injury at the beginning of the season and again after the mid-year vacation. An almost identical pattern was found during both years of the study. In Table 6.4 the total number of matches played, as well as the total number of players injured, are shown for different four-week periods of the season.

This comparison was used because it was possible to determine the exact number of matches played during the four-week periods. The number of injured players do, however, include all players injured during matches and practices during each of the four-week periods. The reason for using this comparison was to determine whether any differences existed between the different four-week periods and the risk does therefore not reflect a match risk for players injured during the

four-week periods. As it was not possible to determine the exact number of practice hours per team per week during this study (1983/84) an assumption was made (three hours per team per week). The time spent practising was therefore a constant during each of the four-week periods and does subsequently not influence the comparison which was used.

Table 6.4 The risk of injury during different four-week periods of the season in the 1983/84 study.

FOUR-WEEK PERIODS	NUMBER OF MATCHES	NUMBER OF INJURED PLAYERS	RISK *
Week 1-4	1513	247	6.1
Week 5-8	1608	202	8.0
Week 9-12	974	113	8.6
	JULY VACATION		
Week 1-4	1906	251	7.6
Week 5-8	765	92	8.3

* One injured player (for matches and practices) per number of matches per four-week period.

The greater risk of injury at the beginning of the season and again after the July vacation probably suggests that players are not physically well-conditioned at the start of the season and do not maintain their fitness during the mid-year vacation. Sparks (1985) and Nathan et al. (1983) also reported that schoolboy players were more prone to injury at the beginning of the season and again after the mid-year vacation. Sparks blames this on keenness and unfitness.

This important aspect is not examined by Davidson et al. (1978) and Davidson (1987) in their studies conducted amongst Australian schoolboys over an 18-year period.

In a prospective study conducted during 1979, Ingles and Stewart (1981) examined 1085 rugby injuries presented at the Accident and Emergency Department of Christchurch Hospital (New Zealand) and claimed that pre-season training proved to be unrelated to injury pattern frequency. However, their research must be treated with the utmost reserve, as they conclude that age, grade and position were not related to injury patterns, a finding which is contradictory to those of almost every other study conducted.

It is of interest to note that studies conducted amongst adult players did not show this pattern of injury. Roy (1974) and Van Heerden (1976) found that injuries were likely to occur at any stage of the season, whereas Williams (1984) found that injuries occurred more frequently in mid-season. Williams does, however, state that pre-season training is taken very seriously at club level in Wales but not at school level. The results found in this study (1983/84) may indicate a similar attitude in South African schoolboys. A further interesting finding was that adult players were more prone to cervical spinal cord injuries at the start of the rugby season (Williams and McKibbin 1978, 1987; Scher 1979; Kew et al. 1991). The same trend was also shown in similar studies conducted amongst schoolboys (McCoy et al.1984; Kew et al. 1991).

The belief that rugby players often play the game in order to get fit is common. This may also be the case with schoolboy players and should be discouraged due to the inherent dangers to which such players are exposed.

This section is best summarised by the advice of O'Connell (1954) almost four decades ago. "By the amateur, this matter of training is sometimes looked upon as something that has to be done when the cup is coming on. This is a serious mistake. A fortnight's serious training at the beginning of the season when the evenings are long has, in my experience, been of far greater value to players in the prevention of avoidable injuries. One example may illustrate my point. The club with which I am associated had a very important and serious fixture early in the season. Consistent training for the match commenced in August. All players were fit early in September, and remained fit and trained throughout the season. Not one muscle or ligament injury occurred amongst these players. In other years an average of 10 - 12 such injuries had been reported in the early half of the season".

(e) Age and level of play

In Figure 6.4 the relative number of injured players in the different age-groups and playing levels, as well as the number of players within the playing levels who sustained injuries during matches and practices, are shown.

Of the 905 injured players 486 (53.7%) were under-19 players. This percentage is slightly higher than the percentages reported for the same age-group in 1982 by Nathan et al. (1983) and by Sparks (1985). In all three studies these figures are more than four times that of under-14 players, the age-group in which the fewest players were injured (Figure 6.5). Davidson (1987) reported similar findings in his study amongst Australian schoolboy players.

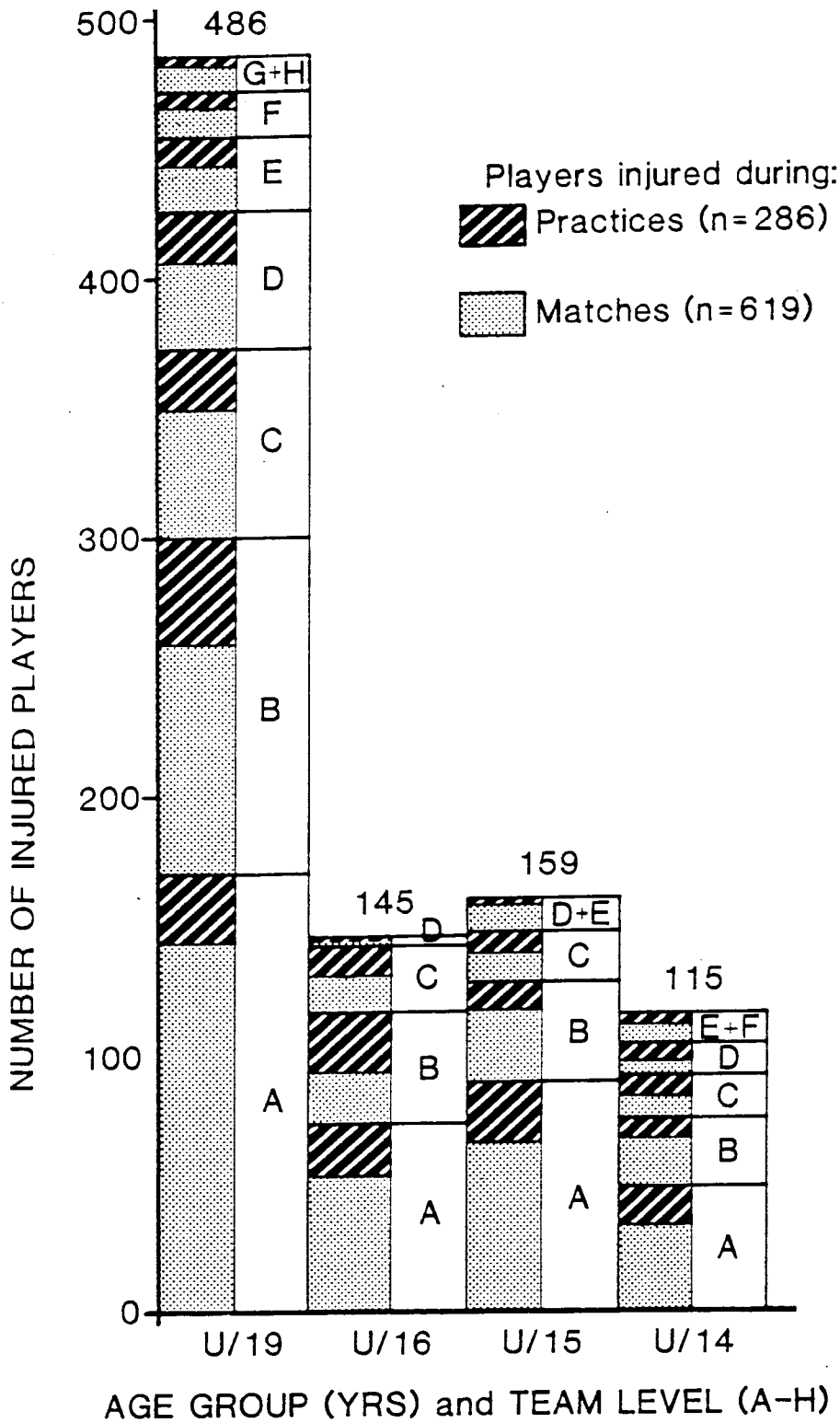

Figure 6.4 The relative number of injured players in the different age-groups and team levels during matches and practices in the 1983/84 study.

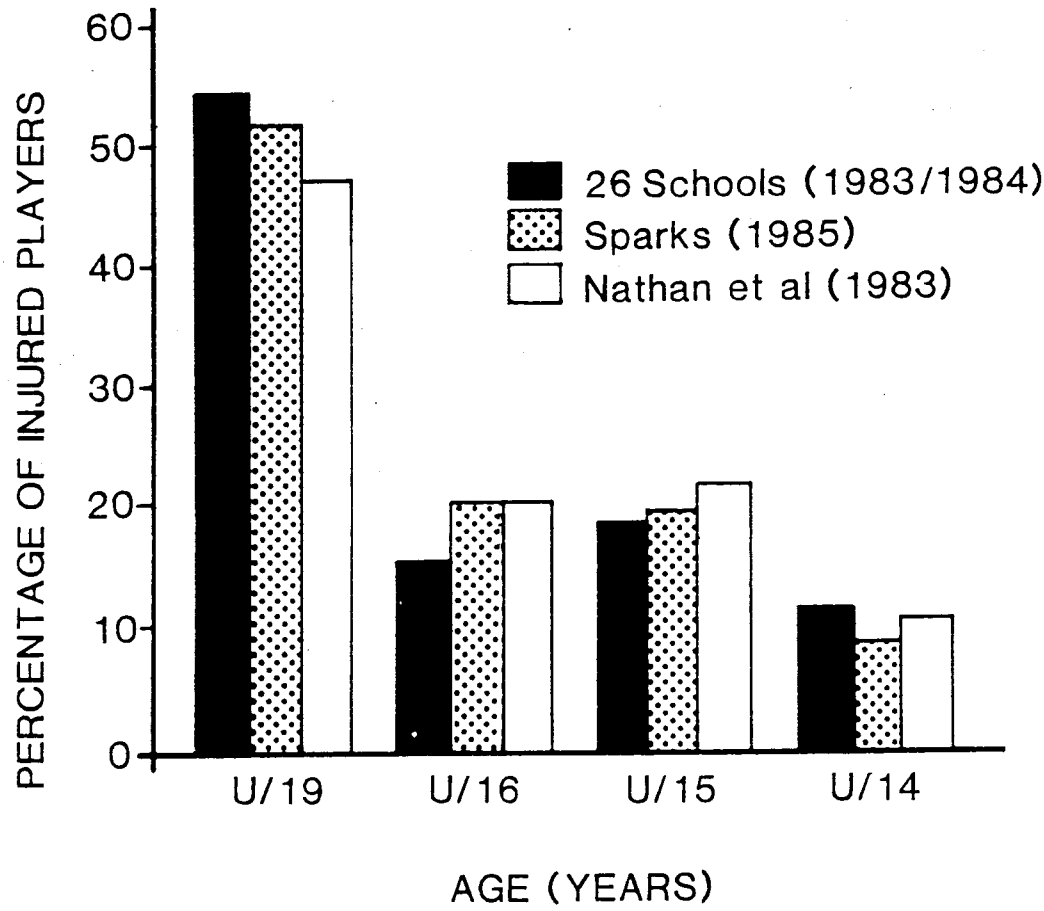

Figure 6.5 The percentage of injured players in the different age-groups in the 1982 study (Nathan et al. 1983), this study (1983/84), and the 1980 - 84 study of Sparks (1985).

To confirm the finding that under-19 players are at much greater risk of injury than players in the other age-groups, the percentage of players participating in each age-group must be examined. In Figure 6.6 the percentage of players participating in each age-group is compared with the percentage of players injured in each age-group during both years of the 1983/84 study. Injured under-19 players accounted for 53.6% of all injured players compared with only the 36.8% that under-19 players represented of all players, a

difference of 16.8%. In contrast, under-14 players accounted for only 12.6% of all injured players compared with 27.3% that they represented of all players.

Thus the percentage that injured under-19 players represented of all injured players is 45.7% higher and that of injured under-14 players 53.8% lower, than the percentages that players in these two groups represented of all players. It is therefore possible to conclude that injury frequency increases with age. Several other studies which included players from different age-groups reported similar findings (Van Heerden 1976; Wessels 1980, 1984).

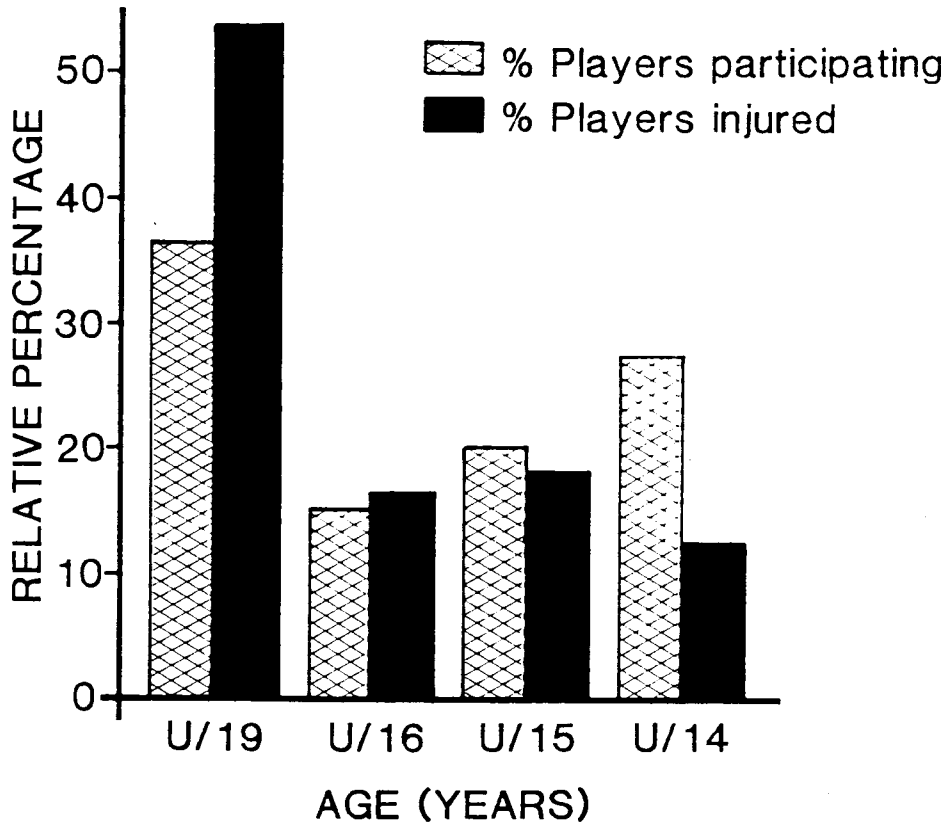

Figure 6.6 The percentage of players participating in each age-group compared with the percentage of players injured in each age-group in the 1983/84 study.

At all ages A-team players were most likely to be injured (Figure 6.4). Overall, injured A-team players accounted for 42.5% of all injured players, compared with only 30.5% that A-team players represented of all players. Under-19 A-team players were particularly at risk and injured under-19 A-team players accounted for 18.8% of all injured players, compared with only 8.3% that under-19 A-team players represented of all players.

To confirm whether under-19 A-team players are indeed more at risk of injury the incidences of injury for A-team players and non A-team players must be examined. In Table 6.5 these incidences, as well as the risk ratios are shown. It can be seen that the incidence of injury was highest for under-19 A-team players when compared with the incidence of injured A-team players in other age-groups.

Table 6.5 The age-group incidence of injured players for A-teams and non A-teams (other teams) in the 1983/84 study.

AGE GROUP	INCIDENCE OF INJURED PLAYERS * #		RISK RATIO
	A-TEAMS	OTHER TEAMS	
Under-19	305	539	1.8
Under-16	465	692	1.5
Under-15	563	1101	2.0
Under-14	1053	1731	1.6
OVERALL	491	785	1.6

* One injured player per boy-hours of rugby per season.
# n = 905 injured players.

However, when the A-team risk for each age-group is compared with the risk for other teams in the same age-group, the percentage difference was greatest at under-15 level (95.6% compared with only 48.8% at under-16 level). The risk of injury for all A-team players was 59.9% higher than the risk for all non A-team players.

Further analysis was conducted to determine whether a similar pattern also existed between different lower level teams. Incidences of injury were calculated for players injured in the following groups of teams; A-teams, B-teams, C + D-teams, and where possible, E to H-teams (only at under-19 and under-14 level). These groups were selected as they represented the following percentages of all players; A-teams - 30.5%, B-teams - 26.5%, C + D-teams - 28.7% and E to H-teams - 14.4%.

At all ages except at under-14 level, B-team players were more likely to be injured than C + D-team players (Table 6.6). Similarly, C + D-team players at under-19 and under-14 level were more likely to be injured when compared with E to H-team players in these age-groups. However, when the overall incidence of injured players for the different groups were examined, the risk of injury for A-team players was 39.2% higher than the risk for B-team players (risk ratio = 1.4). The injury risk for B-team players was 17.8% higher than the risk for C + D-team players (risk ratio = 1.2). At under-19 and under-14 level the injury risk for C + D-team players was 36.9% higher than the risk for E to H-team players (risk ratio = 1.4). Thus the greatest risk difference occurred between the A and B-team player groups, again showing the greater risk of injury that A-team players are exposed to.

Also interesting was that at under-19 level the injury risk for A-team players was only 27.2% higher than the

risk for B-team players (risk ratio = 1.3). The risk for B-team players was 47.5% higher than the risk for C + D-team players (risk ratio = 1.5). A possible explanation for this finding may be that under-19 B-team players play more competitively, particularly during practices, in order to gain selection to under-19 A-teams. That this may be true can be seen from the percentage of players in these teams who were injured during practices. Thirty-four percent of all injured under-19 B-team players sustained injuries during practices, compared with only 19.7% of all injured under-19 A-team players.

Table 6.6 The incidence of injured players for A-teams and lower level teams in the different age-groups during the 1983/84 study.

AGE GROUP	INCIDENCE OF INJURED PLAYERS * #			
	A-TEAMS	B-TEAMS	C+D-TEAMS	E-H-TEAMS
Under-19	301	383	565	825
Under-16	436	647	756	+
Under-15	579	1018	1211	+
Under-14	1098	1762	1441	2319
OVERALL	487	678	799	1092

* One injured player per boy-hours of rugby per season.
\# n = 905 injured players.
\+ Inadequate sample.

The studies of Davidson (1987) and Nathan et al. (1983) both also found that school-boy players in the higher grades were more prone to injury than those in the

lower grades. In the 1982 study by Nathan et al. (1983) 20.3% of all injured players were under-19 A-team players, similar to the percentage (18.8%) found in this study (1983/84). Similar trends were found amongst adult rugby players. Meyers (1980) reported a marked increase in the incidence of injury from lower to higher grades of play in Australian club rugby players. This finding is also confirmed by studies conducted in South Africa by the Northern Transvaal Rugby Union (1982) and by Wessels (1980; 1984).

There are several possible reasons for this finding. Many studies have suggested that, at higher levels, the game is played with increased vigour, determination and speed (Walkden 1975; Myers 1980; Silver 1984; Silver and Gill 1988; Taylor and Coolican 1987). Players in the higher teams are likely to be bigger, stronger, faster and more competitive (Van Heerden 1976; Davies and Gibson 1978). The emphasis on winning may be greater at A-team level, particularly under-19 level, and coaches may be using "psych-up" techniques. Silver (1979) warns of the dangers of "psyching-up" players before competition. Also, according to Wessels (1980) players in top teams more often return to play before complete recovery has occurred.

6.2 Risk of injury for players in different playing positions

The percentage risk of injury to players in the different individual playing positions was determined through the use of the "corrected percentages" method of calculation. The reason for employing this method was explained previously (see Chapter 3.8 [e] and Chapter 4.4). Eighthmen (13.0%) were the players most likely to be injured during both years of this study (1983/84) (Table 6.7). Wings (12.1%) and full-backs (11%) were also at high risk, followed by centres (10.8%), fly-halves (10.3) and scrum-halves and flankers

(each 9.7%). Locks (7.1%), hookers (7.5%) and props (8.8%) were the players least likely to be injured. Thus, tight forward players, who represent a third of the 15 players in a team, accounted for only 23.4% of all injured players. The loose-forward players, who represent a fifth of the 15 players in a team, accounted for 22.7% of all injured players. This indicates, as was the case with some backline positions, that players involved in the tackling phases of play and play executed at speed are at greater risk of being injured.

Table 6.7 The "corrected" percentage risk of injury for players in the different playing positions during the 1983/84 study.

POSITION	NUMBER OF INJURED PLAYERS		INJURY RISK
	ACTUAL #	CORRECTED *	CORRECTED (%)
Eighthman	79	158	13.0
Wing	148	148	12.1
Full-back	67	134	11.0
Centre	132	132	10.8
Fly-half	63	126	10.3
Scrum-half	59	118	9.7
Flanker	118	118	9.7
Prop	107	107	8.8
Hooker	46	92	7.5
Lock	86	86	7.1
Total	905	1219	100.0

Average number of players injured during each season.

* Corrected for positions which have only one player per team (see Chapter 3.8 [e]).

In the 1982 study of Nathan et al. (1983) hookers (31.6%) were the most commonly injured players followed by full-backs (14.7%) and eighthmen (12.6%). However, their method of calculating the corrected percentages for positions which have only one player per team was inaccurate. Instead of only doubling the number of injured players for positions which have one player per team they also halved the number of injured players for positions which have two players per team. It is therefore not surprising to note that players in positions which have only one player per team were most likely to be injured and together represented 77.8% of all injured players. In this study the corresponding figures were 54.2% and 48.2% for 1983 and 1984 respectively, and 51.5% when the results of the two years were combined.

When corrected, the results of the 1982 study (Nathan et al. 1983) still show that 25.9% of all injured players were hookers, more than double the percentage for full-backs (12.2%). However, the study was conducted using a small sample (one school). To show that the very high percentage reported by injured hookers was unusual and not representative, the 1983 results of the school used by Nathan must be examined. Injured hookers at this school accounted for 11% of all players injured during 1983, a figure much closer to that of the larger study.

The corrected percentages for all other positions in the Nathan et al. (1983) study are more representative and most correspond with the findings of this study (1983/84). A trend confirmed by the 1982 study (Nathan et al. 1983) was that props (3.4%) and locks (6.9%) were the players least likely to be injured, whilst full-backs (12.1%) and eighthmen (10.3%) were amongst the most commonly injured.

In the study conducted by the Northern Transvaal Rugby Union (1982), percentages for schoolboy players injured in the different playing positions were remarkably similar to those found in this study (1983/84). It was, however, not stated

whether positional percentages had been corrected for positions in which there is only one player per team.

Clark et al. (1990), who used the same definition for an injury in their study of first-division senior rugby players also found that hookers (19%) sustained most injuries. They also reported high percentages for wings (15%) and full-backs (11%) and low percentages for locks and props (each 6%). With the exception of the high percentage reported for hookers in the Clark et al. (1990) study, percentages for other positions were similar to the findings of this study (1983/84).

Most other studies have reported on the risk of injury for players in different playing positions but a major problem in comparing data from these studies is that many used a different definition for what constitutes an injury. Also, not all studies stated whether positional percentages had been corrected for positions in which there is only one player per team.

Williams (1984), Durkin (1977) and Myers (1980) all reported that full-backs were the players most at risk of sustaining injury. As the studies of Williams (1984) and Durkin (1977) used similar definitions (two weeks out of rugby) and both had corrected positional percentages, these studies may be compared. The percentage of injured players were similar in five of the ten playing positions. In the study of Durkin (1977), centres were the second most injured players, whilst in the study of Williams (1984) these players were least likely to be injured. The opposite occurred in the scrum-half position. Both authors reported relatively low percentages for locks.

The findings of Durkin (1977) compare closest to those of this study (1983/84). In both these studies full-backs, centres and eighthmen were amongst the most commonly injured and locks, props and hookers amongst the least commonly

injured players. The positional percentages found by Myers (1980), who reported on all injured rugby players seen at an Australian hospital's casualty department, resemble those of Williams (1984) more closely.

Roy (1974) found that eighthmen and flanks were the most commonly injured players but also reported high percentages for locks and hookers. The above discussion shows that very few similarities with regard to playing position exist amongst the different studies. The only players for whom almost all studies reported high percentages of injury were wings.

(a) Backline vs forward players (1984 study)

In the section which follows discussion is based on actual figures obtained for backline and forward players injured during the 1984 study. However, cognisance should be taken of the fact that in a rugby team there are seven backline players and eight forward players. Therefore, if for example 50% of fractures were each sustained by backline and forward players, it follows that the individual risk would be greater for backline players. In selected comparisons the individual risk for backline and forward players will be examined but, in general, results and discussion are based on the actual figures found for the two groups of players. The reason for using the actual figures is to allow for comparisons to be made between this study (1984) and the study of Williams (1984). These two studies are the only known studies which have examined differences between backline and forward players as well as interrelationships which exist between these groups of players and other aspects of rugby.

Of the 410 injured players in 1984, 50.2% were backline players. This percentage is 3.5% higher than the 46.7% that backline players represented of all players. When

the individual risk of injury for backline and forward players was calculated, the average backline player had a 15.1% higher injury risk than the average forward player.

Two observations regarding phase of play can be made when backline positions are contrasted with forward positions. Firstly, amongst backline players the risk of injury rises from positions close to the forwards (and set-phases) to those further distant. Figure 6.7 shows that in almost every phase of play in which they are involved wings and centres were most likely to be injured. This observation confirms that in positions where play was executed at greater speed players were more likely to be injured. Players in these positions were also more likely to be involved in the tackling and being-tackled phases of play, the two phases of play during which more than 50% of all players sustained injuries.

Secondly, there was a direct relationship between the playing position of injured players and the phases of play in which they were primarily involved. Thus 68.3% of the 120 players injured while being tackled, and 66.7% of the 45 players injured during open play, were backline players (Figure 6.7). Predictably, forward players (75.8%) were most likely to be injured during loose-scrums and mauls. More than 80% of players injured during scrums were frontrow players and four of the seven players injured during line-outs were locks.

It would seem obvious that no backline players should sustain injuries during the scrum and line-out phases of play and only one such case (scrum-half injured in line-out) was reported. However, Williams (1984) reports more such cases during both line-outs and scrums. An explanation for this may be that these players were actually injured during loose-scrums or

mauls which developed from these phases, but were recorded as being injured in scrums or line-outs.

An interesting finding was that eight (66.6%) of the 12 players injured as a result of foul play were backline players. This differs from the research of Williams (1984) who found that most injuries sustained as a result of foul play were reported by forward players. His findings for backline and forward players injured during the loose-scrum/maul and tackling phases of play were almost identical with the findings of this study (1984).

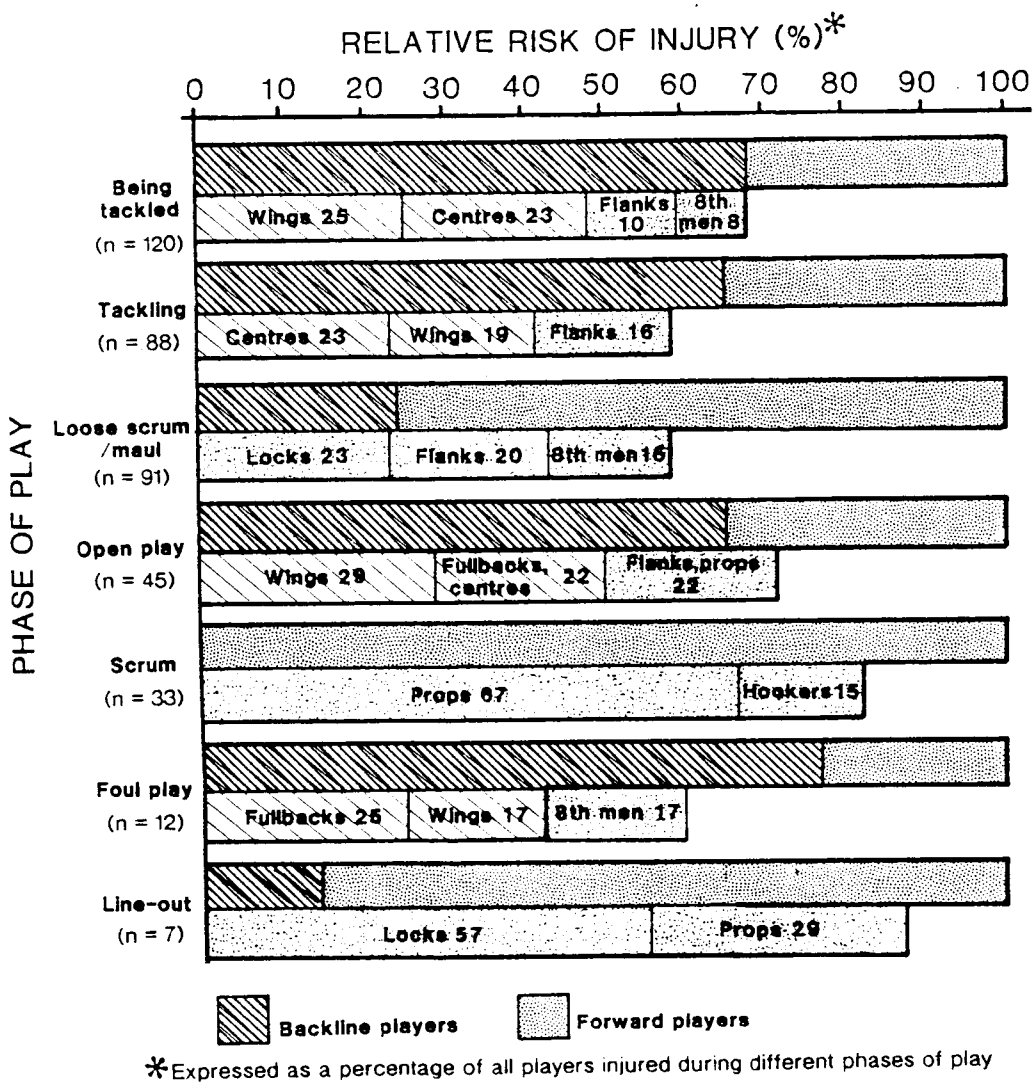

Figure 6.7 Interrelationships between phase of play, backline and forward players and specific playing positions in the 1984 study

Figure 6.8 shows the injury types that backline and forward players were likely to sustain. Forward players were more likely to sustain dislocations and concussion. Backline players sustained more fracture injuries.

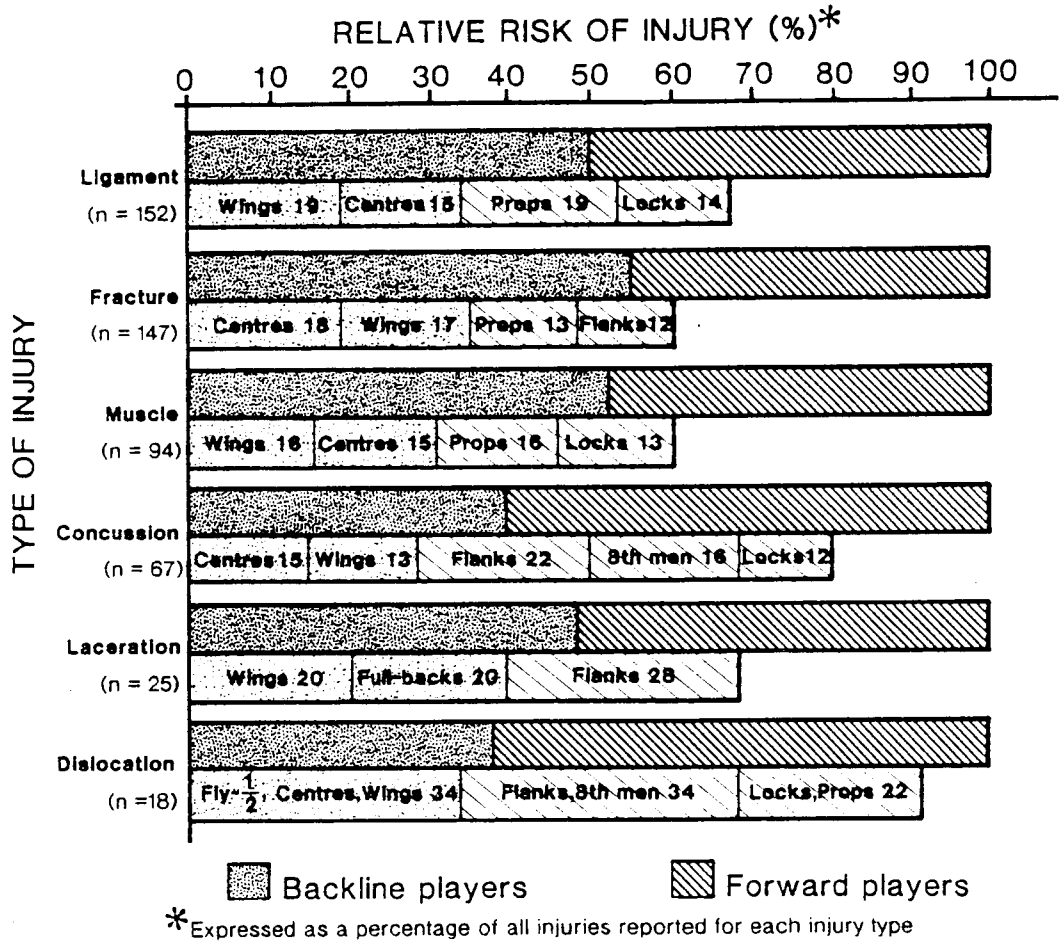

Figure 6.8 Interrelationships between type of injury, backline and forward players and specific playing positions in the 1984 study.

(b) Anatomical site, type of injury and specific injuries (1984 study)

It has been shown that certain players were injured during predictable phases of play. In addition, the findings of this study (1984) show that relationships and patterns exist between playing position, phase of

play, anatomical site of injury, nature of injury and specific injuries sustained. Figures 6.9, 6.10 and Table 6.8 show most of these relationships.

Table 6.8 lists the anatomical sites, types of injury and specific injuries that occurred most commonly to backline and forward players. Forward players sustained most trunk (62.1) and head and neck (61.6%) injuries. Backline players sustained most upper (60.5%) and lower limb injuries (60%). When the risk of injury for individual backline or forward players was calculated, the average backline player had a 72% and 74% higher risk of respectively sustaining upper limb and lower limb injuries than the average forward player. The average forward player had a 40% and 44.4% higher risk of respectively sustaining head and neck and trunk injuries than the average backline player.

Most head and neck injuries occurred during the loose-scrum/maul (27.6%) and the two tackling phases of play (44.1%). They were sustained mainly by loose-forwards (28.3%), props (14.9%) and centres and wings (24.4%). Players in these positions also sustained 70.9% of all upper limb and 63.3% of all lower limb injuries. As 59.8% of all upper and lower limb injuries were sustained during the two tackling phases of play it is possible to deduce that centres and wings were most likely to be injured during the tackling phases of play. Loose-forwards were likely to sustain injuries during the tackling and loose-scrum/maul phases of play, and props during the scrum.

Most previous schoolboy and adult studies have reported on the injury types sustained by injured players but hardly any have analysed the specific injuries. In Table 6.8 (also in Figure 6.8) it is shown that dislocation and concussion injuries occurred more commonly to forward players.

Table 6.8 The anatomical sites at which backline and forward players were likely to sustain injuries, including the type and specific injuries that occurred most frequently in the 1984 study.

ANATOMICAL SITE, TYPE AND SPECIFIC INJURIES	NUMBER OF INJURIES #	RISK OF INJURY (%) BACKLINE	FORWARD
Head and neck	159	38.4	61.6
Upper limb	165	60.0	40.0
Lower limb	124	60.5	39.5
Trunk	58	37.9	62.1
Concussion	67	38.8	61.2
Dislocations	18	38.9	61.1
Vertebral	8	37.5	62.5
Shoulder	5	40.0	60.0
Lacerations	25	48.0	52.0
Head and face	20	45.0	55.0
Body	5	60.0	40.0
Muscles	94	52.1	47.9
Neck	26	26.9	73.1
Shoulder	23	78.3	21.7
Trunk	23	26.1	73.9
Thigh	9	88.9	11.1
Hamstring	4	100.0	-
Calf	4	75.0	25.0
Ligaments	152	50.0	50.0
Knee	42	61.9	38.1
Ankle	34	55.9	44.1
Shoulder	32	53.1	46.8
Neck	19	15.8	84.2
Trunk	11	54.5	45.5
Finger	7	42.9	57.1
Wrist	4	50.0	50.0
Fractures	147	55.1	44.9
Clavicle	39	59.0	41.0
Facial	15	73.3	26.7
Finger	15	66.7	33.3
Radius	11	63.6	36.4
Wrist	11	54.5	45.5
Ankle	10	60.0	40.0
Vertebral	9	11.1	88.9
Rib	9	33.3	66.7
Metacarpal	6	16.7	83.3
Fibula	5	60.0	40.0
Humerus	4	100.0	-
Tibia	4	50.0	50.0

Minimum number of observations = four.

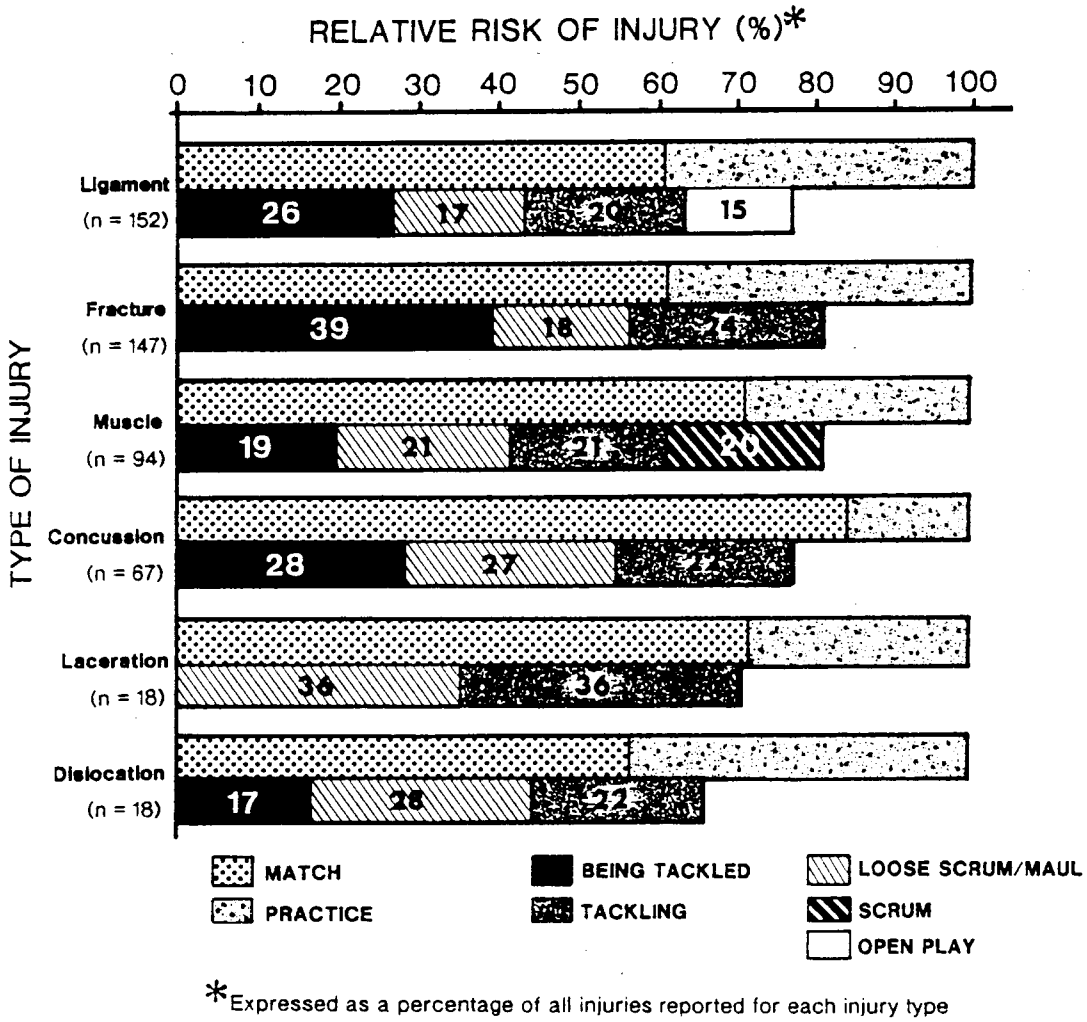

Figure 6.9 Interrelationships between type of injury, match and practice injuries and specific phases of play in the 1984 study.

Laceration, muscle, ligament and fracture injuries were evenly distributed between forward and backline players and relate to the overall injury pattern reported by these two groups. However, when the individual risk for players in these groups was calculated the following emerged. The average forward had a 40% and 35.8% higher

risk of respectively sustaining concussion and dislocation injuries than the average backline player. The average backline player had a 4.6%, 11.1%, 23.3% and 41.1% higher risk of respectively sustaining laceration, ligament, muscle and fracture injuries than the average forward player. Specific playing positions in which these injury types were common is shown in Figure 6.7.

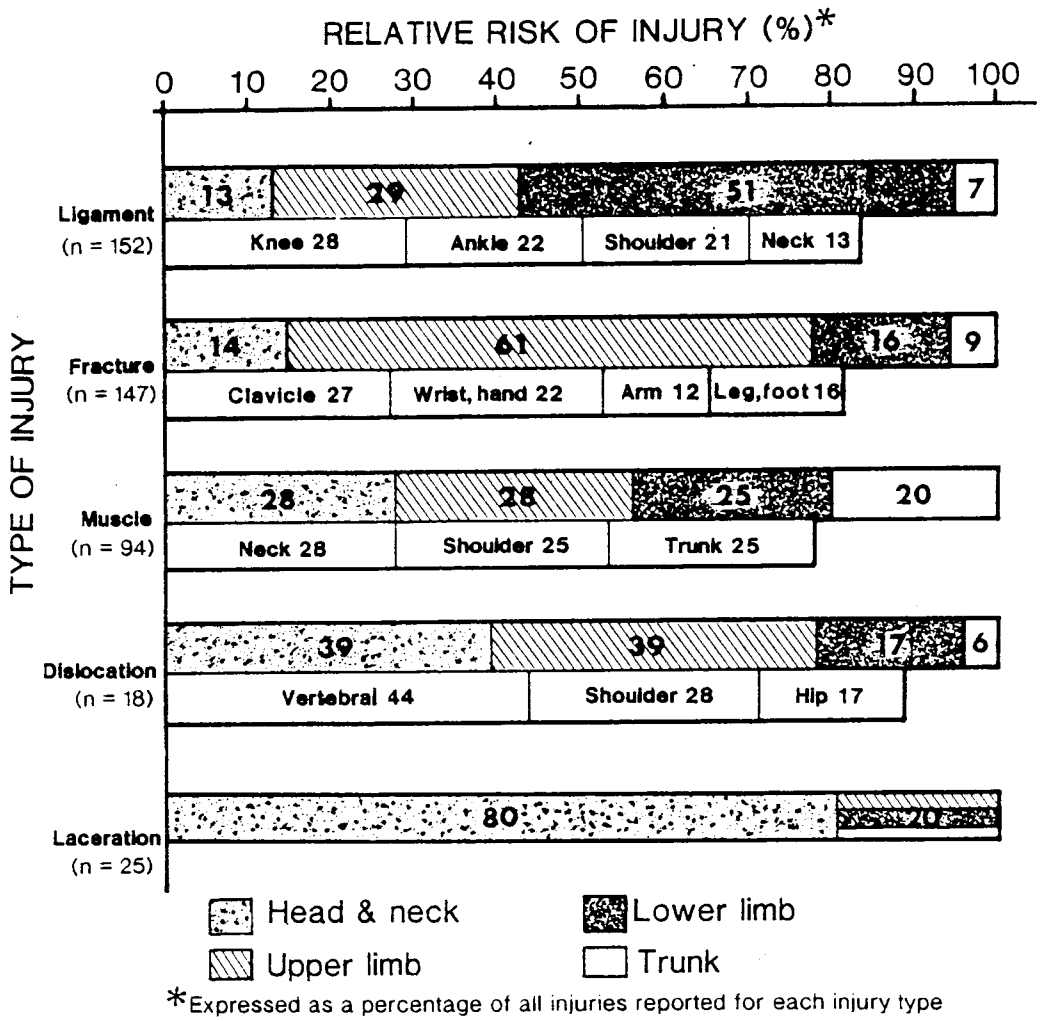

Figure 6.10 Interrelationships between type of injury, anatomical site of injury and specific injuries in the 1984 study.

When specific injuries were analysed the following emerged: vertebral and shoulder dislocations occurred more commonly to forward players and two of the three hip dislocations occurred to backline players; forwards reported more head and face lacerations and backline players more body lacerations; forwards sustained most neck and trunk muscle and neck ligament injuries whilst backline players were more likely to sustain shoulder muscle and ligament injuries, ligament injuries of the knee and ankle and, particularly, muscle injuries of the thigh, hamstring and calf. Forward players reported most vertebral, rib and metacarpal, and backline players most clavicle, facial, finger, ankle, fibula and all humerus fractures.

Although the above relates to the anatomical site analysis discussed earlier, it does show that certain specific injuries occur more frequently, even exclusively, to forward or backline players. Further specific analysis shows even more interesting patterns and for the purpose of this analysis the playing positions were divided into groups in which play is similar; centres, wings and full-backs; scrum-halves and fly-halves; the loose-forwards; and the tight-forwards.

Centres, wings and full-backs reported 57.9% of all humerus, ulna, radius and clavicle fractures, 52.3% of all knee ligament injuries, 49.1% of all shoulder muscle and ligament injuries, 40% of all head and face lacerations, 40% of all fibula, tibia and ankle fractures, and 32.8% of all concussion injuries. Sixty-one percent of the above-mentioned injuries occurred during the two tackling phases of play (81.8% of all humerus, ulna, radius and clavicle fractures). A total of 86.6% of all injured centres, wings and full-backs sustained injuries while being tackled (43.3%), while tackling (28.7%) and during open play (14.6%).

Scrum-halves and fly-halves sustained most of their injuries during the tackling phases of play (53.1%) and during loose-scrum and mauls (22.4%). They were more likely to be injured during loose-scrums and mauls than centres, wings and full-backs, who sustained only 7% of their injuries during this phase of play. Very few trends regarding specific injuries types sustained by scrum-halves and fly-halves were found. They reported 35.7% of all finger, and three of the ten wrist fractures. Fly-halves sustained two of the three hip dislocations and scrum-halves were the only backline players who were more frequently injured while tackling than while being-tackled.

Loose-forward players sustained two of the five shoulder dislocations, 30% of all metacarpal and finger fractures, 38.8% of all concussion injuries, 35% of all head and face lacerations, and three (25%) of the 12 neck vertebral fractures and dislocations. Seventy-five percent of these injuries were sustained during the tackling and loose-scrum/maul phases of play.

Tight-forwards sustained four (80%) of the five neck vertebral fractures, three (75%) of the four trunk vertebral fractures, 73.7% of neck ligament injuries, 61.5% of neck muscle injuries, 54.5% of trunk muscle and ligament injuries, and five (55.6%) of the nine rib fractures. Almost 65% of these injuries occurred during the scrum (40.6%) and loose-scrum/maul (24%) phases of play. These players also reported 26.9% of knee, ankle and foot ligament injuries but, interestingly, only one (5.9%) of the 17 thigh, hamstring and calf muscle injuries.

(c) Age and playing level

For the discussion in this section the 905 players injured during the 1983/84 study were divided into two

groups; under-19 players and junior age-group players (under-14, under-15 and under-16). This was done for two reasons. Firstly, the two groups each accounted for more or less 50% of all injured players and favourable comparisons could therefore be made. Secondly, at junior age-group levels players were still undergoing physical growth changes whereas at under-19 level most of these changes had already occurred. It would therefore be interesting to determine whether these growth changes influenced results found for the two groups of players. Table 6.9 shows the relative risk of injury for players in different positions in the two groups. In both groups eighthmen and wings were amongst the most commonly injured and props and locks amongst the least commonly injured players.

The following other interesting observations were made. In all backline positions except the full-back position, junior age-group players were more at risk of being injured than their under-19 counterparts. In the 1984 study it was shown that of the 410 injured players, 208 (50.7%) were injured during the two tackling phases of play. Of these players 66.8% were backline players and 58.2% junior age-group players. This therefore suggests that junior backline players (excluding full-backs) were not only more likely to be injured when compared with under-19 backline players, but also more particularly during the tackling phases of play. There was, however, a marked difference in the percentages reported by full-backs in the two groups of players (Table 6.9). The likely explanation for this is that at younger ages the fullback participates only occasionally in the game, whereas at the under-19 level he is more involved in collisions that usually occur at speed (catching the up-and-under; joining the line; tackling opposing backs).

Table 6.9 The "corrected" percentage risk of injury for under-19 and junior age-group (under-14 to under-16) players in different playing positions during the 1983/84 study.

POSITION *	INJURED PLAYERS (%) #		
	UNDER-19	JUNIOR AGES	OVERALL
Eighthman	13.2	12.6	13.0
Full-back	13.6	8.2	11.0
Wing	11.8	12.5	12.1
Centre	9.8	12.0	10.8
Fly-half	9.1	11.6	10.3
Scrum-half	9.1	10.3	9.7
Flank	10.1	9.2	9.7
Prop	7.6	10.1	8.8
Lock	6.5	7.7	7.5
Hooker	9.1	5.8	7.1
TOTAL	99.9	100	100

* Corrected for positions which have only one player per team (see Chapter 3.8 [e]).

\# n = 1219 injured players (corrected).

Amongst forward players, under-19 eighthmen, flankers and hookers were more at risk of being injured than their junior counterparts. Marked differences were found for hookers and props in the two groups of players (Table 6.9). Under-14, under-15 and under-16 props accounted for 10.1% of all injured players in these age-groups, compared with 7.6% that under-19 props represented of all injured under-19 players. The higher percentage reported by injured junior age-group props suggest that these players are not sufficiently developed physically, or adequately conditioned and

coached in scrumming techniques. In the 1984 study it was shown that of the 33 players injured during scrums, 22 were props (66.7%) and 18 junior age-group players (54.5%). Finally, in the case of hookers it was not clear what the cause for the higher percentage sustained by injured under-19 hookers had been.

One interesting finding emerged when the playing levels were compared for backline and forward players in the 1984 study. Backline players represented 46.7% of all players but accounted for 57.7% of all injured A-team players. When the risk for individual players was calculated, the average A-team backline player had 54.7% greater risk of being injured than the average A-team forward player. Overall, individual backline players had a 41.1% higher risk of injury than individual forward players. Thus the proportional risk of injury for backline players compared to forward players was particularly high for A-team players when compared to players in lower teams. The most probable explanation for this finding was that at A-team level backline players executed movements at greater speed, which led to an increase in the impact of collisions which occurred during the tackling phases of play. The increase in impact during collisions most probably resulted in an increase in the number of injuries sustained by these players.

6.3 **Risk of injury at different anatomical sites**

Most of the 905 injured players sustained injuries to the lower limb (32.5%), followed by the head and neck (30.4%) and upper limb (25.8.%) (Figure 6.11). The trunk (11.3%) was the anatomical site to which the fewest players sustained injuries. In the 1984 study, when it was possible to determine the percentage of neck injuries, these injuries accounted for 37.1% of head and neck injuries. This

percentage is similar to the 33.3% found in the 1982 study (Nathan et al. (1983). Nathan et al. further reported figures of 25.3% for head and face and 7.6% percent for trunk injuries, but found that more injuries occurred to the upper limb (29.1%) than to the lower limb (25.3%) (Figure 6.11).

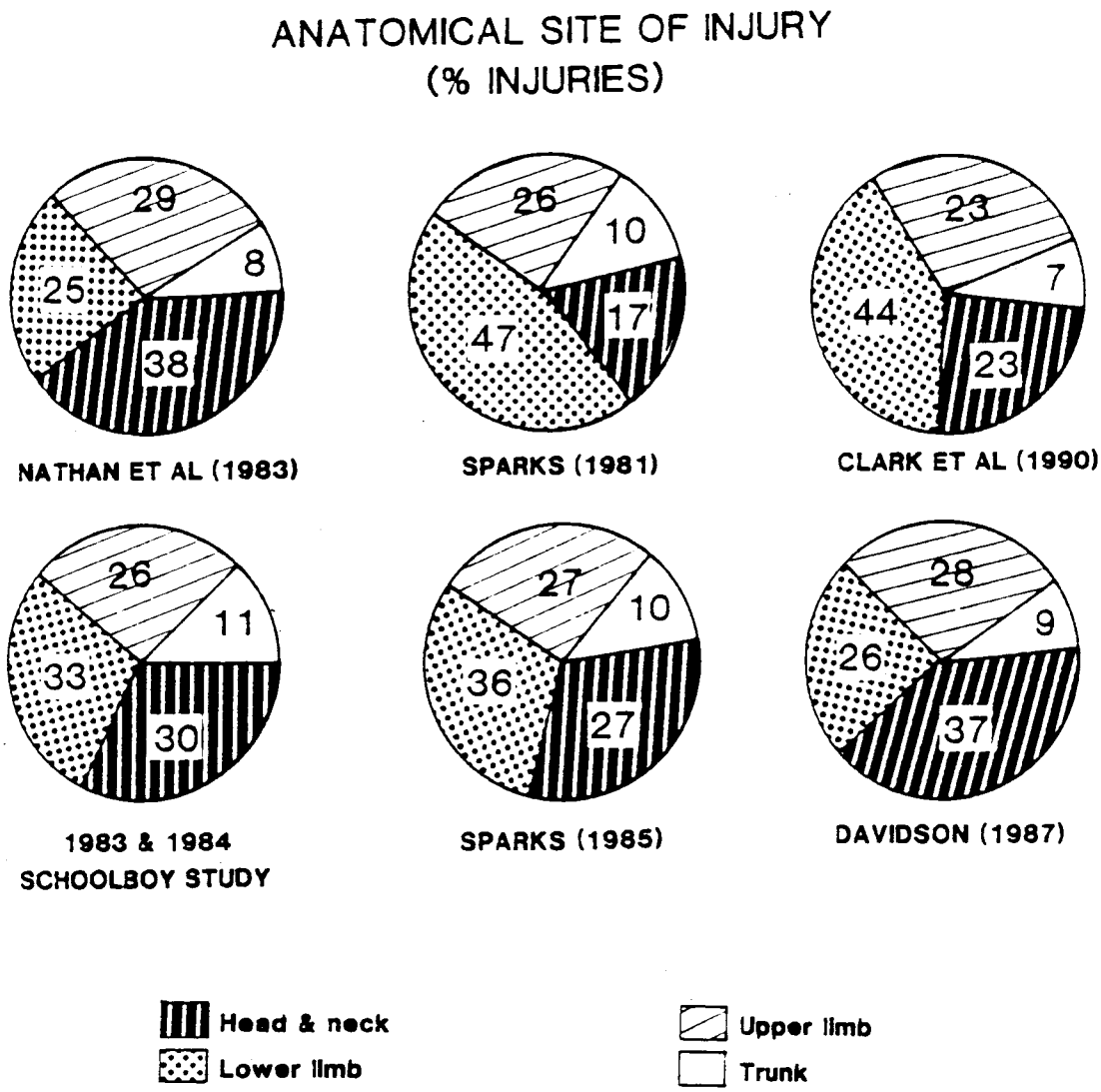

Figure 6.11 The percentages of injuries sustained at different anatomical sites compared in five schoolboy studies (Nathan et al. 1983; Sparks 1981, 1985; Davidson 1987; this study - 1983/84) and one adult study (Clark et al. 1990).

Clark et al.(1990) did not distinguish between head and neck injuries and reported a combined figure of 23% for injuries to this anatomical site. However, they also found that more injuries occurred to the lower limb (44%) than the upper limb (23%) (Figure 6.11). Trunk injuries represented seven percent of all injuries in their study.

The findings of this study (1983/84) are also similar to those reported by Davidson (1987) in Australian schoolboy players. He found most injuries occurred to the head and neck (36.6%), followed by upper limb (27.5%) and lower limb (26.2%)(Figure 6.11). All injuries, regardless of degree, were however considered and these included injuries to the head such as headaches, nausea and dizziness (14.9% of all injuries reported). The inclusion of these injuries may suggest why Davidson reported a slightly higher incidence for head and neck injuries.

Sparks (1981) reported that only 16.9% of all injuries sustained by players at Rugby School over a period of 29 years (1950 to 1979) occurred to the head and neck (Figure 6.11). Lower limb (47.2%) and upper limb injuries (25.9%) were the commonest injuries reported. In a further study (1980 to 1983), which was conducted using a similar definition as that of this study (1983/84) and covered a similar time period, Sparks (1985) reported figures for all four anatomical sites which were remarkably similar to the findings of this study (1983/84). He also notes that there had been an increase in the proportion of head and neck injuries (from 16.9% to 26.8%) at Rugby School during these years. A similar finding was made by Briscoe (1985), who noted that the incidence of minor head injuries caused by contact sports at Eton School (England) had risen fourfold during the period 1977 to 1982 when compared with the period 1965 to 1977. Two reasons were cited by Briscoe (1985) for the increase in minor head injuries. Firstly, that there had been an increase in the popularity at Eton School of rugby "which is well known to produce more head injuries than

Association football and Eton football and partly due to more aggressive play by the participants at all forms of football". Secondly, that "referees, masters and housematrons have become more aware of the symptoms and signs of minor head injury and the need for medical attention".

The similarity in results between this study (1983/84) and that of Sparks (1985) clearly refutes Davidson's speculation that differences in the texture of playing fields may explain the differences found between his study and that of Sparks. A more probable explanation for the difference in findings may be the different definitions of an injury used by these two researchers.

The finding by Sparks (1985) and Briscoe (1985) that the number of head and neck injuries had increased in recent years is confirmed in some adult studies. In his study of rugby injuries over a period of 20 years (1930 to 1950) O'Connell (1954) reported that 23.6% of all injuries sustained were head and neck injuries. Some more recent studies have shown an increase in the incidence of injuries to this anatomical site (Weightman and Browne 1974; Lingard et al. 1976; Ingles and Stewart 1981; Northern Transvaal Rugby Union 1982; Williams 1984). In all these studies more than 30% of injuries occurred to the head and neck. However, not all recent studies show such an increase (Van Heerden 1976; Davies 1978; Addley and Farren 1988; Clark et al. 1990). In most of these studies the incidence of head and neck injuries was between 20 to 25%. The differences that exist among the various adult studies are most probably due to the different definitions for an injury and different research methods used. This again stresses the need for standardised research methodology.

Finally, it is of interest to note that in both rugby league and soccer the incidence of head and neck injuries is much lower than in rugby (Alexander et al. 1979; Weightman and

Browne 1974). This is of particular interest in the case of rugby league where the scrum consists of only six players (vs 16 players in rugby) and is only used as a quick method to restart the game (no pushing occurs). In rugby it has been shown in almost every study that the scrum contributes to a large proportion of head and neck injuries, particularly cervical spinal cord injuries. Over the years many calls have been made to depower or radically change the format of the scrum, but this has yet to find favour with administrators who see the scrum as unique to rugby and are hesitant to make changes for traditional reasons.

6.4 Risk of injury during different phases of play

Of the 905 players injured during the 1983/84 study, 29.4% were injured while being tackled and 23.3% while tackling (Figure 6.12). A further 20% sustained injuries during loose-scrums and mauls bringing the total for players injured during the above three phases of play to 72.7%. Almost all previous schoolboy rugby injury studies have identified these phases of play as the major causes of injuries. In the 1982 study Nathan et al. (1983) reported that 46.8% of injured players sustained injuries during the tackling phases of play (Figure 6.12). They did, however, report a much higher percentage for players injured during scrums (17.7% vs 7.8% in this study - 1983/84) but this may be due to the unusually high number of hookers injured in that study. Sparks (1985), who separated all injuries into two groups found that 39.6% of all minor and 53% of severe injuries occurred to players tackling or being tackled.

Roy (1974) found that 49% of injured university players sustained injuries during the tackling phases of play, but that only 9% were sustained by the tackling player. Clark (1990) and Addley and Farren (1988) reported lower percentages for senior club players injured during the tackling phases of play (40% and 33.3% respectively).

Williams (1984) and Ingles and Steward (1981), who both studied injuries occurring to players of all ages and levels, reported percentages slightly lower than those of schoolboy players. These findings suggest that adult players are more competent tacklers than schoolboys and are therefore less prone to injury when tackling an opponent.

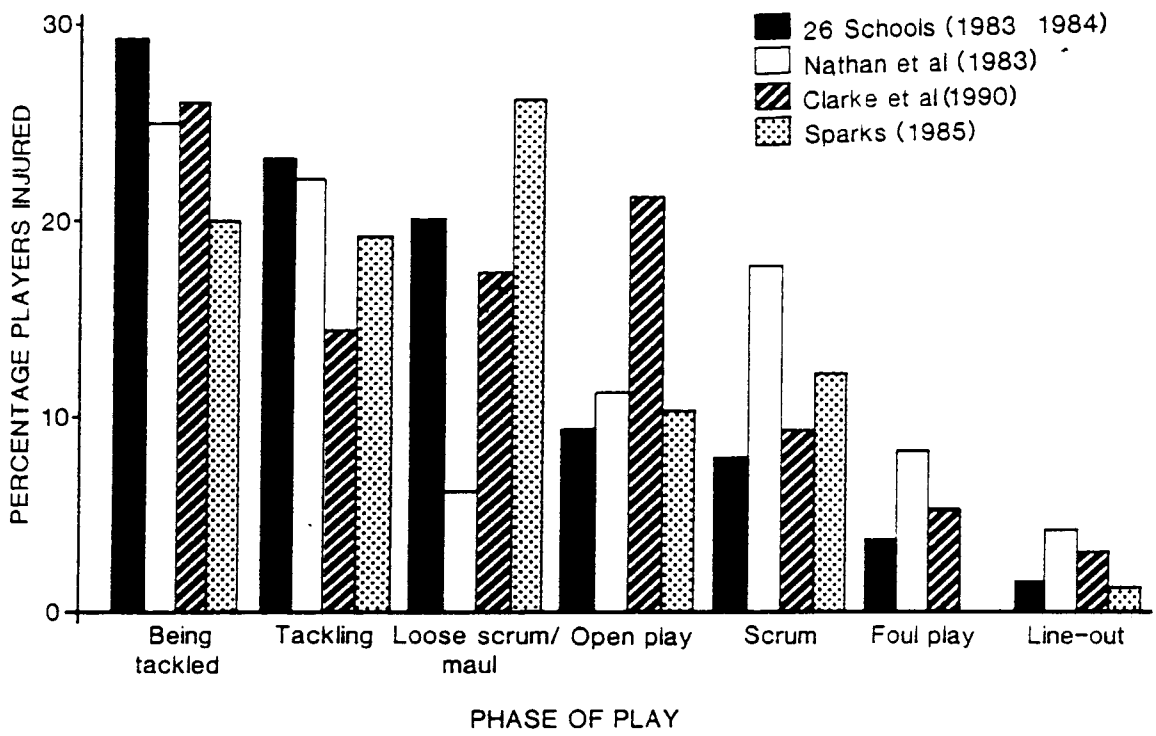

Figure 6.12 The percentage of players injured during different phases of play in the 1982 (Nathan et al. 1983), 1983/84 (this study) and 1988 (Clark et al. 1990) studies, compared with the study of Sparks (1985).

The above suggestion is best illustrated in a study conducted by the Northern Transvaal Rugby Union (1982). Twenty-five percent of international players, 28.4% of first

league players, 33.3% of under-20 and reserve league players, and 39.5% of schoolboy players sustained injuries during the tackling phases of play. Finally, in all studies which differentiated between players injured during the two tackling phases of play the tackling player sustained fewer injuries than the player being tackled.

(a) Playing position, age and playing level (1984)

The 1984 results show that when the phase of play is reflected as a percentage of all players injured within the different age-groups, two interesting patterns emerge. The percentage of players injured during loose-scrums and mauls was low at under-14 level (9.8%) but increased through the age-groups to 29.1% at under-19 level. The opposite occurred to players injured while being tackled. The percentage is a high 41.2% at under-14 level but decreases to 21.4% at under-19 level.

The most probable explanation for the rise with age of the percentage of players injured during loose-scrums and mauls may be the higher intensities at which the game is played at senior schoolboy levels. The decreasing percentage observed with age for players injured while being-tackled may confirm the finding that younger players are more at risk of injury during the tackling phases of play. This emphasizes the suggestion that more attention should be paid by coaches when teaching correct tackling and falling techniques, particularly to players in the younger age-groups.

Percentages for players injured while being-tackled or while tackling were consistently high amongst all levels of play and no patterns emerged. Backline players (66.8%) were more likely to be injured during these phases of play, particularly centres, wings and full-backs (54.3%). These findings are almost identical

with those of Ingles and Steward (1981) and Williams (1984). Both studies reported that 64% of all tackling injuries occurred to backline players. Flankers and eighthmen (19.2%) were the forward players most at risk and coaches, particularly those of junior teams, should therefore concentrate on teaching players in these high-risk positions correct tackling and falling techniques during practices.

Front-row players sustained 81.8% of all scrum injuries, a figure similar to the 75% found by Ingles and Steward (1981). The injuries were evenly distributed amongst age-groups and levels of play, which suggests that the scrum remains a dangerous phase of play, particularly to front-row players, irrespective of age and playing level. These findings also correspond with those reported in the study by the Northern Transvaal Rugby Union (1982) which found that front-row players sustained 71.4% of all scrum injuries. Their findings further state that 82.8% of all scrum injuries occurred as a direct result of foul play and of these 53.8% were caused by collapsing scrums.

This has obvious implications for front-row players and is possibly the main cause of injury to players in these positions. The current trend in world rugby for heavier and stronger forward players, particularly props and hookers, could result in the scrum becoming an increasingly dangerous phase of the game and it will be of crucial importance that players in the high risk positions be properly conditioned and trained in scrumming techniques.

Flankers (19.8%), locks (23.1%) and eighthmen (15.9%) were commonly injured during loose-scrums and mauls (Table 6.10). Hookers accounted for only 6.6% of all players injured during this phase of play. Of the 45

injured locks, 46.7% were injured during loose-scrums and mauls. The high injury percentages reported by locks and loose-forwards may have resulted from loose-scrums or mauls that developed from line-outs or from driving play. This may also explain the low percentage reported by hookers. Hookers are generally smaller and lighter than props and locks and therefore not normally the players most involved in driving play. They are also usually not so centrally involved during loose-scrums which follow line-outs.

Table 6.10 The playing positions in which players were likely to be injured during different phases of play in the 1984 study.

PHASE OF PLAY	POSITION AND RISK (%) *		TOTAL (%) *
Being-tackled (n = 120)	Wing	25.0	
	Centre	22.5	
	Flanker	10.0	57.5
Tackling (n = 88)	Centre	22.7	
	Wing	19.3	
	Flanker	15.9	57.9
Loose-scrum/maul (n = 91)	Lock	23.1	
	Flanker	19.8	
	Eighthman	15.9	58.8
Line-out (n = 7)	Lock	57.1	
	Prop	28.8	85.9
Open play (n = 45)	Wing	28.9	
	Fly-half	13.3	42.2
Foul play (n = 12)	Fullback	25.0	
	Wing	16.7	
	Eighthman	16.7	58.4
Scrum (n = 33)	Prop	66.7	
	Hooker	15.1	81.8

* Expressed as a percentage of the total number of players injured during different phases of play.

(b) Anatomical site, injury type and specific injuries (1984 study)

Of the 120 players injured while being tackled, 45.8% sustained upper limb and 29.2% lower limb injuries (Table 6.11). The most common types of injury sustained during this phase of play were fractures (40.8%), ligament (27.5%) and muscle injuries (12.7%) (Table 6.12). Specific injuries sustained were clavicle fractures (18.7%), concussion (13.4%) and knee ligament injuries (11.3%).

The high percentage of clavicle fractures (66.7% of all clavicle fractures were sustained by the player being tackled) and concussion injuries suggest that these injuries occurred when the tackled player fell after being tackled. Clavicle fractures were probably sustained when the injured player fell on his shoulder, on an outstretched arm or with the ball held under an arm. Williams (1984) reported that 56% of these injuries were caused by falling on an outstretched arm after being tackled. Knee ligament injuries may have been caused by direct tackles on the knee or twisting of the knee during a tackle.

Of the 88 players injured while tackling, a large percentage (42%) also sustained sustained upper limb injuries. However, players injured during this phase of play were more likely to sustain head and neck injuries (31.8%) when compared with players sustaining head and neck injuries while being tackled (23.3%). Ligament (29.2%), fracture (25.5%) and muscle injuries (18.9%) were the types of injury most commonly reported.

Concussion injuries accounted for 14.2% of all tackling injuries, and when added to concussion injuries sustained by players while being tackled, these two phases of play accounted for 50.7% of all concussion

injuries. Williams (1984) also found that 51% of concussion injuries occurred during the tackling phases but reported that 43% were sustained by the tackler compared with 22.4% in this study (1983/84). Other specific injuries commonly sustained by tackling players were shoulder muscle and ligament injuries (19.8%).

Table 6.11 The anatomical sites at which most players sustained injuries during different phases of play in the 1984 study.

PHASE OF PLAY	ANATOMICAL SITE AND RISK (%) *		TOTAL (%) *
Being-tackled	Upper limb	45.8	
(n = 120)	Lower limb	29.2	
	Head and neck	23.3	98.3
Tackling	Upper limb	42.0	
(n = 88)	Head and neck	31.8	
	Lower limb	19.3	93.1
Loose-scrum/maul	Head and neck	38.5	
(n = 91)	Upper limb	24.2	
	Lower limb	23.1	85.8
Line-out (n = 7)	Head and neck	57.1	
	Lower limb	28.6	85.7
Scrum (n = 33)	Head and neck	42.4	
	Trunk	39.4	81.8
Open play (n = 45)	Lower limb	51.1	
	Upper limb	26.7	77.8
Foul play (n = 12)	Head and neck	58.3	58.3

* Expressed as a percentage of the total number of players injured during different phases of play.

Of the 33 players injured during scrums in 1984, 81.8% sustained head and neck (42.4%) and trunk injuries (39.4%). Most of the injuries sustained during scrums in 1983/84 were ligament (40%) and muscle (38%) injuries. Neck muscle and ligament (38%) and trunk muscle and ligament injuries were the specific injuries most commonly reported. Frontrow players sustained 44.8% of all neck injuries and of these 21.3% were neck vertebral fractures or dislocations.

Table 6.12 The most common injury types which occurred during different phases of play in the 1983 and 1984 studies.

PHASE OF PLAY	INJURY TYPE AND RISK (%) *		TOTAL (%) *
Being-tackled	Fractures	40.8	
(n = 266)	Ligaments	27.5	
	Muscle	12.7	81.0
Tackling	Ligaments	29.2	
(n = 211)	Fractures	25.5	
	Muscle	18.9	73.6
Loose-scrum/maul	Ligament	23.0	
(n = 181)	Fractures	21.2	
	Muscle	17.7	61.9
Scrum (n = 71)	Ligament	40.0	
	Muscle	38.0	78.0
Line-out (n = 13)	Ligament	44.4	
	Muscle	22.2	66.6
Open play (n = 83)	Ligament	40.4	
	Fracture	22.8	
	Muscle	19.3	82.5
Foul play (n = 33)	Concussion	35.7	
	Ligament	21.4	
	Fractures	21.4	78.5

* Expressed as a percentage of the total number of injuries sustained during different phases of play.

As stated earlier, 81.8% of injured frontrow players were injured during scrums and this again points to collapsing, wheeling and raised scrums as the major cause of neck injuries sustained by frontrow players. Williams (1984) reports that 68% of all serious neck injuries treated at Cardiff Royal Infirmary over a two-year period occurred to frontrow players, 50% were sustained in the scrum and of these 80% were caused by collapsing (45%), raised (25%) and wheeling scrums (10%). The findings of this study (1983/84) are also similar to those found by the Northern Transvaal Rugby Union (1982). They reported that 64.6% of all injuries sustained during scrums were to the head, neck and trunk, 31.7% of all neck injuries were sustained in the scrum and almost all of these were sustained by frontrow players.

Of the 91 players injured during loose-scrums and mauls, 38.5% sustained head and neck, 24.2% upper limb and 23.1% lower limb injuries. Ligament (23%), fracture (21.2%) and muscle (18.9%) injuries were the injury types most commonly reported. Of the head and neck injuries, 50% were concussion injuries and 25% head and face lacerations. Four of the eleven serious dislocation injuries (neck and hip) were also reported during this phase of play.

Of the 45 players injured during open play, 51.1% sustained lower limb and 26.7% upper limb injuries. The injury types that occurred most commonly were ligament (40.4%), fracture (22.8%) and muscle (19.3%) injuries. Forty-one percent of all hamstring, thigh and calf muscle and 22.4% of knee and ankle ligament injuries occurred during this phase of play. As 64.4% of all players injured during open play were either fly-halves, centres, wings or full-backs, this suggests that these injuries were sustained whilst running at speed and that changes in direction (side-stepping and

swerving) may have accounted for many of the injuries, particularly ankle and knee ligament injuries.

6.5 Match vs practice injuries

As previously discussed, more than two-thirds of all players were injured during match play and the risk of injury was nine times higher for players during an hour of match play than for players during an hour of practice. In general, injury patterns were similar when players injured during matches were compared with players injured during practices. However, a few interesting differences were found and these will be briefly examined. Regrettably, as this is the only study which has examined the differences which exist between match and practice injuries and the factors that cause such injuries, very few comparisons can be made.

(a) Age and playing level (1984 study)

No significant difference from that of the overall injury pattern was found for players in the different age-groups but when the playing levels were examined one pattern emerged. In the 1984 study 39.5% of all injured players were A-team players. Of these injured A-team players 70.8% were injured during match play, compared with only 60.6% of non A-team players injured during match play. This finding shows that players at higher levels are not only more likely to be injured but that they are also more likely to be injured during match play. This again points to a more competitive level of play amongst players in the better teams.

(b) Anatomical site, injury type and specific injuries (1984 study)

When players injured during matches were contrasted with those injured during practices, the most

significant differences emerged in the above three categories. Of all players who sustained head and neck injuries 79.5% were injured during match play. By comparison only 58% of players sustaining injuries to other anatomical areas were injured during match play. As head and neck injuries are generally of a more serious nature this finding is of particular concern. The following examples emphasize this point.

Twelve (80%) of the 15 facial fractures, 23 (88.5%) of the 26 neck muscle injuries, 56 (83.7%) of the 67 concussion, four (80%) of the five neck vertebral fractures and 16 (80%) of the 20 facial lacerations were sustained during match play. These figures are all much higher than the 62.7% of all other injuries which occurred during matches.

Several other studies found that a very high percentage of cervical spinal cord injuries occurred during match play and these studies have blamed the competitive level of play for the occurrence of these injuries.

Kew et al. (1991) reported that 98% of 117 cervical spinal cord injuries occurred during match play and suggested that competitiveness and aggression had been an important factor contributing to these injuries. Taylor and Coolican (1987) found that all 37 cervical spinal cord injuries that were reported in Australia between 1960 and 1985 had occurred in matches. They also blamed competitiveness and aggression as causes of these injuries. Burry and Gowland (1981) reported that 87% of 54 cervical spinal cord injuries which had occurred in New Zealand between 1973 and 1978 were sustained during matches. Similar findings have been reported by Silver (1984).

The phases of play during which most cervical spinal cord injuries were sustained have been analysed and discussed and they correspond with the findings of most other studies. In almost every study conducted worldwide the mechanisms that caused cervical spinal cord injuries have been well documented. It has also been shown that most of these injuries are preventable (Taylor and Coolican 1987; Burry and Calcinai 1988).

With particular reference to the high percentage of cervical spinal cord and concussion injuries that occur during matches, the following suggestions have been made: (i) the "win at all cost" attitude must be strongly condemned and discouraged; (ii) a balanced approach to aggression and self-discipline must be developed; (iii) referees should exercise stricter control, particularly during play phases which have been identified as causes of these injuries; and (iv) teams and players should be effectively matched.

Two further interesting findings emerged when match and practice injuries were contrasted. Firstly, that clavicle fractures were as common during practices as during matches. It has previously been shown that clavicle fractures occurred primarily to players while being tackled and it was suggested that these injuries were sustained when a player fell on his shoulder or on an outstretched arm after being tackled. The finding that as many clavicle fractures occurred during practices as during matches clearly shows that incorrect falling techniques, and not aggressive play, was the primary cause of these injuries.

Secondly, more ankle ligament injuries (55.9%) had occurred during practices than during match play. It is not clear what the reason for this finding might be but it does suggest that, should ankle strapping be used as a preventative measure, players should strap their

ankles for matches and practices. Ankle strapping is still uncommon in rugby, particularly amongst schoolboy players. Yet many American football trainers and orthopaedic surgeons associated with well-known teams advocate routine strapping of ankles for all practice sessions and matches.

(c) Phase of play (1984 study)

Several interesting findings were made when the phases of play were compared for injuries which occurred during matches and practices. Firstly, that 62% of all injured players sustaining injuries while being-tackled or while tackling were injured during match play. This percentage is slightly lower than 67.3% of all players injured during match play in other phases of play and confirms earlier findings that competitive play was not the primary cause of tackling injuries, but poor tackling and falling techniques were. In contrast, 71.4% of players injured during loose-scrums and mauls sustained injuries during matches and this may indicate more aggression in matches play during this phase of play.

Finally, the aspect of play with the most conclusive evidence that competitive and aggressive play had been a major cause of injuries was foul play; all such injuries were reported during match play.

6.6 **Percentage risk for different types of injury**

Fracture (27.9%) and ligament (27.6%) injuries were the types of injury most commonly reported during both years of the study (Figure 6.13). When the results for the two studies were combined these injuries accounted for 55.5% of all injuries. Muscle injuries accounted for 17.7% and concussion for 12.8% of all injuries.

Findings from the studies of Sparks (1985) and Nathan et al. (1983) differed markedly when the percentages for different injury types sustained were compared with those of this study (1983/84). Particularly interesting were the reported percentages for concussion, dislocations and fractures. In the study of Sparks (1985) the percentages for these types of injury accounted respectively for only 6.3%, 3.2% and 9.3% of all injuries (Figure 6.13). All were markedly lower than the respective percentages (12.8%, 6.6% and 27.9%) found for these injury types in this study (1983/84).

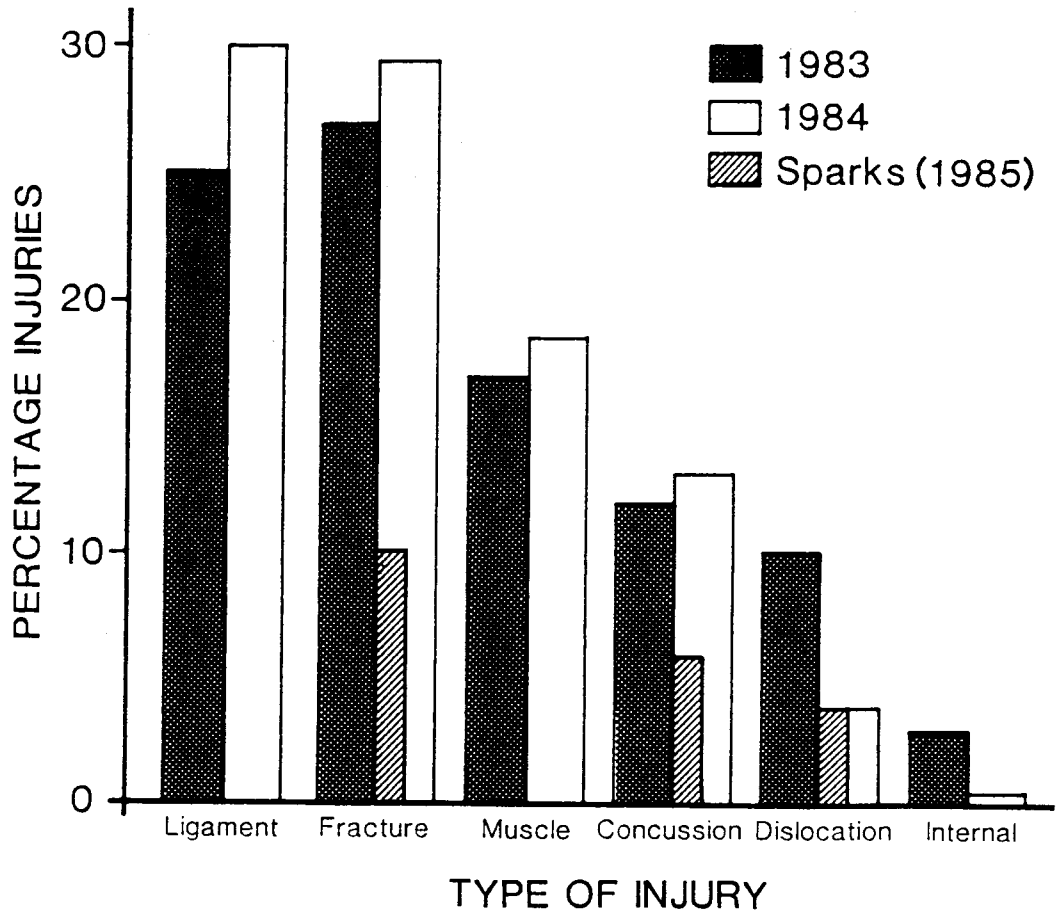

Figure 6.13 The percentage risk for different injury types sustained during the 1983 and 1984 studies, compared with the percentage risk for fracture, concussion and dislocation injuries sustained in the study of Sparks (1985).

It is not clear what the reasons for these lower percentages were. In both this study (1983/84) and that of Sparks (1985), most injuries occurred during the two tackling phases of play. Since 51.6% of concussion and 64.9% of fracture injuries were reported during these phases of play in this study (1983/84), the findings by Sparks are indeed strange. The only probable explanation may be that playing fields are softer in England, thereby lessening the impact of players falling to the ground after being tackled or tackling.

In the study of Williams (1984) which was conducted in Wales, fractures accounted for 20% and concussion for 5% of all injuries. Both percentages are also lower than the percentages found in this study (1983/84). That the softer playing fields in Great Britain may explain the lower percentages reported for fractures by both Williams (1984) and Sparks (1985) seems likely as Williams states that more fractures had occurred when playing fields were hard or firm, but found no difference in the occurrence of concussion.

In the 1982 study of Nathan et al. (1983) concussion and muscle injuries (each 21.5%) were the most commonly reported injury types. Fracture (15.2%) and ligament injuries (17.7%) accounted for only 32.9% of all injuries, compared with 55.5% in this study (1983/84). Two reasons may explain the high percentage of concussion injuries reported by Nathan et al. (1983). Firstly, their study was conducted for one season and at one school only. Thus it is possible that the high percentage reported for concussion was an unusual occurrence and therefore influenced the overall percentages reported for other injury types. Secondly, and most probably, that through close monitoring of players these injuries did not go undetected. In the 1982 study of Nathan et al. (1983) one school was closely monitored by two researchers.

This point was best illustrated when the percentages for concussion injuries sustained by players from the two groups of schools during each year of this study (1983/84) were examined. The percentage difference for concussion injuries reported by the two groups of schools was 9.3% in 1983. In 1984 when personal contact with the six closely monitored schools was relaxed, the percentage difference was only 3.4%.

In the study of Malan and Strydom (1987), conducted during the 1985 Craven Week for High Schools, ligament , muscle and concussion injuries were most commonly reported injury types. Davidson (1987) reported that only one and seven percent of 1444 Australian schoolboy players who were injured in match play over a 18-year period respectively sustained concussion and fracture injuries.

The differences between the percentages reported for different injury types, as discussed for the above schoolboy studies, again emphasise the need for standardised definitions and survey methods. A comparison between the different methods used in the following two studies illustrates this point. Davidson (1987) examined all **match play** injuries presented at a **high** school's **medical clinic.** No distinction was made between **minor** and **major** injuries and the study was conducted over a **18-year** period. Concussion accounted for **one percent** of all reported injuries; Nathan et al. (1983) examined all **match** and **practice** injuries reported by **junior** and **high** school players. **All players** participating in the game formed part of the study which was conducted over a **one-year** period (1982). Only players who were prevented from participation in rugby for a period of **one week** due to injury were considered for the study. Concussion accounted for **22%** of all reported injuries.

Even greater variations amongst the percentages reported for different injury types in adult studies were found. These will not be discussed and reference will only be made to the

findings of adult studies which can be reliably compared. In adult studies conducted by Durkin (1977), Adams (1977) and Davies and Gibson (1978) concussion respectively accounted for 5.7%, 2.1% and 2% of all injuries reported. Williams (1984), who studied Welsh rugby players from all ages and levels of play found that ligament injuries (20.3%) and fractures (19.4%) were most commonly reported (definition for injury: two weeks out of rugby). Another interesting finding reported by Williams (1984) which seems to confirm findings of this study (1983/84) was that "schoolboys suffered far more concussion and fractures relative to total numbers of injuries compared with top club players". A study by the Northern Transvaal Rugby Union (1982) showed similar findings. More than 50% of all concussion injuries were sustained by under-20 and schoolboy players.

Conversely, adult players suffered a higher proportion of laceration and muscle injuries (Williams 1984; Northern Transvaal Rugby Union 1982). Durkin (1977), who used a similar definition to that used by Williams (1984) found that 59% of all injuries sustained by adult players were laceration and muscle injuries.

The discussion in this section has shown that schoolboys may be more at risk of sustaining particularly concussion injuries. Adult players were more likely to sustain lacerations. The following may be the reasons for these findings. It was suggested previously in this thesis that schoolboys are poorer tacklers than adults. As most concussion injuries occurred during the tackling phases of play, this may explain the higher percentage of these injuries sustained by schoolboys. More aggressive play by adult players, particularly during loose-scrums and mauls, most probably led to them sustaining more laceration injuries.

(a) Period out of rugby (1984 study)

The period out of rugby was only calculated for cases where a player reported only one specific injury as well as the number of days out of rugby due to that injury. It was possible to use this information to determine the average number of days out of rugby for each type of specific injury. This would not have been possible in cases where more than one specific injury was reported, as the reported number of days out of rugby applied to the injury incident and all specific injuries that were sustained during that incident. As could be expected, players who reported more than one specific injury were, on average, out of rugby for periods longer than those who reported single injuries only. The discussion which follows includes data from the 1984 study only, as the period out of rugby was not examined in 1983.

Nine of the 410 players (2.2%) sustained injuries of such a serious nature that they were out of rugby forever. These included five players who reported vertebral fractures and one each that respectively reported a neck vertebral dislocation, a kidney rupture and concussion.

Seventeen players (4.1%) were out of rugby for the rest of the season. All these players sustained injuries of a serious nature. Four of these 17 players reported concussion injuries. Two players each reported tibia and fibula fractures and three players knee ligament injuries

Of the 410 players injured during 1984, 326 (79.5%) reported only one specific injury. In 17 of these cases it was not possible to determine the number of days out of rugby as some of these players were out of rugby for either the rest of the season or forever. The remaining

309 players were out of rugby for a total of 7014 days (average 22.7 days). Two interesting observations follow from this. Firstly, that the average period out of rugby found for this group of players represents the lowest average period for the study as a whole. If it were possible to include figures for players who reported more than one specific injury and for players who were out of rugby for the season or forever, the average number of days out of rugby for all injured players would inevitably have been higher.

The second interesting observation was that the average period out of rugby (22.7 days) was more than three times that of the period (7 days) which qualified injuries for this study (1983/84). In this study it was shown that between 40 and 50% of injuries were under-reported. The difference between the average period out of rugby and the period which qualified injuries for this study (1983/84) may indicate that injuries of a less serious nature were under-reported. Regrettably, it was not possible to examine this aspect. However, it was shown that concussion, which requires a high degree of clinical suspicion, was under-reported in the schools monitored only by correspondence.

The average number of days that players were out of rugby is shown for each injury type in Figure 6.14. The 53 players who reported concussion injuries only were out of rugby for an average period of 15 days. Rugby and medical authorities recommend that players who sustain concussion injuries should not participate in the game for a period of three weeks following such an injury. Forty (75.5%) of the above-mentioned 53 players did not follow these recommendations.

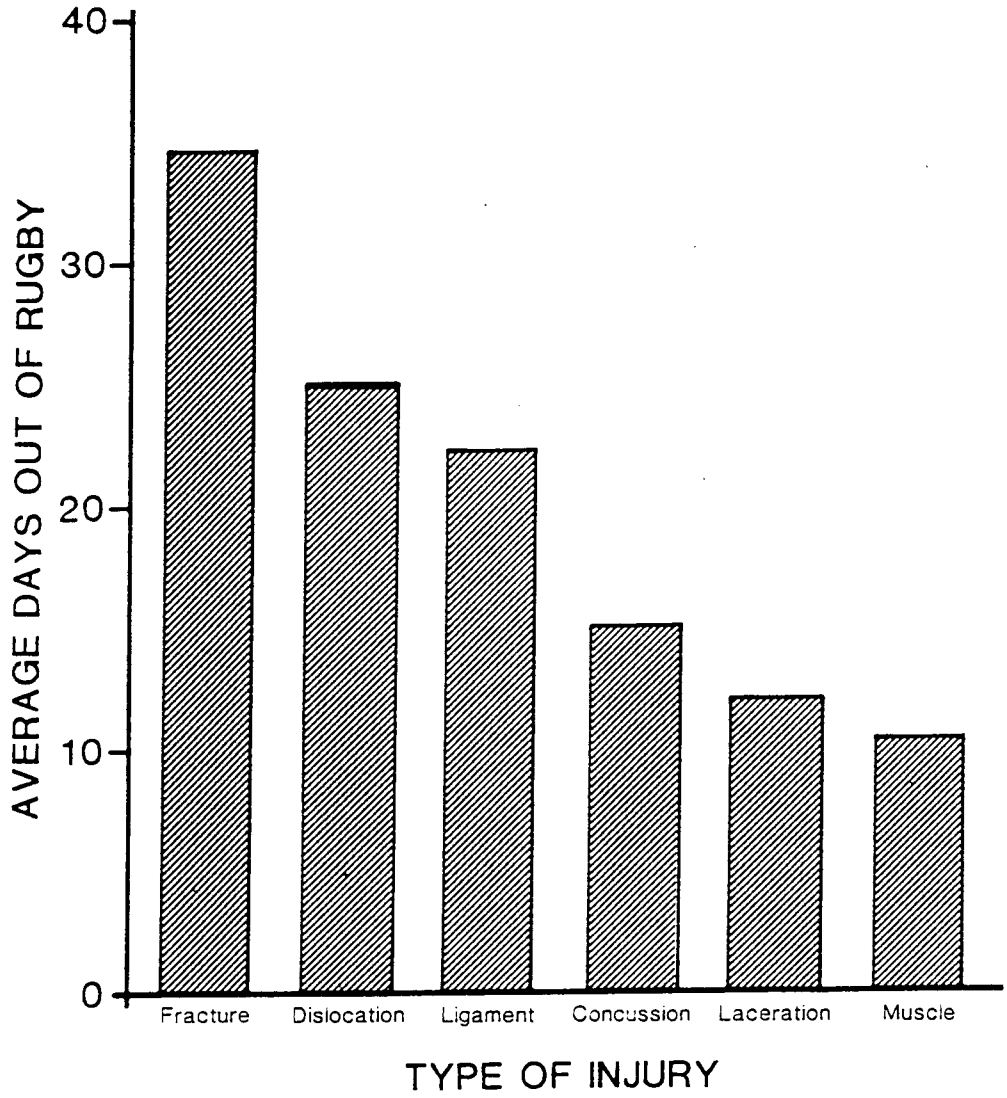

Figure 6.14 The average number of days out of rugby for each injury type in the 1984 study.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

The principal conclusions and recommendations of the study are as follows:

7.1 Under-reporting of injuries

Between 40 and 50% fewer rugby players were recorded as injured in the schools monitored by correspondence. This phenomenon was attributed to under-reporting rather than decreased risk in the rural schools. Although it seems probable that most of the under-reported injuries may have been of a less serious nature it was shown that concussion, which requires a high degree of clinical suspicion, was also under-reported. It appears that the most accurate method of data collection is direct personal contact between the researcher and the injured player.

Furthermore, intensive monitoring of a single school in 1982 (Nathan et al. 1983) identified the overall injury trends that were corroborated in studies of 26 schools (1983 and 1984). Future epidemiological rugby injuries studies should use personal monitoring as a survey method in preference to correspondence as the personal contact method appears to obtain the most accurate and reliable data.

7.2 Incidence and risk of injury

There was no decrease in the incidence of injured players during the two years of the study. Although fewer players were reported injured during 1984, this lower figure appears to be due to under-reporting (in comparison with 1983) in the six closely monitored schools after personal contact had been relaxed. The incidence of injured players in the 20

schools monitored by correspondence was almost identical during each of the two years that the study was conducted.

Thus the injury incidences reported in this study (1983/84) do not, as a result of under-reporting, reflect the true levels of risk of injury in South African schoolboy rugby players. Actual levels could be as much as 100% higher than the incidences reported. More well-planned scientific research studies are needed to determine the true risk of injury in South African schoolboy rugby players and whether or not the incidence of injury is increasing amongst these players.

7.3 Time of the season

Schoolboy rugby players were more commonly injured during the early season and directly after the mid-year winter vacation. Also, the incidence of players injured during match play was particularly high at the beginning of the season. This finding points to a lack of match fitness and proper conditioning at the start of the rugby season and also that players do not maintain their fitness during the mid-year vacation. Coaches and players should pay more attention to pre-season training. Special strength-building and flexibility programmes should be followed by players in high risk positions and particular attention should be paid to correct tackling techniques. All players should be made aware that it is essential that they maintain their fitness during the mid-year vacation.

7.4 Match vs practice injuries

Sixty-eight percent of all injured players were injured during match play. However, practice hours are longer than match play hours, so that when incidence was calculated, it was found that players were 10.8 times more likely to be injured during a match play hour than during a practice

hour. Also, four of the five (80%) neck vertebral fractures and 56 (83.6%) of the 67 concussion injuries occurred during match play. No foul play injuries were reported during practices.

The above findings suggest that competitive levels are higher during match play and may result in more players sustaining serious injuries. A high level of competition during matches is most probably a result of "psyching up" of players by coaches, parental and/or peer pressure and a "win at all cost" attitude. These factors may be highly dangerous and it seems reasonable to suggest that they be discouraged by all involved. Balanced attitudes towards aggression and self-discipline should be promoted and developed. Referees should enforce stricter control, particularly in play phases where dangerous or illegal play is likely to occur.

7.5 **Age and team level**

The risk of injury rises with age and also with team level. Under-19 players were 45.7% more likely, and under-14 players 116.7% less likely to be injured than the percentage of all players participating in each age-group. Even when the under-reporting of injuries is not taken into account, one out of every 7.1 under-19 players and one out of every 22.5 under-14 players is likely to sustain an injury which would prevent him from participation for at least one week during a season. In each age-group, A-team players were most likely to be injured. Under-19 A-team players (8.3% of all players) accounted for 18.8% of all injured players during the two years that the study was conducted.

These findings also suggest that competitive levels are higher, not only during match play as discussed in 7.4 above, but also in the older age-groups and at higher levels of play within the age-groups. These players are generally bigger, stronger, faster and play the game with

more vigour. Recommendations of 7.4 therefore apply here, and possibly with greater emphasis for the age and team levels at greater risk.

7.6 Mechanism of injury

The majority injured players sustained injuries while being tackled or while tackling (52.7%). The number of injured players attributed to loose-scrums and mauls and the number for the two tackling phases of play, accounted for 72.7% of all injured players during the two years of the study. Younger schoolboy players (under age 16) were more at risk of being injured during the two tackling phases of play. In general, schoolboy rugby players were at greater risk of injury during the tackling phases of play than adult players. Players in specific positions were more likely to sustain predictable injuries during certain phases of play. These findings emphasizes the necessity for coaches to teach players, particularly those in the younger age-groups, correct tackling and falling techniques.

7.7 Playing position

Eighthmen and backline players, particularly full-backs, wings and centres, were the players most likely to be injured, whereas the tight-forwards were the least frequently injured players. The relative incidence of injured players amongst props falls with increasing age, whereas that of the full-back rises. These findings suggest that younger props are neither physically developed enough, nor adequately conditioned and coached in scrumming techniques, and that at a young age, the full-back participates only occasionally in the game, whereas at under-19 age these players are involved in collisions that occur at speed (catching the up-and-under; joining the line; tackling opposing backs). Particular attention should therefore be paid to players in high risk positions during practice sessions. Extensive conditioning programmes should

be followed and the correct techniques coached to players in specialist and high risk positions.

7.8 Anatomical site of injury

Injuries sustained to the head and neck and lower limb accounted for more than 60% of all injuries. Head and neck injuries were generally of a more serious nature, particularly cervical spinal cord and concussion injuries. Most head and neck injuries occurred to forward players during the loose-scrums/maul phase of play and 79.5% of head and neck injuries were sustained during match play. Backline players were more likely to sustain upper and lower limb injuries and most occurred during the tackling phases of play. Competitive play and poor tackling and falling techniques probably contributed to the majority of the above injuries. Recommendations are similar to those previously discussed for these injury mechanisms.

7.9 Type of injury

More than half of all injuries reported were fracture or ligament injuries. Typically, backline players sustained fracture and ligament injuries when tackling or while being tackled and muscle injuries during open play. Tight-forwards sustained muscle, ligament, fracture and dislocation injuries during the scrum and loose-scrum/maul phases of play. The loose-forwards, eighthmen in particular, were prone to injuries commonly sustained by backline players, as well as those occurring in the loose-scrum/maul. This finding would explain why, overall, eighthmen were most likely to be injured. Concussion injuries seem under-reported and the very high percentage sustained during match play suggests competitive and aggressive play.

Furthermore, concussed players did not follow official recommendations and 75.5% returned to the game within three weeks following a concussion injury. Coaches, parents and

players should be more aware of the dangers associated with concussion injuries.

Preventative techniques such as strapping should be encouraged to reduce the risk of sustaining ligament injuries, whilst recommendations to prevent or limit other injury types are similar to those in 7.7 above.

7.10 **Specific injuries**

Predictable injury patterns were found when specific injuries were analysed. Players participating in the fast, open phases of play were likely to sustain specific injuries associated with running (thigh, hamstring and calf muscle injuries), side-stepping (ankle ligament and fracture injuries), fending off (finger fractures), tackling (shoulder dislocations, facial lacerations and fractures, concussion, shoulder muscle and ligament injuries), being tackled (neck vertebral and hip dislocations, shoulder muscle, knee and ankle ligament and femur, patella, tibia, fibula and ankle fracture injuries) and falling (clavicle, humerus, ulna, radius, wrist, metacarpal, and finger fractures).

Players participating in the tight, set phases of play were likely to sustain specific injuries associated with scrummaging (neck vertebral dislocations and fractures, neck and trunk muscle, neck ligament and rib fracture injuries) and loose-scrum/mauls (neck vertebral dislocations and fractures, concussion, facial lacerations, trunk and thigh muscle and trunk fracture injuries). Many of the injuries discussed in this section were very common in specific playing positions and it is therefore most important that particular attention be given to players in such positions during practices.

7.11 **Statistical significance of major findings**

The log-linear analysis for injured player x school (six closely monitored vs 20 correspondence monitored) x year established that there were marked effects of the factors school and year, and that the effects of school are different across the two year period. Statistically fewer injuries were reported (p = 0.00007) in year two (1984), and statistically higher injury rates occurred in the six schools closely monitored during 1983. These patterns were so strong that the method can select no better summary for the data than the complete table itself (Table 7.1).

Table 7.1 Log-linear analysis of factors associated with injured players and with concussion injuries.

FACTORS AFFECTING INJURED PLAYERS	DEGREES OF FREEDOM	LIKELIHOOD RATIO CHI-SQUARE	P VALUE
School	1	30.9	0.0000
Year	1	8.0	0.0048
School x year	1	15.7	0.0001
Age-group	3	198.7	0.0000
Level	1	82.2	0.0000
Age-group x year	3	14.7	0.0021
Level x year	1	5.5	0.0191
Forward vs backline player	1	22.9	0.0000
FACTORS AFFECTING CONCUSSION			
School	1	23.2	0.0000
School x year	1	6.9	0.0087

Note: The term "school" refers to the two groups of schools (six personally monitored and 20 correspondence monitored).

Similarly, for the log-linear analysis of concussion x school x year, while the number of concussions in toto did not change, there were statistically significant differences across the years in both the closely and correspondence monitored schools (Table 7.1). These changes suggest that fewer concussions were reported in the six closely monitored schools after personal contact with the schools was relaxed in 1984.

The injured player x position x year analysis indicated that fewer players were injured during 1984 ($p = 0.0021$), and that consistently during both years, there were more injured players ($p < 0.00005$) amongst positions in which the play is fast and open (eighthman, fly-half, centre, wing and full-back) when compared with injured players in positions involved in the tight phases of play (prop, hooker, lock, flank and scrum-half). The individual risk of injury for the average backline player was 16.1% higher than that of the average forward player.

The injured player x level x age x year analysis showed a significant drop in the number of injured players from 1983 to 1984. Across these years there was a pattern of higher injury rates amongst A-team players ($p < 0.0005$), but the pattern was less marked during 1984. Also, across the years there were higher injury rates amongst older players ($p < 0.0005$), but the differences between age-groups are not consistent.

All of the analyses consistently suggest fewer injured players in 1984. It was argued elsewhere that this observation was a result of under-reporting rather than of a decrease in the number of injured players.

7.12 **Major aetiological factors found in this study (1983/84)**

The two major aetiological factors in rugby injuries appear to be the speed of the game and the competitive level at

which the game is played. Evidence for these conclusions are:

(a) the high percentage of injured players amongst fast, mobile players, playing in the best teams;

(b) the high percentage of players injured during the tackling and being-tackled phases of play, both of which occur at speed;

(c) the high percentage of players injured in the older age-groups playing in the best teams;

(d) the significant difference in incidence between players injured during match play and during practices.

The many similarities which were found when this study (1983/84), the 1982 study (Nathan et al. 1983), and the study of Sparks (1985) were compared, have been discussed. With particular reference to (b), (c) and (d) above, these similarities may indicate that the major aetiological factors, as suggested by the findings of this study (1983/84), are common in schoolboy rugby players across the world. However, this view can only be confirmed once more studies, using similar definitions and survey methods, have been conducted.

7.13 **Prevention of injuries**

One of the major aims of this research was to identify injury patterns and then to make recommendations aimed at the prevention of injuries. The injury patterns identified in this study (1983/84) have been discussed and several recommendations related to these findings were made. A general discussion on the prevention of injuries concludes this thesis. Some recommendations may have been discussed earlier and some may or may not relate directly to the findings of this study (1983/84). Also, some incorporate

value judgements that are not specifically the matter of this research. All are, however, directly aimed at those involved in schoolboy rugby.

(a) Spirit of the game

Schoolboy players should be taught from a young age that the game of rugby, and every sports game for that matter, is played for enjoyment, to make friends and to gain some physical and skills benefit. Nurturing such "correct" attitudes amongst young rugby players do, however, greatly depend on the attitudes of coaches and parents. The "win at all cost" attitude must be discouraged as dangerous as well as anti-social and the value of participation should be stressed. Coaches should ensure that the game is played for reasons that affirm the value of sportsmanship. Players should learn to play skillfully, and then apply skill in order to win. Opponents should be outwitted and not taken out.

Finally, no schoolboy should ever be forced to play rugby. Compulsory participation is finally disappearing at schools, but parental and peer pressure still exists.

(b) The role of the coach

A successful coach is concerned with the well-being and interests of his players. He should know the rules of the game intimately and should be well informed on the correct techniques relating to, particularly, tackling, scrummaging and falling after being tackled. Players should be matched according to age, size, ability and experience. They should not be played in unfamiliar positions and particular attention should be given to players in high risk positions. Practice sessions should be well planned and should commence long before the start of the match season. Coaches should assist

and encourage players to maintain their fitness during the off-season periods.

(c) The role of the referee

The referee plays an important role in the prevention of injuries. Not only should he enforce the rules of the game, but through strict and timely control of potentially dangerous incidents or playing phases should ensure that injuries, particularly serious injuries, are prevented or minimised. An unfit referee, with poor control and knowledge of the rules and playing techniques, may even contribute to the increased occurrence of injuries.

(d) Physical and specific conditioning

Rugby has become a highly specialised game which demands total commitment from coaches and players alike, even at schoolboy level. Physical preparation should include all aspects of fitness such as strength building, flexibility and cardio-vascular fitness. Specially designed programmes, incorporating all-round fitness, should be followed in the off-season period, and specialist training programmes in the pre-season period. Fitness training should be maintained throughout the entire playing season and potentially dangerous exercises should be discouraged. Correct tackling, falling and scrumming techniques must receive utmost priority. Coaches must ensure that players are aware of the dangers of badly timed tackles, or the incorrect positioning of the head during tackles. Controlled scrum collapses should be practised.

(e) First-aid availability and injury management

At all venues where rugby is played, basic first-aid equipment and facilities should be readily available.

The equipment must include a hard stretcher, neck braces and limb splints. Adequately trained personnel must also be available at all rugby venues. Coaches, interested parents and even fellow pupils should be encouraged to undergo first-aid courses which focus on specific rugby injuries and the treatment and management thereof. These courses should be organised by Schoolboy Rugby Unions in conjunction with medical and educational authorities.

(f) Playing surfaces and protective equipment

Playing surfaces should be even, clear of sharp objects such as stones, and well grassed. Rugby posts must be padded and corner flags should be flexible. The wearing of mouthguards should become standard equipment for all rugby players and shin guards should be recommended for forward players. Strapping of ankles during matches and practices could reduce the risk of injuries to those anatomical sites, particularly in players who have previously sustained such injuries. Players must wear the correct boots (no front or sharp studs) and no dangerous objects such as rings and neck chains.

7.14 **Future rugby injury research studies**

It has been shown in this study that a need for further research into the nature and frequency of rugby injuries, particularly schoolboy injuries, still exists. The definition of an injury is possibly the most crucial factor which will determine whether legitimate comparisons can be made between future studies. Important factors related to injuries which future studies should explore are: age and playing level; time of the season; phase of play and playing position; match and practice injuries; anatomical site and type of injury; specific diagnosis of injury; medical treatment received; number of days out of rugby; pre-season

preparation; player attitudes, and knowledge of injury prevention techniques. It is hoped that this study (1983/84), which is almost certainly the most comprehensive to date, will serve as a basis for future epidemiological rugby injury studies.

APPENDIX

WEEKLY REPORT FORM

Education Bureau, P.O. Box 13, CAPE TOWN 8000

FORM "B" (TEACHER)

INVESTIGATION INTO THE OCCURRENCE AND PREVENTION OF RUGBY INJURIES

WEEKLY RUGBY INJURY REPORT

N.B.: 1. Please read the accompanying instructions for filling in the forms.

2. This report must be completed weekly and be returned by post on the Friday immediately following the week covered by this report.

3. Pupils' individual injury reports must be attached to this weekly report.

---

1. Report for this week ending SATURDAY | | | | | | | (D D M M Y Y)

2. Controlling body (e.g. Eastern Province Schools' Rugby Union): .....

3. Number of boys playing rugby (Complete for FIRST WEEK of each term only.)

Age group/league (e.g. Under 19)	Number of participants
TOTAL	

4. Summary of injuries sustained (List ALL teams. Enter a nil response if no injuries occurred.)

Team (e.g. Under 16B)	Number of injuries

(Continued)

4. Summary of injuries sustained (List ALL teams. Enter a nil response if no injuries occurred.) (Continued)

Team (e.g. Under 16B)	Number of injuries
TOTAL	

Thank you for your co-operation.

HAVE YOU ATTACHED THE INDIVIDUAL PUPILS' REPORTS?

Please return to:

The Head
Education Bureau
P.O. Box 13
CAPE TOWN
8000

.....

SIGNATURE OF RESPONSIBLE TEACHER

INJURY QUESTIONNAIRE

Note: A retrospective analysis of the injury questionnaire used during 1984, which contained some inconsistencies, is presented in Chapter 3.2.

FORM "A" (PLAYER)

INVESTIGATION INTO THE OCCURRENCE AND PREVENTION OF RUGBY INJURIES

Please read the accompanying instructions for filling in the form (Leave blank.) | |

A. PERSONAL DATA

1. Name: .....

2. Age (years): ..... Date of birth: | | | | | | |
D D M M Y Y

3. Name of school: ..... (Leave blank.) | |

4. Height (cm): ..... | | | . |
H T U

5. Mass (kg): ..... | | | |
H T U

6. Team: ..... (Leave blank.) | |

7. Playing position: ..... Prop | 0 | 1 |

Hooker | 0 | 2 |

Lock | 0 | 3 |

Flanker | 0 | 4 |

Eighth Man | 0 | 5 |

Scrumhalf | 0 | 6 |

Flyhalf | 0 | 7 |

Centre | 0 | 8 |

Wing | 0 | 9 |

Fullback | 1 | 0 |

B. INJURY DATA

8. Site of injury: ..... Head and neck | 0 | 1 |

Upper limb (upper-arm; thigh) | 0 | 2 |

Lower limb (fore-arm; lower leg) | 0 | 3 |

Trunk | 0 | 4 |

9. Specific diagnosis (nature of injury):

..... (Leave blank.) | | |

.....

10. Severity: How many days were you off rugby?

..... | | |

T U

11. Mechanism of injury:

(Leave blank.) | | |

Did the injury occur during -

Being tackled | 0 | 1 |

Tackling | 0 | 2 |

Scrum | 0 | 3 |

Lineout | 0 | 4 |

Loose scrum/maul | 0 | 5 |

Foul play | 0 | 6 |

Open play | 0 | 7 |

Other | 0 | 8 |

If "Other", please describe type of play:

.....

.....

12. Match or practice:

Did the injury occur during a match or practice?

Match ..... | | 0 | 1 |

Practice ..... | | 0 | 2 |

13. Date of injury ..... | | | | | | | |

D D M M Y Y

14. In the space provided below, please give a brief account of how the injury occured:

.....

.....

.....

.....

15. Please list any previous RUGBY INJURIES you might have had and the year you sustained them:

1. ..... in 19..

2. ..... in 19..

3. ..... in 19..

4. ..... in 19..

5. ..... in 19..

6. ..... in 19..

7. ..... in 19..

16. What was the final score of the match in which you were injured? (If injury occurred in practice, ignore this question.)

T U

Your team's score: .... | | |

Opponents' score: ..... | | |

17. Name of school you were playing against:

.....

18. For how many years have you played Rugby? .... ☐ years

PLEASE HAND THIS FORM TO THE RESPONSIBLE TEACHER

Thank you for your co-operation.

ADDENDUM

INSTRUCTIONS

NB All rugby players who have (1) missed 7 days or more of rugby, due to a rugby injury or (2) been concussed, must please fill in this addendum. By concussion, it is meant a loss of consciousness no matter how short the time interval might be. e.g. even 1 second is long enough.

1. INJURY DATA

- Put a cross in ONE block. Example: If you fractured your collarbone put and X in the block next to FRACTURE INJURIES and collarbone. Remember a fractured bone and a broken bone are the same.
- If you had more than one injury at the same time then fill in 2 blocks.
- If you had an injury which you cannot fit into Sections A, B, C, or D, then fill in E.

A. CONCUSSION

B. MUSCLE INJURIES

	Neck	☐
Upper limb	Arm	☐
	Shoulder	☐
Lower limb	Groin	☐
	Thigh	☐
	Hamstring	☐
	Calf	☐
Trunk	Trunk	☐

C. LIGAMENT INJURIES

	Neck	☐
Upper limb	Shoulder	☐
	Elbow	☐
	Wrist	☐
	Finger	☐

Lower limb	Knee	☐
	Ankle	☐
	Trunk	☐

D. FRACTURE INJURIES

Head and neck	Head	☐
	Nose/Face	☐
	Neck vertebrae	☐
Upper limb	Collarbone	☐
	Humerus	☐
	Ulna	☐
	Radius	☐
	Wrist	☐
	Thumb	☐
	Finger	☐
Lower limb	Femur	☐
	Fibula	☐
	Tibia	☐
	Ankle	☐
	Toe	☐
Trunk	Ribs	☐
	Trunk vertebrae	☐

E. OTHER INJURIES NOT MENTIONED ABOVE

.....

State type of injury.

2. <u>ADDITIONAL INFORMATION REQUIRED</u>

2.1 Describe in a few words your injury. (i.e. what did the doctor say your injury was?) .....

.....

2.2 Did you see a doctor?

YES ☐

NO ☐

If you answered YES answer the following by putting a cross in the appropriate empty block/blocks:

Saw doctor during match ☐

Saw doctor at a hospital ☐

Saw a private practitioner ☐

Saw a specialist ☐

2.3 time that you will be off rugby (in days)

T	U

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The references have been divided into two sections. The first section, "Thesis References", contains publications cited in this thesis. The second section, "Additional References", contains publications not cited but which may be of use for other reasons and to other researchers. Also, by including the second section, an attempt was made to compile a complete list of publications on rugby injuries and related research.

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