



AFL INJURY REPORT 2001

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Dr John Orchard, Dr Hugh Seward, AFLMOA

Highlights:

- This report analyses in detail injuries in the AFL over the last ten seasons
- Documents a slight increase in missed playing time through injury for season 2001 compared to season 2000, but shows that historically season 2001 was below average with respect to numbers of injuries and time missed through injury
- Details the relationship between player age and injury, showing that despite a slightly different injury profile that younger players suffer less time missed through injury in the AFL than older players
- Details the relationship between match injuries and Penetrometer readings, showing only a minimal trend towards increased injuries on harder grounds

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INTRODUCTION

The AFL Injury Survey completed its tenth consecutive season in 2001, after being developed by the AFL out of a survey of Australian football, rugby league and rugby union injuries in 1992¹. It continues as the longest running multi-team survey of injuries in Australian sport, and leads the world of professional sport in terms of public disclosure and comprehensive publication of injury data². In addition to the tenth anniversary of surveillance, it is also the fifth continuous year of 100% compliance of all teams in the league with supplying a medical diagnosis for all games missed due to injury for all players.

The AFL approach to injuries has evolved over this ten-year period. The injury survey is still considered a 'core' item in terms of monitoring the state of injuries in the competition. However, where it once represented the entirety of research that was funded by the AFL, it now represents only a small fraction. The AFL's research budget is now over \$200,000 per annum. The injury survey maintains a critical position in terms of helping direct this funding appropriately to studying injuries that are common and/or severe in AFL players. It also is the ultimate reference as to whether evolutionary changes to the game of Australian football and the way that injuries are managed have led to changes in the burden of player injuries.

The most important secondary surveillance to have direct arisen from the injury survey is the monitoring of ground conditions at all AFL major venues. This monitoring also has distinguished the AFL as a world leader in ground safety research, and it is likely that it may have already had a casual association with a reduction in knee ACL injuries³.

METHODS

The methods of the injury survey are now well established and have been previously described in detail². The major change in methods for season 2001 from season 2000 was that the scope of the survey was expanded to include 'rookie list' players for the entire season (and not only when they were promoted to the 'senior list') and that AFL finals matches were included. These expansions were possible because the AFL monitoring of player movement expanded to include finals matches and rookie list players during the home and away season. Player movement monitoring essentially requires that all clubs define the status of each player each round to be either: (1) playing AFL football (2) playing football at a lower level (3) not playing football due to injury or (4) not playing football for another reason.

The definition of an injury was "any medical condition that prevents a player from participating in a regular season (home and away) or finals match". The major measurement of the number of injuries occurring is seasonal injury incidence measured in a unit of new injuries per club per season (where a club is defined as 40 players and a season is defined as 22 rounds). The major measurement of the amount of playing time missed through injury is injury prevalence measured in a unit of missed games per club per season, or alternatively percentage of players unavailable through injury. The recurrence rate is the number of recurrent injuries expressed as a percentage of the number of new injuries. A recurrent injury was an injury in the same injury category occurring on the same side of the body in a player during the same season. Therefore, by this definition, an injury of one type that recurred the following season was defined as a new injury in that next season.

Some minor changes to the categories of injury that various diagnoses were placed in were made in 2001, with the changes retrospectively applied to previous data. This means that there are some slight changes to injury category incidence and prevalence rates from last year's report, although these changes do not affect the overall injury incidence and prevalence.

As this report includes data from seasons 1992-1996, it should be noted that:

1. There were only 15 teams in the competition from 1992 to 1994 and therefore all teams had 2 byes during the season.
2. Teams only played 20 matches (not the usual 22) during the home and away season in 1993.
3. There were only 2 players permitted on the interchange bench in 1992-1993, and only 3 players permitted on the interchange bench in 1994-1997.
4. Only 12 out of 15 clubs participated in the injury survey in 1992, and only 14 out of 15 in 1993, and 15 out of 16 in 1995.
5. Some of the data from seasons 1992 to 1995 was obtained retrospectively by historical search during 1996-1998.
6. The AFL did not formally track 'player movement' prior to 1996, although it did keep records for matches played in the reserve grade competition (which involved the majority of teams), and records of numbers of injury payments made by clubs for players missing senior AFL matches. In 1992 and 1993 clubs were able to make substantial alterations to their list during the course of a season as a 'mid-season' draft existed.

RESULTS

Table 1 details player status on a weekly basis over the past decade. The 'average' status of a club list of 42 players in any given week over the last 10 years was: 33 players playing football per week, 7 missing through injury and 2 missing through other reasons (such as suspension, being used as a travelling emergency, team bye in lower grade etc.).

Status	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Playing AFL	20.0	20.0	21.0	21.0	21.0	21.0	22.0	22.0	22.0	22.0
Playing lower grade football	15.0	13.0	11.2	10.4	12.6	11.8	11.4	11.4	11.3	12.9
TOTAL playing	35.0	33.0	32.2	31.4	33.7	32.8	33.4	33.4	33.3	34.9
Not playing because of injury	7.6	6.2	5.6	6.4	7.0	7.7	6.7	6.4	6.2	6.7
Not playing for other reasons	1.7	1.4	1.7	0.7	1.0	1.9	1.6	1.8	1.8	1.8
TOTAL not playing	9.3	7.6	7.3	7.1	8.0	9.6	8.3	8.3	8.0	8.5
Players in injury survey (per club)	44.3	40.6	39.5	38.4	41.7	42.3	41.7	41.7	41.4	43.4
Injury prevalence (%)	17%	15%	14%	17%	17%	18%	16%	15%	15%	15%

Table 1 - Average weekly player status by season

Table 2 details the five most frequent injury types and the number of these occurring per 40-man club per 22-week season. Hamstring strains were the most common injury in every year of the survey, with generally 6 of these injuries occurring per club per season. Other lower-body muscle strains were also common, including groin strains, which are grouped together with osteitis pubis cases, due to the high amount of overlap between these two conditions. In the appendix, Table 10 lists the injury incidence for all injury categories.

Injury type	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Hamstring strains	6.7	5.4	6.3	6.8	6.0	6.8	6.3	6.7	5.7	5.9	6.3
Groin strains and osteitis pubis	2.7	2.0	3.1	3.3	3.6	4.1	3.2	3.1	3.0	3.4	3.2
Ankle sprains or joint injuries	2.4	2.3	1.6	2.1	2.7	2.7	2.8	2.1	2.7	2.0	2.4
Quadriceps strains	1.7	1.5	2.1	1.8	2.0	2.5	3.0	2.4	2.0	1.6	2.1
Calf strains	1.3	1.6	1.3	1.6	2.0	1.9	2.3	1.4	1.9	1.6	1.7
TOTAL INJURIES PER CLUB	39.6	36.4	38.8	40.9	43.1	41.9	40.3	36.9	37.4	35.6	39.1

Table 2 - Injury incidence (new injuries per club per season) for highest categories

Table 3 shows the high rate of recurrence of the most common injury types (particularly muscle strains) which lead to a high overall recurrence rate for injuries in the AFL as a whole. Table 12 in the appendix details the recurrence rate for all injuries, showing the many of the other injury types (such as fractures, concussion and 'cork' injuries) have a low recurrence rate. According to this table, ACL injuries also have a low recurrence rate, as the majority of these injuries do not return to play during the same season. Further research is currently under way to investigate why muscle strains recur so commonly.

Injury type	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Hamstring strains	46%	40%	31%	30%	24%	37%	36%	31%	38%	26%	33%
Groin strains and osteitis pubis	29%	41%	33%	27%	22%	36%	31%	6%	16%	21%	26%
Ankle sprains or joint injuries	9%	28%	4%	9%	11%	20%	21%	9%	11%	17%	14%
Quadriceps strains	35%	19%	15%	21%	26%	35%	20%	20%	18%	10%	22%
Calf strains	28%	26%	0%	20%	15%	15%	15%	17%	32%	17%	18%
ALL INJURIES	22%	20%	16%	15%	12%	20%	19%	14%	16%	15%	17%

Table 3 - Recurrence rates (recurrent injuries as a percentage of new injuries)

Table 4 shows the major injuries accounting for the most missed playing time in the AFL. It should be noted that prior to 1997, not all instances of players missing matches through injury had a diagnosis determined (Table 10 – second last row). In all but one year of the decade, hamstring strains accounted for the most missed playing time. In 1996, there was more time missed through knee ACL injuries than hamstring strains. Whereas hamstring strains have shown a fairly steady injury prevalence over the decade, knee ACL injuries vary far more from season to season. The highest injury prevalence for knee ACL injuries was in 1997 and the lowest prevalence was in 2000. Groin injuries (including osteitis pubis) was the third most prevalent category of injuries across the decade. These injuries accounted for more missed time in 2001 than in an average year, but below their peak in 1997. Two other major injury categories showed divergent trends in 2001 – knee cartilage injuries were at their highest prevalence for the decade, whereas quadriceps strains were at their lowest prevalence for the decade. The full comparison of injury prevalence can be seen in the appendix in Table 10.

Injury type	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Hamstring strains	20.7	19.0	16.9	19.6	17.6	21.0	20.8	21.2	22.8	21.3	20.1
Knee ACL	15.2	5.5	10.1	14.3	17.9	19.8	15.8	10.8	4.8	13.7	12.9
Groin strains and osteitis pubis	11.5	8.2	10.3	10.1	10.8	17.4	13.8	9.4	7.4	13.7	11.3
Knee cartilage	9.1	4.6	5.9	7.6	6.8	4.0	5.6	5.3	8.6	12.5	7.1
Quadriceps strains	7.1	4.5	6.1	4.5	6.9	8.6	9.5	6.7	5.6	3.8	6.3
MISSED GAMES PER CLUB	146.0	122.5	116.3	133.1	146.4	159.2	141.9	135.9	131.8	136.8	137.2

Table 4 - Injury prevalence (missed games per club per season) for highest categories

Average injury severity for the major injury categories is shown in Table 5, and for all injuries in the appendix in Table 13. Most injuries show consistent injury severity from season to season, whereas ACL injuries vary considerably, depending on whether most of these injuries, in a given year, occur at the start of, or later in, the season. ACL injuries will generally cause a player to miss the entire season after having a knee reconstruction, although there are occasional exceptions to this rule.

Injury type	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Hamstring strains	3.1	3.5	2.7	2.9	2.9	3.1	3.3	3.2	4.0	3.6	3.2
Knee ACL	12.4	7.8	12.4	15.1	14.4	16.8	18.8	16.4	9.9	15.6	14.4
Groin strains and osteitis pubis	4.2	4.0	3.3	3.1	3.0	4.3	4.3	3.0	2.5	4.0	3.6
Knee cartilage	6.6	4.1	3.9	4.3	4.3	4.3	4.9	4.6	7.1	6.5	5.1
Quadriceps strains	4.3	3.0	2.9	2.4	3.4	3.4	3.2	2.8	2.8	2.3	3.0
ALL INJURIES	3.7	3.4	3.0	3.2	3.4	3.8	3.5	3.7	3.5	3.8	3.5

Table 5 - Injury severity (matches missed per new injury)

Table 6 shows that two major ‘types’ of injury account for a high proportion of missed time (joint/ligament injuries and muscle/tendon stress injuries). Bony injuries (both traumatic and stress fractures) account for a surprisingly low amount of missed playing time.

Category	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Joint/ligament	56.1	40.9	43.3	46.9	58.4	59.0	52.8	50.0	50.6	60.6	52.1
Muscle/tendon stress	46.1	42.3	39.8	44.7	46.1	62.3	57.7	47.9	49.3	47.4	48.6
Stress fractures	8.6	7.9	6.6	3.9	4.7	6.1	4.3	7.0	3.8	4.6	5.7
Traumatic fractures	14.5	12.6	12.3	20.6	20.0	14.8	16.8	20.5	17.4	16.3	16.7
Soft tissue trauma	5.0	3.7	3.1	5.8	7.3	8.6	4.6	5.0	6.4	2.7	5.2
Other medical	5.8	2.6	3.4	7.2	6.9	8.4	5.7	5.5	4.3	5.1	5.5
ALL INJURIES	146.0	122.5	116.3	133.4	146.4	159.2	141.9	135.9	131.8	136.7	137.3

Table 6 - Injury prevalence by type of injury

Table 7 shows clearly that player age is a risk factor for many injury types. Hamstring strains, calf strains, lumbar spine and knee cartilage injuries are particularly much more common in older players, making the overall burden of injury much greater in players aged 24 and over compared to those 23 and younger. There are certain injuries that follow a reverse pattern, particularly stress fractures, which are more common in younger players. Groin strains and osteitis pubis are slightly more common in younger players, although they are much more evenly distributed than hamstring and calf strains. A full comparison of player age and injury prevalence is shown in Table 14.

Age group	Injury category	<21	21-23	24-26	27-29	30+
Injuries affecting more younger players	A/C joint injuries	2.6	2.2	1.9	1.5	1.2
	Fractured clavicles	1.8	1.3	1.2	1.5	0.8
	Groin strains and osteitis pubis	12.0	10.8	12.9	8.8	10.3
	Leg and foot stress fractures	6.9	6.3	3.6	1.9	0.0
Injuries affecting more older players	Rib and chest wall injuries	1.4	1.5	1.9	1.8	2.7
	Lumbar and thoracic spine injuries	4.5	4.0	7.2	11.5	13.3
	Hamstring strains	15.0	17.8	24.6	27.3	32.3
	Knee cartilage	5.6	3.4	10.1	13.6	8.6
	Calf strains	1.8	2.2	6.5	10.1	12.0
	Achilles tendon injuries	0.5	0.5	2.7	2.2	5.5
	TOTAL MISSED GAMES	115.3	127.2	151.6	157.2	169.1

Table 7 - Injury prevalence by player age

Over the past 4 seasons, the major AFL venues have recorded Penetrometer readings prior to games to assess the risk of injury and its relationship to ground hardness. The most accurate and valuable measurement has been the first drop reading of the Penetrometer 3. This study was undertaken in response to the finding that the overall injury prevalence was consistently higher in the teams based in northern states compared to teams based in Victoria 4. It was hypothesized that perhaps grounds are generally harder in the northern venues, which might lead to greater injury rates. The relationship of injury risk to Penetrometer readings is not strong (Tables 8 and 15). With the possible exception of knee ACL injuries and calf strains, there has been little correlation between Penetrometer readings and injury risk to date (Table 8). There is a tiny increase in overall injury rate on grounds with harder readings compared to grounds with softer readings, but it is not enough to clearly explain the difference in injury risk based on location. Ground analysis has also found that there is only a small correlation between location (state) and ground hardness, with some non-Victorian grounds often showing softer readings and some Victorian grounds harder readings 3. Unfortunately, Penetrometer readings have not proven to be a simple method for classifying (and therefore lowering) injury risk. Factors other than ground hardness are almost certainly involved in the relationship between ground conditions and injury, including grass type, grass density, player boot selection, water evaporation and rainfall 3-5 and also speed of the game 6 7. Nevertheless, ongoing monitoring of ground hardness, and publication of results of any correlation with injury risk, will occur at AFL matches in a continued effort to monitor and reduce injuries.

Injury category	Harder (2.5 or less)	Medium (2.6-3.0)	Softer (3.1 or greater)
Concussion	0.8	0.8	0.7
Facial fractures	0.3	0.4	1.2
Hamstring strains	5.0	5.0	3.5
Knee ACL	0.9	0.7	0.5
Knee MCL	1.0	1.0	1.3
Ankle sprains or joint injuries	1.8	2.3	2.0
Calf strains	1.5	1.0	0.8
ALL INJURIES	26.8	25.4	23.5

Table 8 – Injury match incidence (injuries per 1000 player hours) by first drop of Penetrometer

Although injury rates for most injuries do not show much variation between grounds, there is a high variation between rates of ACL injuries between grounds in Victoria and grounds in the northern states (Table 9). All non-Victorian grounds have a higher rate of ACL injuries over the decade 1992-2001, particularly when those that occur from a non-contact mechanism are considered.

Subiaco Oval had 11 ACL injuries occur in matches over the decade, although remarkably 5 of these occurred during season 2001. However, because 4 of the 5 injuries in 2001 involved contact between players, this occurrence of so many ACL injuries at the one ground in the one season probably involves a great deal of chance. In 1997 at the MCG there were 6 ACL injuries (3 with non-contact and 3 with contact mechanisms) although it is expected that this ground would have more injuries than other grounds as it hosts the highest number of matches.

Ground name	1992-2001		ACL Injury rate/1000 games		
	ACL Injuries	Games	All mechanisms	Non-contact	Contact
Colonial Stadium	3	100	30.0	10.0	20.0
Football Park	11	192	57.3	41.7	15.6
Gabba	5	113	44.2	44.2	0.0
Kardinia Park	2	90	22.2	11.1	11.1
MCG	23	546	42.1	18.3	23.8
Optus Oval	3	172	17.4	11.6	5.8
SCG	11	123	89.4	48.8	40.7
Subiaco Oval	11	149	73.8	33.6	40.3
Waverley Park	10	283	35.3	21.2	14.1
ALL MAJOR GROUNDS	79	1768	44.7	24.9	21.1

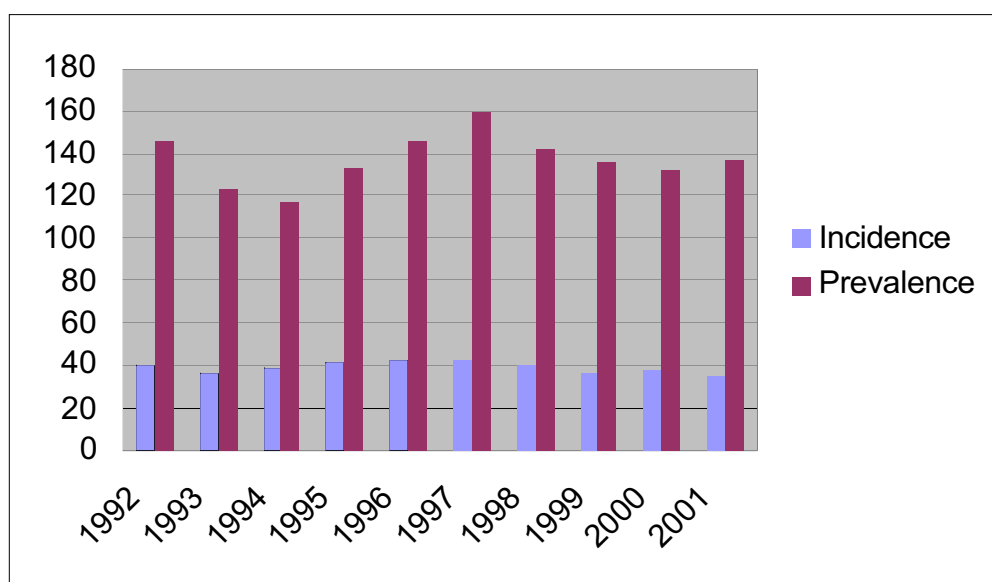
Table 9 – Ground ACL injury incidence (injuries per 1000 games) during senior matches

DISCUSSION

Overall injury rates

The overall injury rates (incidence and prevalence) in the AFL have stayed fairly constant over the last decade. There was a decreasing trend in the overall injury prevalence over the periods 1992-1994 and 1997-2000, with a sharper increase over the period 1994-1997. Although player movement recording (for all listed players) was only introduced in 1996, numbers of senior player matches missed through injury per club have been tallied by the AFL since 1988. The injury payment figures prior to the injury survey, for 1990 and 1991, were both higher than 1992, suggesting that the overall injury prevalence probably decreased between 1990 and 1994.

The relationship between overall injury rate and overall speed of the game has been discussed and studied by Kevin Norton and associates over the past few seasons, including studies funded as part of the AFL research and development program^{6,7}. This group has undertaken innovative work which has found that the overall speed of the game has increased over the past 30 years⁷ and that the overall speed of the game has a positive correlation with ground hardness⁶. Although this group has suggested that injuries are probably more common and severe today than 30 years ago, which is a popular and sensible theory, unfortunately there is no data from 30 years ago that can be used to assess whether this is actually the case. Whilst this group has quite clearly shown that the speed of the game, size of players and number of collisions have all increased in modern football^{6,7}, hopefully medical and rehabilitation advances have had an effect to counteract these trends in terms of the overall injury burden on players.

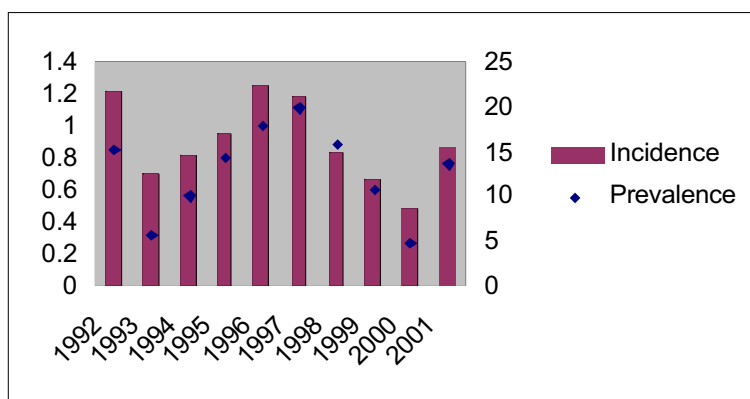


Knee Anterior Cruciate Ligament (ACL) injuries

The injury prevalence rates over the 1990s suggest that there are upwards and downwards trends in injury rates from year-to-year. The external measurement that has shown the greatest correlation with these trends has in fact been weather conditions^{5,8}. In seasons where there has been higher rainfall in the preceding 12 months in Melbourne, the rates of knee ACL injuries have been lower⁵. The seasons in which there are higher rates of knee ACL injuries (Figure 2) tend to be seasons with high rates of injuries overall (Figure 1), as knee ACL injury prevalence varies significantly from year to year, whereas the rates of other prevalent injuries (such as muscle strains) are far more consistent. Although this observation suggests that softer grounds may be the mechanism by which injury rates vary, the results of the Penetrometer study to date do not show a strong correlation between ground hardness and injury. It is likely that grass cover and traction also play an important role. Perhaps in seasons where there is less rainfall, the grass root density is thicker, and players can gain more traction. These theories need to be further tested over coming years.

There is a strong relationship between location and the risk of ACL injury, with all non-Victorian venues showing a higher risk for ACL injury than the Victorian venues 3-5. This relationship has prompted further study of ground conditions to try to reverse the trend. There has been a lowering of the rate of ACL injuries in the competition as a whole since the 1997 season, which may be partially as a result of extra measures to soften the grounds, water the grounds more often, and to promote rye grass over couch grass. Nevertheless, the difference in the ACL injury rates between Victorian and non-Victorian venues remains, suggesting that it may not be possible to totally counteract the forces of nature.

Although it is likely that there is a significant relationship between ground conditions and ACL injuries that we do not fully understand to date, a much stronger relationship is well established between individual injury history and ACL injury risk ⁸. Unfortunately, players who are returning from ACL injury have a 10-times greater risk of recurrence in the immediate months after their return, and have a lifetime 4-times greater risk of both re-injury of the same knee ACL and also of the opposite knee ACL ⁸. Further research is under way (as part of the AFL research and development program) to analyse the relationship between player movement skills and risk of ACL injury. It is obviously a tragic event for an individual to suffer multiple episodes of ACL injury, and therefore this injury will remain a priority for future AFL research.



Groin injuries and osteitis pubis

Osteitis pubis has been the focus of intense media interest over the last 12 months. Although there has allegedly been an ‘epidemic’ of this injury, the AFL injury data shows that groin injuries have always been common in the AFL over the past 10 years. The explanation for the osteitis pubis phenomenon is almost certainly that there has recently been more consensus amongst AFL medical staff with respect to diagnosis of groin injuries. Whereas in the 1990s a variety of different theories were used to explain the occurrence of chronic groin pain ⁹, there is more agreement that the primary pathology is a chronic overuse injury that involves the bony part of the pubic symphysis (hence the name ‘osteitis pubis’). A study published by Geoff Verrall and associates has been influential in this change of approach towards groin pain amongst AFL medical staff ¹⁰.

There has also been concern at the apparently high prevalence of injury amongst very young players of osteitis pubis, and the AFL injury surveillance data supports the theory that this is a prevalent injury in young players. This injury may stand out more in younger players because across the board, the injury prevalence for younger players is generally much lower than for older players (Table 7).

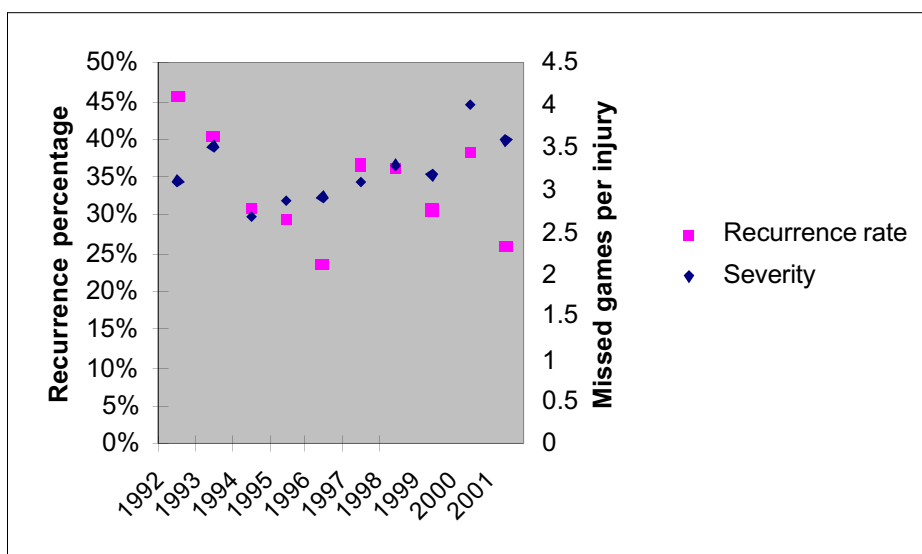
The data from the injury survey support the notion that groin injuries and osteitis pubis should be priority areas of AFL research funding over the next few seasons.

Hamstring strains

Hamstring strains remain the no. 1 injury in the AFL, and are also currently a priority area of AFL research funding, with 3 major studies of hamstring strains in progress. Previous analysis of hamstring and other muscle strain data shows a high rate of recurrence 11-14. The current AFL data shows that management of these injuries has become more conservative over the last decade in the AFL. The amount of time that players miss per injury has increased over the last ten years, whereas the recurrence rate has decreased (Figure 3). A trade-off between early return and risk of recurrence has been described 14.

The data presented in this report confirms the findings of previous studies that hamstring muscle strains, along with calf muscle strains, are both far more common in older players 11-13. It is thought that there is a relationship between lumbar spine problems, which are also common in older players, and hamstring injuries, but this relationship is still poorly understood.

A recent study has found that hamstring strains are more common amongst Aboriginal players 11. Although there may be some genetic predisposition, a contributing factor may also be that Aboriginal players are more likely to play in 'speed' type roles (such as forward pocket/goal sneak). Positional analysis of injuries has not been performed over most of the last decade, because of the increasing redundancy of the named positions in the official line-ups. It is possible in the future that an accurate picture of player role may be able to be assessed retrospectively from game statistics (e.g. midfielder = player with a high number of overall possessions and centre clearances, forward = player with a high number of shots on goal).



Conclusion

The AFL injury survey has completed a successful decade of data collection and analysis. The AFL injury profile has been clearly defined and published in both the sports medicine scientific literature and in public media releases. Hamstring injuries, knee ACL injuries and groin injuries (including osteitis pubis) are the most prevalent injuries in AFL players. The AFL has directed substantial further funding towards these areas. The speed of the game is probably increasing and potentially driving the injury rates in the AFL higher, but to counteract this, medical and scientific breakthroughs are helping to relieve the injury burden on AFL players.

Acknowledgments:

The authors and AFL Medical Officers would like to acknowledge the following people who contributed to the survey in 2001: Peter Waldie and Dr Brian Sando (trainer and doctor, Adelaide), Peter Stanton (physiotherapist, Brisbane), Dr Phil Perlstein (doctor, Carlton), Dr Andrew Jowett (doctor, Collingwood), Bruce Connor (physiotherapist, Essendon), Dr Ken Withers and Norm Tame (doctor and football staff, Fremantle), Dr Jeanne McGivern and Dr Hugh Seward (doctors, Geelong), Chris Ward (physiotherapist, Hawthorn), Dr Andrew Daff (doctor, Melbourne), Dr Con Mitropolous (Kangaroos), Andrew Russell (physiotherapist, Port Adelaide), Dr Tim Barbour (doctor, Richmond), Dr Ian Stone (doctor, St. Kilda), Matt Cameron (physiotherapist, Sydney), Dr Rod Moore and Bill Sutherland (doctors and trainer, West Coast Eagles), Dr Gary Zimmerman (doctor, Western Bulldogs), Professor Ken Hardy, Dr Peter Harcourt (AFL Medical Commission), Rod Austin, Jill Lindsay and Andrew Demetriou (AFL administration), all those acknowledged in the injury reports for previous years (particularly Dr Tim Wood who had a major administrative role during the early years of the injury survey) and all AFL Ground managers and ground staff.

Appendix – Detailed tables

Table 9 – Injury incidence (new injuries per club per season)

Injury type	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Head/neck											
Concussion	1.3	0.9	0.8	0.9	0.9	0.6	0.7	0.5	0.6	0.7	0.8
Facial fractures	0.8	0.6	0.8	0.6	0.6	0.8	0.7	0.8	0.7	0.4	0.7
Neck sprains	0.3	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1
Other head and neck injuries	0.1	0.0	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.3	0.1
Shoulder/arm/elbow											
Shoulder sprains and dislocations	0.9	0.7	0.6	0.6	0.7	1.0	0.9	0.7	0.7	1.1	0.8
A/C joint injuries	0.9	0.6	1.0	0.9	1.2	0.9	0.9	0.6	1.3	0.9	0.9
Fractured clavicles	0.2	0.1	0.2	0.1	0.2	0.4	0.4	0.3	0.5	0.3	0.3
Elbow sprains or joint injuries	0.1	0.1	0.1	0.1	0.4	0.2	0.1	0.1	0.1	0.2	0.2
Other shoulder/arm/elbow injuries	0.5	0.2	0.5	0.6	0.5	0.6	0.5	0.2	0.5	0.5	0.5
Forearm/wrist/hand											
Forearm/wrist/hand fractures	1.0	0.8	1.2	1.5	2.2	1.1	1.7	1.7	1.4	0.8	1.3
Other forearm/wrist/hand injuries	0.6	0.2	0.6	0.4	0.1	0.4	0.4	0.4	0.7	0.3	0.4
Rib and chest wall injuries	1.2	1.1	0.7	1.1	0.9	1.2	0.6	1.0	0.8	0.5	0.9
Lumbar and thoracic spine injuries	1.4	1.1	1.8	1.7	2.0	1.8	1.7	1.7	2.3	1.5	1.7
Other trunk/back/buttock injuries	0.9	0.1	0.4	0.9	0.5	1.0	0.9	0.8	0.6	0.4	0.7
Hip/groin/thigh											
Groin strains and osteitis pubis	2.7	2.0	3.1	3.3	3.6	4.1	3.2	3.1	3.0	3.4	3.2
Hamstring strains	6.7	5.4	6.3	6.8	6.0	6.8	6.3	6.7	5.7	5.9	6.3
Quadriceps strains	1.7	1.5	2.1	1.8	2.0	2.5	3.0	2.4	2.0	1.6	2.1
Thigh and hip haematomas	1.8	0.9	1.0	1.4	1.5	1.3	1.3	1.1	1.1	0.6	1.2
Other groin/hip/thigh injuries	0.1	0.3	0.2	0.1	0.2	0.4	0.2	0.3	0.3	0.3	0.2
Knee											
Knee ACL	1.2	0.7	0.8	0.9	1.2	1.2	0.8	0.7	0.5	0.9	0.9
Knee MCL	1.1	1.8	1.0	1.2	1.0	0.7	1.3	1.2	0.9	1.2	1.1
Knee PCL	0.5	0.3	0.5	0.6	0.6	0.6	0.3	0.7	0.5	1.0	0.6
Knee cartilage	1.4	1.1	1.5	1.8	1.6	0.9	1.1	1.1	1.2	1.9	1.4
Patella instability	0.1	0.3	0.3	0.4	0.5	0.2	0.4	0.1	0.2	0.2	0.3
Knee and patella tendon injuries	0.1	0.4	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.5	0.5
Other knee injuries	0.8	1.1	0.9	0.8	1.1	1.4	0.4	0.9	1.3	0.8	0.9
Shin/ankle/foot											
Ankle sprains or joint injuries	2.4	2.3	1.6	2.1	2.7	2.7	2.8	2.1	2.7	2.0	2.4
Calf strains	1.3	1.6	1.3	1.6	2.0	1.9	2.3	1.4	1.9	1.6	1.7
Achilles tendon injuries	0.4	0.6	0.6	0.3	0.4	0.4	0.3	0.5	0.4	0.2	0.4
Leg and foot fractures	0.7	0.5	0.5	1.0	0.6	0.5	0.8	1.1	0.6	1.0	0.7
Leg and foot stress fractures	0.7	0.9	1.1	0.7	0.6	0.8	0.7	0.8	0.5	0.9	0.8
Other leg/foot/ankle injuries	0.9	1.4	1.1	2.3	1.2	1.9	1.7	1.3	1.4	1.7	1.5
Medical illness/Medical illnesses	0.9	0.4	0.8	1.1	3.0	2.5	2.8	1.6	1.9	1.8	1.7
Unaccounted injuries	4.1	6.1	5.1	2.6	2.4	0.0	0.0	0.0	0.0	0.0	1.9
TOTAL INJURIES PER CLUB	39.6	36.4	38.8	40.9	43.1	41.9	40.3	36.9	37.4	35.6	39.1

Table 10 – Injury prevalence (missed games per club per season)

Body category	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Head/neck											
Concussion	2.0	1.3	0.9	0.8	1.3	0.7	0.7	0.5	0.7	1.3	1.0
Facial fractures	3.7	1.3	2.7	2.0	1.5	2.5	2.1	2.3	2.0	1.3	2.1
Neck sprains	0.3	0.1	0.1	0.4	0.2	0.7	0.7	1.6	0.3	0.2	0.5
Other head and neck injuries	0.1	0.0	0.3	0.7	0.1	0.3	0.2	0.4	0.8	1.5	0.5
Shoulder/arm/elbow											
Shoulder sprains and dislocations	5.9	3.9	4.0	2.7	3.1	5.3	5.9	5.6	4.0	5.4	4.6
A/C joint injuries	2.0	1.7	1.9	2.4	2.8	2.2	2.1	0.9	3.1	2.1	2.1
Fractured clavicles	1.4	0.8	1.3	1.0	1.1	1.4	1.6	1.2	3.0	1.6	1.5
Elbow sprains or joint injuries	0.3	0.9	0.1	1.1	0.7	1.2	0.2	0.1	0.4	0.5	
Other shoulder/arm/elbow injuries	1.3	0.5	1.1	2.1	1.1	2.4	1.9	0.3	1.3	1.3	1.3
Forearm/wrist/hand											
Forearm/wrist/hand fractures	3.5	3.2	3.3	6.4	9.8	4.1	5.4	5.9	5.6	2.8	5.0
Other forearm/wrist/hand injuries	2.2	0.4	1.1	0.7	0.4	0.7	1.3	0.9	1.8	0.3	1.0
Trunk/back											
Rib and chest wall injuries	2.2	2.4	1.3	1.8	1.1	2.8	1.0	2.0	1.3	0.8	1.7
Lumbar and thoracic spine injuries	5.5	4.7	2.8	5.9	5.6	9.7	4.7	8.5	8.5	5.8	6.2
Other trunk/back/buttock injuries	1.7	0.1	0.4	2.1	2.4	5.8	1.6	2.7	2.1	1.4	2.1
Hip/groin/thigh											
Groin strains and osteitis pubis	11.5	8.2	10.3	10.1	10.8	17.4	13.8	9.4	7.4	13.7	11.3
Hamstring strains	20.7	19.0	16.9	19.6	17.6	21.0	20.8	21.2	22.8	21.3	20.1
Quadriceps strains	7.1	4.5	6.1	4.5	6.9	8.6	9.5	6.7	5.6	3.8	6.3
Thigh and hip haematomas	2.4	1.4	1.1	2.2	2.5	2.4	1.8	1.5	1.8	0.6	1.8
Other groin/hip/thigh injuries	0.1	1.3	0.7	0.1	0.8	1.7	0.5	2.3	1.4	1.7	1.1
Knee											
Knee ACL	15.2	5.5	10.1	14.3	17.9	19.8	15.8	10.8	4.8	13.7	12.9
Knee MCL	3.6	6.1	4.7	2.9	4.0	3.3	4.3	3.3	3.5	4.8	4.0
Knee PCL	3.5	2.4	3.4	2.0	3.3	1.9	2.2	5.2	2.3	5.9	3.2
Knee cartilage	9.1	4.6	5.9	7.6	6.8	4.0	5.6	5.3	8.6	12.5	7.1
Patella instability	1.1	1.3	1.3	1.1	4.3	0.9	1.6	0.8	1.8	0.8	1.5
Knee and patella tendon injuries	0.1	0.6	1.1	1.6	3.1	2.4	1.6	3.9	3.9	2.5	2.1
Other knee injuries	2.9	3.5	2.4	1.6	2.3	3.9	1.2	2.2	3.6	2.5	2.6
Shin/ankle/foot											
Ankle sprains or joint injuries	6.5	6.1	4.3	6.1	7.3	7.2	6.9	3.9	6.8	4.3	5.9
Calf strains	3.5	4.3	2.4	4.4	4.6	5.8	6.4	3.4	5.7	3.4	4.4
Achilles tendon injuries	0.9	3.5	2.0	0.3	1.5	1.3	1.4	1.3	1.6	0.7	1.4
Leg and foot fractures	4.3	4.6	3.6	8.8	6.0	2.6	5.4	8.8	4.6	7.2	5.6
Leg and foot stress fractures	7.2	7.5	6.0	3.0	4.2	4.9	4.0	6.7	3.8	4.4	5.1
Other leg/foot/ankle injuries	2.2	3.9	2.3	4.8	2.6	6.4	5.1	3.1	4.1	4.2	3.9
Medical illness											
Medical illnesses	2.2	0.9	1.5	4.4	5.3	4.2	3.7	3.3	2.8	2.6	3.1
Unaccounted missed games	9.9	12.6	7.8	4.4	2.8	0.0	0.0	0.0	0.0	0.0	3.5
MISSED GAMES PER CLUB	146.0	122.5	116.3	133.1	146.4	159.2	141.9	135.9	131.8	136.8	137.2

Table 11 – Recurrence rate (recurrent injuries as a percentage of new injuries)

Body area	Injury category	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Head/neck	Concussion	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%
	Facial fractures	0%	0%	8%	0%	0%	0%	9%	0%	0%	0%	2%
	Neck sprains	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	4%
Shoulder/arm/elbow	Other head and neck injuries	0%	0%	0%	0%	0%	0%	0%	33%	0%	0%	4%
	Shoulder sprains and dislocations	42%	20%	11%	11%	8%	12%	13%	27%	17%	10%	17%
	A/C joint injuries	8%	11%	6%	7%	5%	6%	0%	0%	0%	12%	5%
	Fractured clavicles	33%	0%	67%	0%	0%	0%	0%	20%	38%	20%	22%
	Elbow sprains or joint injuries	0%	0%	0%	0%	0%	25%	0%	0%	0%	25%	8%
	Other shoulder/arm/elbow injuries	14%	33%	13%	0%	0%	18%	33%	33%	11%	0%	13%
Forearm/wrist/hand	Forearm/wrist/hand fractures	7%	8%	11%	9%	14%	0%	10%	7%	0%	0%	7%
	Other forearm/wrist/hand injuries	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trunk/back	Rib and chest wall injuries	0%	27%	0%	6%	0%	5%	0%	13%	0%	11%	6%
	Lumbar and thoracic spine injuries	15%	50%	4%	30%	18%	30%	18%	10%	16%	21%	20%
Hip/groin/thigh	Other trunk/back/buttock injuries	0%	0%	0%	36%	22%	6%	20%	0%	20%	14%	13%
	Groin strains and osteitis pubis	29%	41%	33%	27%	22%	36%	31%	6%	16%	21%	26%
	Hamstring strains	46%	40%	31%	30%	24%	37%	36%	31%	38%	26%	33%
	Quadriceps strains	35%	19%	15%	21%	26%	35%	20%	20%	18%	10%	22%
	Thigh and hip haematomas	8%	8%	0%	5%	4%	9%	5%	0%	0%	0%	4%
	Other groin/hip/thigh injuries	0%	50%	67%	0%	0%	14%	67%	0%	20%	20%	24%
Knee	Knee ACL	0%	10%	0%	7%	5%	0%	0%	0%	0%	0%	2%
	Knee MCL	7%	15%	13%	0%	0%	33%	14%	10%	7%	9%	10%
	Knee PCL	43%	0%	50%	56%	10%	10%	0%	25%	13%	11%	26%
	Knee cartilage	58%	25%	25%	21%	7%	38%	42%	16%	0%	26%	25%
	Patella instability	50%	0%	25%	0%	38%	0%	0%	0%	67%	0%	17%
	Knee and patella tendon injuries	0%	17%	40%	14%	14%	33%	0%	27%	33%	78%	29%
Shin/ankle/foot	Other knee injuries	45%	13%	14%	0%	16%	9%	0%	0%	9%	14%	12%
	Ankle sprains or joint injuries	9%	28%	4%	9%	11%	20%	21%	9%	11%	17%	14%
	Calf strains	28%	26%	0%	20%	15%	15%	15%	17%	32%	17%	18%
	Achilles tendon injuries	60%	38%	20%	0%	17%	50%	20%	11%	14%	0%	23%
	Leg and foot fractures	20%	0%	25%	13%	10%	0%	23%	16%	0%	5%	12%
	Leg and foot stress fractures	40%	0%	12%	18%	10%	7%	33%	31%	11%	18%	17%
Medical illness	Other leg/foot/ankle injuries	23%	5%	35%	8%	0%	13%	7%	5%	9%	10%	10%
	Medical illnesses	33%	0%	15%	6%	0%	5%	11%	4%	13%	3%	7%
ALL INJURIES		22%	20%	16%	15%	12%	20%	19%	14%	16%	15%	17%

Table 12 – Injury severity (average matches missed per new injury)

Body area	Injury category	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Av.
Head/neck	Concussion	1.6	1.4	1.1	0.9	1.4	1.1	1.0	1.1	1.1	1.8	1.3
	Facial fractures	4.6	2.0	3.3	3.2	2.5	3.0	3.2	2.9	2.8	3.3	3.1
	Neck sprains	1.0	1.0	2.0	3.0	2.0	6.0	3.7	8.7	1.7	1.5	3.2
Shoulder/arm/elbow	Other head and neck injuries	1.0	0.0	4.0	3.7	1.0	1.3	1.3	2.0	7.0	5.4	3.1
	Shoulder sprains and dislocations	6.8	5.5	7.1	4.8	4.4	5.3	6.5	8.5	5.6	4.9	5.9
	A/C joint injuries	2.3	2.7	1.9	2.5	2.3	2.3	2.3	1.5	2.5	2.3	2.3
Forearm/wrist/hand	Fractured clavicles	6.3	6.0	6.7	8.0	4.5	3.8	3.9	4.0	6.3	6.0	5.2
	Elbow sprains or joint injuries	1.0	2.0	15.0	1.0	3.0	3.0	10.0	2.0	2.0	1.8	3.4
	Other shoulder/arm/elbow injuries	2.6	2.3	2.1	3.4	2.4	3.7	3.4	1.7	2.3	2.6	2.8
Trunk/back	Forearm/wrist/hand fractures	3.5	3.8	2.8	4.4	4.5	3.8	3.1	3.5	4.0	3.4	3.7
	Other forearm/wrist/hand injuries	3.9	1.7	2.0	1.6	3.5	1.7	3.5	2.5	2.7	1.0	2.4
	Rib and chest wall injuries	1.9	2.3	1.9	1.7	1.3	2.4	1.7	2.1	1.6	1.6	1.9
Hip/groin/thigh	Lumbar and thoracic spine injuries	3.8	4.1	1.6	3.5	2.9	5.5	2.8	4.9	3.7	3.8	3.6
	Other trunk/back/buttock injuries	1.9	1.0	1.0	2.4	4.4	5.8	1.7	3.5	3.5	3.6	3.2
	Groin strains and osteitis pubis	4.2	4.0	3.3	3.1	3.0	4.3	4.3	3.0	2.5	4.0	3.6
Knee	Hamstring strains	3.1	3.5	2.7	2.9	2.9	3.1	3.3	3.2	4.0	3.6	3.2
	Quadriceps strains	4.3	3.0	2.9	2.4	3.4	3.4	3.2	2.8	2.8	2.3	3.0
	Thigh and hip haematomas	1.3	1.5	1.1	1.6	1.7	1.8	1.4	1.3	1.6	1.0	1.5
Shin/ankle/foot	Other groin/hip/thigh injuries	1.0	4.5	3.7	1.0	4.3	4.0	3.0	7.6	4.6	6.2	4.7
	Knee ACL	12.4	7.8	12.4	15.1	14.4	16.8	18.8	16.4	9.9	15.6	14.4
	Knee MCL	3.3	3.3	4.7	2.4	4.0	4.7	3.4	2.8	3.9	4.0	3.6
Medical illness	Knee PCL	7.0	8.5	6.8	3.6	5.5	3.3	7.4	7.2	4.8	5.9	5.8
	Knee cartilage	6.6	4.1	3.9	4.3	4.3	4.3	4.9	4.6	7.1	6.5	5.1
	Patella instability	7.5	4.8	5.3	3.0	9.1	4.0	4.3	7.0	10.0	5.0	5.9
ALL INJURIES	Knee and patella tendon injuries	1.0	1.5	3.6	3.6	7.4	4.4	2.6	5.9	5.4	5.1	4.5
	Other knee injuries	3.6	3.3	2.8	2.0	2.1	2.9	2.9	2.4	2.7	3.2	2.8
	Ankle sprains or joint injuries	2.7	2.7	2.6	2.8	2.7	2.7	2.4	1.9	2.5	2.2	2.5
ALL INJURIES	Calf strains	2.7	2.7	1.9	2.8	2.3	3.0	2.7	2.4	3.1	2.1	2.6
	Achilles tendon injuries	2.6	6.1	3.2	1.3	4.3	3.7	4.8	2.4	3.9	3.0	3.6
	Leg and foot fractures	5.9	9.3	7.3	8.8	10.2	4.9	6.9	7.7	7.6	6.9	7.5
ALL INJURIES	Leg and foot stress fractures	9.9	8.2	5.6	4.4	7.1	5.9	5.5	8.6	7.0	4.8	6.6
	Other leg/foot/ankle injuries	2.4	2.8	2.2	2.1	2.1	3.4	2.9	2.4	3.0	2.5	2.6
	Medical illnesses	2.6	2.2	1.8	4.1	1.8	1.7	1.3	2.0	1.4	1.4	1.8
ALL INJURIES		3.7	3.4	3.0	3.2	3.4	3.8	3.5	3.7	3.5	3.8	3.5

Table 13 – Injury prevalence by player age

Body area	Injury category	<21	21-23	24-26	27-29	30+
Head/neck	Concussion	1.1	0.9	0.9	0.8	1.5
	Facial fractures	1.5	2.7	2.3	2.3	2.0
	Neck sprains	0.3	0.2	0.3	0.8	2.6
	Other head and neck injuries	0.4	0.0	0.1	1.0	0.4
Shoulder/arm/elbow	Shoulder sprains and dislocations	4.4	4.6	5.5	4.0	4.0
	A/C joint injuries	2.6	2.2	1.9	1.5	1.2
	Fractured clavicles	1.8	1.3	1.2	1.5	0.8
	Elbow sprains or joint injuries	0.7	0.2	0.7	0.6	0.2
	Other shoulder/arm/elbow injuries	1.2	1.4	0.9	2.1	2.1
Forearm/wrist/hand	Forearm/wrist/hand fractures	5.6	4.2	3.9	6.1	7.5
	Other forearm/wrist/hand injuries	1.0	1.2	1.0	0.5	0.4
Trunk/back	Rib and chest wall injuries	1.4	1.5	1.9	1.8	2.7
	Lumbar and thoracic spine injuries	4.5	4.0	7.2	11.5	13.3
	Other trunk/back/buttock injuries	1.3	1.3	3.8	3.1	1.8
Hip/groin/thigh	Groin strains and osteitis pubis	12.0	10.8	12.9	8.8	10.3
	Hamstring strains	15.0	17.8	24.6	27.3	32.3
	Quadriceps strains	5.7	7.6	6.5	5.6	4.9
	Thigh and hip haematomas	1.9	1.7	2.1	1.4	0.7
	Other groin/hip/thigh injuries	0.7	1.3	0.9	2.0	0.7
Knee	Knee ACL	9.4	14.4	17.0	13.4	13.8
	Knee MCL	2.8	4.2	4.1	7.1	3.9
	Knee PCL	2.3	3.7	3.5	4.4	3.8
	Knee cartilage	5.6	3.4	10.1	13.6	8.6
	Patella instability	1.6	2.1	1.1	1.0	1.1
	Knee and patella tendon injuries	1.6	2.5	2.7	1.4	3.7
	Other knee injuries	2.1	2.2	2.6	3.2	6.6
Shin/ankle/foot	Ankle sprains or joint injuries	5.8	5.8	4.9	6.9	9.0
	Calf strains	1.8	2.2	6.5	10.1	12.0
	Achilles tendon injuries	0.5	0.5	2.7	2.2	5.5
	Leg and foot fractures	4.6	8.1	6.4	2.5	3.9
	Leg and foot stress fractures	6.9	6.3	3.6	1.9	0.0
	Other leg/foot/ankle injuries	3.2	3.8	5.4	3.8	3.7
Medical illness	Medical illnesses	4.1	2.4	2.5	2.8	4.2
TOTAL MISSED GAMES		115.3	127.2	151.6	157.2	169.1

Table 14 – Injury match incidence (injuries per 1000 player hours) by Penetrometer first drop

Body area	Injury category	Harder (2.5 or less)	Medium (2.6-3.0)	Softer (3.1 or greater)
Head/neck	Concussion	0.8	0.8	0.7
	Facial fractures	0.3	0.4	1.2
	Neck sprains	0.1	0.1	0.2
	Other head and neck injuries	0.2	0.2	0.2
Shoulder/arm/elbow	Shoulder sprains and dislocations	0.7	0.8	0.5
	A/C joint injuries	0.9	0.4	0.6
	Fractured clavicles	0.3	0.0	0.3
	Elbow sprains or joint injuries	0.0	0.2	0.1
	Other shoulder/arm/elbow injuries	0.3	0.4	0.2
Forearm/wrist/hand	Forearm/wrist/hand fractures	1.6	0.8	1.2
	Other forearm/wrist/hand injuries	0.2	0.2	0.4
Trunk/back	Rib and chest wall injuries	0.3	0.6	0.8
	Lumbar and thoracic spine injuries	0.4	1.3	0.9
	Other trunk/back/buttock injuries	0.6	0.4	0.4
Hip/groin/thigh	Groin strains and osteitis pubis	1.5	1.3	1.7
	Hamstring strains	5.0	5.0	3.5
	Quadriceps strains	0.8	1.3	0.7
	Thigh and hip haematomas	1.4	1.2	0.9
	Other groin/hip/thigh injuries	0.0	0.1	0.2
Knee	Knee ACL	0.9	0.7	0.5
	Knee MCL	1.0	1.0	1.3
	Knee PCL	1.2	0.4	0.7
	Knee cartilage	0.8	0.8	0.6
	Patella instability	0.0	0.1	0.2
	Knee and patella tendon injuries	0.1	0.1	0.2
	Other knee injuries	0.4	0.7	0.8
Shin/ankle/foot	Ankle sprains or joint injuries	1.8	2.3	2.0
	Calf strains	1.5	1.0	0.8
	Achilles tendon injuries	0.3	0.2	0.2
	Leg and foot fractures	0.7	0.8	0.5
	Leg and foot stress fractures	0.4	0.1	0.0
	Other leg/foot/ankle injuries	1.9	1.4	0.8
Medical illness	Medical illnesses	0.4	0.2	0.2
	ALL INJURIES	26.8	25.4	23.5

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