Common Injuries in Sub-Elite Tennis Players

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CONTENTS

Abstract

Tennis is a popular racquet sport played at various ability levels. It can be played from early childhood through to an elderly age. The aim of this study was to determine the injuries obtained by Victorian Institute of Sport, Australian Institute of Sport and Grade 1 or State Grade pennant players in the 15-25 year age group, over a 6-month period from February-July 2005. This study also sought to determine the medical care participants sought for their injuries and the impact of the injury in terms of time lost from play.

16 questionnaires were handed out with a total of 15 being completed. Participants reported a total of 17 injuries. The study investigated injury patterns in players attempting to enter into a world-class standard of tennis. By researching this particular population group we are assessing those who will benefit greatly from the information this study provides. From the study we concluded:

From this study it was concluded that upper extremity injuries were the most common region injured. The wrist is the most common specific location of a tennis injury. Overuse injuries, especially sprains and strains are the most common type of perceived injury in this population. Players who are injured spend less time cross training than non-injured players.

Remedial/Massage Therapists is the most common health professional sought by the young sub-elite tennis player.

It is hoped that data obtained from this study may be useful in constructing strength/conditioning programs to help potentially reduce the number of injuries and effect of injuries in the sub-elite junior tennis player.

Key Words: Tennis, injury, sub-elite, elite, prevalence, incidence, type

Introduction

Tennis is a game for all ages. It is a popular racquet sport played by both genders with people frequently beginning in childhood and progressing right through until late adulthood.[1] Tennis is a complex neurophysiological activity that requires full body involvement and combines running, hitting, swinging and throwing. The technique of hitting a tennis ball is based on a kinetic link system of force transfer from the legs, through the trunk and into the racquet arm. If there is a disruption of the link system it is likely to result in excessive strain or breakdown of a more distal link.[2]

Whilst there have been a number of studies that have investigated injury prevalence associated with playing tennis, in general, the volume of research is less than that of other popular sports. Dalziel & Dixon[2] suggest that most injuries in recreational tennis players are associated with slowness moving to the ball, late strokes, poor footwork and faulty wrist mechanics. Whilst these authors did not state which injuries were the most common, they did propose that weakness of scapular stabilising muscles, abdominal muscles and lumbar muscles contributes to a higher frequency of muscle strain at these sites. Marx et al.[3] studied overuse injuries of the upper extremities in tennis players. These authors demonstrated that overuse injuries of the wrist and shoulder are common in tennis players due to repetition and the amount of motion involved in performing a tennis stroke.

Injuries occurring in junior tennis players have been reasonably documented. [4,5,6] Silva & Takahashi[4] performed a study on Brazilian juniors of sub elite level. These authors reported that muscle contractures, muscle pain, muscle strain, tendinopathies and cramps were the most frequent injuries. However with a different climate and different playing surfaces the results cannot be directly applied to the population of the present study. The study conducted by Reece et al.[5] investigated prevalence and aetiology of injuries of elite young tennis players at the Australian Institute of Sport and demonstrated a dominance of lower limb injuries over those involving the trunk and upper limbs. Hutchinson et al.[6] performed a 6-year study on elite, junior, male tennis athletes playing in the United States Tennis Association National Boys' Tennis Championships and documented injuries that required physical or medical assistance. They determined what type of injuries were common and what regions were most

commonly injured. This study reported that lower extremity injures occurred twice as frequently as upper extremity injuries and that strains and sprains were the most common type of injury. These results were similar to those reported by Reece et al.[5] Reece et al.[5]and Hutchinson et al.[6] have classified their population groups as elite. The present study involves participants of a similar ability level but has classified the players as sub-elite. They have been classified as sub-elite due to their being a known level of tennis ability above this group.

Research evaluating young tennis players' fitness has shown that the physical demands placed on the tennis player increase with extended playing time and with the increased skill level required at higher competition levels[7]. Thus it is important to determine what anatomical regions these specific physical demands act on in a sub-elite player and what sort of injuries result from the extra demand. This also suggests that common injuries affecting young tennis players and, in particular, recreational tennis players, may not necessarily be the same as those affecting sub-elite players.

Previous studies[4,5,6] have asked participants to report on injury incidence over a long period of time that may pose problems with recall bias[8]. The level of player ability was broad or undefined in many studies thus making results non-specific to particular playing abilities[1,2,3,9]. Unlike the present study, prior studies[1,2,3,5] have also not investigated what treatment was sought, if any, and by whom. This particular study focuses on a six-month period in an attempt to minimise recall bias. The study looks at a particular level of player thus making the results specific to a particular playing ability

Prevention of injury in tennis players, or at least a reduction in the incidence, is possible.[1] An injury can prevent a player from playing at their optimal performance level and may even prevent them from playing a particular sport again. The consequences of injury to the sub-elite athlete are therefore quite severe. The injury may prevent them from playing at an important time of their maturing career or it may permanently hinder their rise to the pinnacle of their sport. Thus it is imperative to identify common injuries in a sub-elite level population.

The aim of the present study was to determine the injuries obtained by Victorian Institute of Sport, Australian Institute of Sport and Grade 1 or State Grade pennant players in the 15-25 year old age group over a 6-month period from February-July 2005 inclusive. This study also sought to determine the medical care participants sought for their injuries and the impact of the injury in terms of time lost from play. The present study investigated injury patterns in those players who are attempting to enter into a world-class standard of tennis. By researching this particular population group we are assessing a group who will benefit greatly from the information this study provides. No studies have been performed on the incidence of injuries in the particular level of Australian tennis player concerned in this study for nearly 20 years.

Methods and Procedures

Definition of Injury

For the purpose of this study injury was defined as damage inflicted on the body as a direct consequence of playing in the sport of tennis.

Outline of study design

The study was a retrospective study design over a six-month period from February-July 2005 inclusive. Recruited participants were required to complete a survey at the beginning of August 2005.

Participants

Potential participants were recruited from both the Victorian Institute of Sport (VIS) and Australian Institute of Sport (AIS) Tennis Academies. These academies consist of eight players each. Two of the players are currently participating in both academies hence the total number of players in the VIS and/or AIS tennis academies that could potentially participate in this study were fourteen (n=14). Non VIS and AIS participants also participated in this study. These participants played either State Grade or Grade 1 (Tennis Victoria pennant program). They were approached as individuals via their connection with the VIS hitting partners or Boroondara Tennis Centre. Ten players were approached that were not part of the VIS or AIS.

The withdrawal criteria for this study was those players who did not complete a survey fully or if they withdrew their consent.

Questionnaire

The questionnaire consisted of two parts: a general questionnaire to determine the average age, height, weight, number of hours spent on court, number of hours training and how long they have been participating in the sport of tennis. The second part of the questionnaire was a tennis injury survey. Table 1 lists the injury information requested by the questionnaire. The questions were not based on other questionnaires.

Insert Table 1 here

Establishing face and content validity of questionnaire

The survey was initially completed by 5 sub-elite level tennis players and 5 experienced health care professionals who were asked to provide feedback on the questions asked in the survey and style of the survey. The results obtained from tennis players in this pilot study were not included in the overall analysis.

Sub-elite level tennis players were able to provide feedback indicating if the survey was easy to follow and that all questions in the survey were clearly explained. This determined if the survey formatting was appropriate for the subject population.

There was limited access to the participants due to their heavy travelling and training loads so due to time constraints a retrospective study was chosen to increase the response percentage. A major limitation of this study design is recall bias. To offset this, players were asked to report injuries over a 6-month period rather than a longer period in the hope of minimising recall bias.

Procedures

Questionnaires were distributed to the tennis coaches at the VIS and AIS. The coaches were given a detailed description on what was involved in the study and an indication of how players will be excluded by not meeting the inclusion criteria. The coaches were instructed to distribute the questionnaire and a written consent form to all VIS

and AIS tennis academy players. Once the questionnaire was completed, participants were asked to return the questionnaire to the coaches in a sealed envelope. Within this sealed envelope, participants were also asked to place the study consent form in a separate envelope inside the main envelope to ensure player confidentiality. At no time were the coaches able to access the information provided on the questionnaires provided by an individual player. Players participating in Pennant Grade 1 or State Grade who were between the ages of 15-25 years old inclusive were also invited to participate in the study. Approval for this study was granted via the Victoria University Human Ethics Committee.

Statistical Analysis

Surveys were collected and checked for a signed consent or parental consent form. The raw data from the surveys was entered into a personal computer using Microsoft Excel 2002. Graphs and tables were also created via the use of the Microsoft Excel 2002 program. Descriptive statistics were generated with the body regions characterised according to a body diagram used by Mansfield & Marshall (2001) [13]

Results

A total of 15 questionnaires were completed with a response rate of 94%. If AIS players are included the response rate was at 58%. Participants reported a total of 17 injuries. Players were aged from 15-25 years with 13 males and 2 females participating in the study. Participants were invited from the VIS, AIS tennis academies. In addition players were randomly selected from both Grade 1 and State Grade Pennant teams. The AIS players were unable to participate due to their playing commitments seeing them overseas for the duration that data was being collected.

The median number of years the respondents had been playing tennis for was 11-14 years and players spent a median of 9-11 hours hitting tennis balls (training or competing) and a median of 6-8 hours cross-training per week (i.e. training time not spent hitting tennis balls)

A total of seventeen (n=17) injuries were reported amongst the fifteen participants in the 6 months from February through to July inclusive in 2005 equating to a mean of 1.13 injuries per player. Nine (60%) participants reported that they had suffered an injury or injuries in the 6 month period and six players (40%) indicated that they suffered more than one injury during the time period.

Injuries by Anatomical Region

The incidence of injury by anatomical region and the average duration of each region injured are shown in Table 2. The most common site of injury was the wrist, with average injury duration of 13.9±15.7 weeks. Foot injuries were the next most common type of injury with an average duration of 0.5±0.4 weeks making their length of time significantly lower than wrist injuries. The least common were injuries of the groin and abdomen.

The incidence of upper limb injuries was approximately the same as those injuries affecting the lower limb. There were a total of eight injuries (47.1%) and seven (41.2%) injuries respectively. Upper limb injuries had an average duration of 15.1±9.2 weeks. This length of time was considerably longer than the average that affected the lower limb. The average duration of lower limb injury was 0.8±0.1 weeks. There were a total of two central injuries indicating the incidence of central injuries being far less than those of the extremities.

Insert Table 2 here

Nature of injury

The injuries that presented were categorised into clinical type. There are five injury subtypes (Table 3). Sprains and strains were by far the most common injury. They constituted 56.3% of all injuries reported. More sprains and strains occurred in the upper limb than anywhere else in the body. The upper limb was also the only region for tendonitis to occur.

A limited number of injuries affected the central region with the only type of injury affecting this region being a strain or sprain. There were twice as many sprains and strains in the upper limb as there were in the central region.

Through the course of the six months studied there were only two instances of blisters, both instances occurring only in the lower limb.
Of the fifteen respondents, only one required surgical intervention, it was to a tear of the wrist triangular fibrocartilage.

Insert Table 3 here

Perceived Injury Cause

Participants were asked to comment on what they believe resulted in their injury or injuries (Table 4). 37.5% of the injuries were believed to have been caused by overuse. This was the most common self-reported mechanism of injury. Other relatively common mechanisms were; lack of strength (18.8%), lack of warm up (12.5%) and poor technique (12.5%).

Insert Table 4 here

Treatment of Injury

Of the fifteen respondents seven of them were prevented from playing tennis due to their injury or injuries. The median amount of time the athletes were kept from playing tennis was less than one week.
77.8% of players who were injured had injuries which required treatment from a health professional. The most common health professional sought for treatment by the athletes was a Remedial/Massage Therapist (37.5%) closely followed by a Physiotherapist (31.3%) (Figure.1)

Insert Figure 1 here.

Cross training and time spent on court

Injured athletes were compared to non-injured athletes in regards to amount of hours per week that was spent hitting tennis balls and how many hours per week was spent cross training i.e. training time not spent hitting tennis balls (Table 5)
Injured players spent a median of 6 to 11 hours per week on court compared to a median of 9 to 11 hours for non-injured players. Injured players spent less time cross training than non-injured players.

Insert Table 5 here

Discussion

The results of this study confirm the common occurrence of injuries in the sport of tennis and their impact on training and participation. Due to the small sample size of this study, it limits the ability to do inferential statistics on the data. So the differences in results may only be apparent in this particular sample. If the same sort of differences appear in future studies it is reasonable to suggest that these results are supported.

The current literature contains very little research on tennis injuries particularly in Australia. Much of the previous literature is based on players of the same age and ability level but has used the term elite. This study is using the term sub-elite for the same population. This is the first study to look at injuries specific to Australian junior sub-elite tennis players in almost twenty years. Previous reports that have discussed the junior elite tennis athlete have been conflicting especially when distinguishing the relationship between upper and lower extremity injuries.[6]

The most common region injured in this study was the upper limb (47.1%) closely followed by the lower limb (41.2%). This yielded similar results to Winge et al. [11] who presented a prospective study of 104 elite Danish tennis athletes and noted 45.7% of injuries occurred in the upper extremity and 39% occurred in the lower extremity. In contrast, Reece et al.[5] noted that at the Australian Institute of Sport over a 4 year period, 59% of injuries affected the lower limb. The rest of the injuries were evenly distributed between the upper limb and trunk. Hutchinson et al.[6] found similar results in their study with lower extremity injuries occurring twice as frequently as upper extremity injuries.

In the present study the wrist was the most common site of injury. The average duration of injury was 13.9±15.7 weeks. Reece et al.[5] and Hutchinson et al.[6] did not demonstrate that wrist injuries were common amongst their prospective population

groups. This difference in data could possibly be due to a change in technology of racquets and stroke technique over the past decade. It may also be due to a difference in study time frame. This particular study looked at injuries over a 6 month period unlike the other studies which were undertaken over four and six years respectively.

The studies by Reece et al.[5], Winge et al.[11], and Hutchinson et al.[6] all noted that overuse or sprain/strain injuries were the most common type of injuries. The athletes surveyed in this study also demonstrated predominance (56.3%) of sprain/strain type injuries.

Silva & Takahashi[4] performed a study on Brazilian juniors of sub-elite level. These authors reported that muscle contractures, muscle pain, muscle strain, tendinopathies and cramps were the most frequent injuries. However with the different climate and different playing surfaces in Brazil it is difficult to directly apply these results to Australian players. Tennis is an open skill meaning that the game can be influenced by many different variables including climate, court surface and type of tennis ball used.[12] With these variables differing between countries, it is understandable why the results may vary between studies. It also indicates that although results may have been produced on a similar ability level in a different study it does not necessarily mean that they are of exact relevance to a similar population group of another country.

Kibler et al.[7] and Marx et al.[3] suggest that overloading results in the majority of tennis injuries, particularly of the upper extremity. Kibler & Chandler[14] demonstrate in their study that a specific program of stretching exercises can have a positive effect for improving range of motion variables, which are considered risk factors in microtrauma overload injuries. It was noted in the present study that injured athletes spent less time cross training than those who were non-injured. This result adds weight to Kibler & Chandler's[14] results and supports the notion that cross-training can reduce the risk of injury. By emphasising and encouraging appropriate strength and conditioning regimes of areas at risk, a reduction in the incidence of overuse injuries in young athletes may be achieved.

There is a lack of information in the literature regarding the medical treatment sought by injured sub-elite tennis players. Considering the importance of receiving adequate

medical treatment for this sub-elite population, the present study gathered data to determine what type of health professional, if any, was sought. The most common health professional sought for treatment by the athletes was a Remedial/Massage Therapist (37.5%) closely followed by a Physiotherapist (31.3%). 77.8% of injured players sought treatment for their injury or injuries. Despite technological advances and an increase in the number of practitioners there are many junior players who fail to become professional players due to injuries that make them unable to play and practice adequately.[4] With this in mind, it is imperative to stress to junior sub-elite players the importance of seeking not only medical treatment, but treatment from someone who has knowledge of the game of tennis and its technique. There are other possible prevention strategies that could be implemented to reduce the severity of injury or risk of injury to tennis players. From the results of the present study it is suggested that tennis academies employ health professionals who specialise in sports injuries or injuries of a specific sport to work closely with the elite coaches to help construct and monitor a strength and conditioning program with the aim of reducing the number of injuries, in particular, overuse injuries.

This study has some limitations that restrict the ability to generalise the results. Only sub-elite juniors were evaluated. This group of players spend a higher number of hours training making it probable that they would suffer a higher number of injuries than the average player. Only two females were involved in this study making it impossible to make the study gender specific. As was mentioned previously it is also quite difficult to relate this data directly to other countries. Further studies need to look into the effect of different playing surfaces and climate on injuries.
The number of participants in this study was quite low however the population group of Australian sub-elite tennis players is relatively small. The study had a return rate of 94%. If AIS players are included the response rate was at 58%. The AIS players were eventually excluded from the study due to their travelling commitments. The players were overseas for a large portion of the year rendering it impossible to include them in the study.

Tennis has evolved immeasurably along with technological advances. The racquets, footwear, and court surfaces have all undergone consistent change.[10] This highlights the importance of ongoing research into the field of tennis. With continual change of

tennis equipment (i.e. shoes, strings, court surface, apparel and tennis shoes), it is hypothesised that injury data presented in the present and previous studies, could become rapidly out-dated.

Conclusion

This study presented the incidence of injuries in a young sub-elite group of Australian tennis athletes and provides a foundation for further research into the injuries of young tennis athletes.

From this study it was concluded that upper extremity injuries were the most common region injured. The wrist is the most common specific location of a tennis injury. Overuse injuries, especially sprains and strains are the most common type of perceived injury in this population. Players who are injured spend less time cross training than non-injured players.

Remedial/Massage Therapists is the most common health professional sought by the young sub-elite tennis player.

The data from the present study may be useful in constructing strength and conditioning programs to help potentially reduce the number of injuries and effect of injuries in the sub-elite junior tennis player.

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Table 1. Information requested by the tennis injury survey.

Question	Question Format
Have you suffered from an injury related to participating in the game of tennis that has occurred in the past six months?	Yes/No
How many tennis related injuries have you suffered from in the past 6 months?	6 tick box options
What region/s of the body were injured?	Diagram
State the length of time each injury has affected you	Text
What do you feel was the cause of your tennis injury or injuries?	Text
Detail the nature of the injury/s	Text
Has your injury or injuries prevented you from playing tennis?	Yes/No
If yes, for how long has the injury or injuries prevented you from playing tennis?	4 tick box options
Was treatment sought for any injury/s that you have suffered over the past six months?	Yes/No
Which type of health professional did you commonly seek for the treatment of your tennis related injuries?	6 tick box options

Table 2. Incidence of injury by region.

Region	Number of reported injuries	Average injury duration (weeks)	Standard Deviation
Wrist	4	13.9	15.7
Upper arm	2	9.2	11.5
Shoulder	2	22.2	29.1
Total Upper	**8**	**15.1**	**9.2**
Foot	3	0.5	0.4
Ankle	2	0.5	0.2
Thigh	2	1.3	0.4
Total Lower	**7**	**0.8**	**0.1**
Chest	1	1	n/a
Abdomen	1	0.4	n/a
Total Central	**2**	**0.7**	

Table 3. Incidence of injury by nature.

Nature of injury	Injuries in upper limb	Injuries in lower limb	Injuries in central region	%
Sprain/Strain	4	3	2	56.3
Tendonitis	2	0	0	12.5
Blister	0	2	0	12.5
Tight muscle	1	0	0	6.3
Other	1	2	0	12.5

Table 4. Self reported mechanism of injury.

Believed injury cause	Number of reported injuries	%
Overuse	6	37.5
Lack of strength	4	18.8
Lack of warm up	2	12.5
Poor technique	2	12.5
Other	3	18.8

Figure 1. Health care professional sought by injured players.

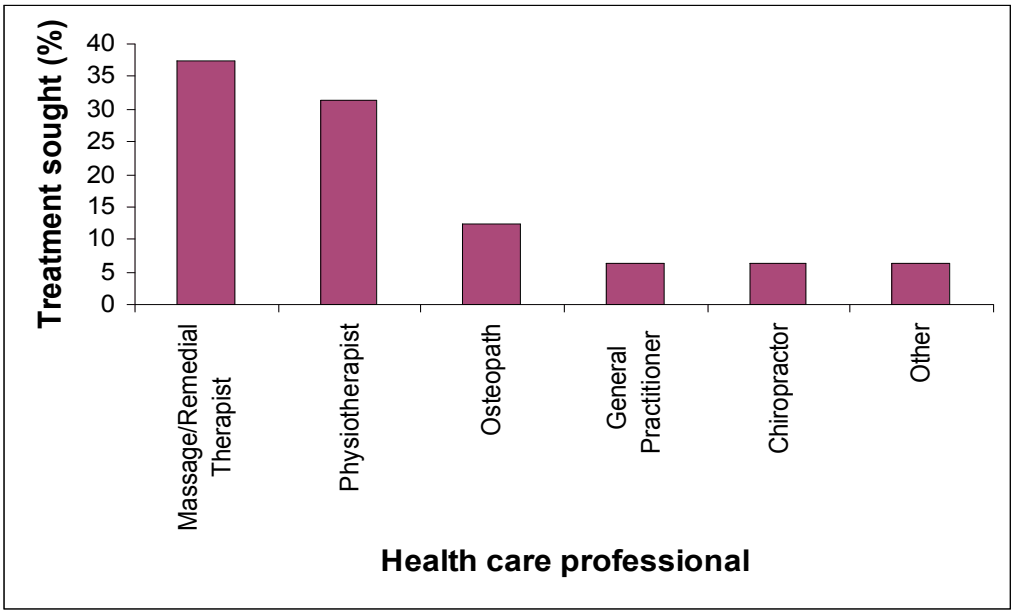

Table 5. Cross training and time spent on court.

	Hitting tennis balls (hrs/week)	Cross training (hrs/week)
Injured players	6 to 11	3 to 5
Non-injured players	9 to 11	6 to 8

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