

## Rising Trend of Anterior Cruciate Ligament Injuries in Females in a Regional Hospital

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### Abstract

**Introduction:** We see a rising trend in the number of anterior cruciate ligament (ACL) injuries in females over the past 4 years (1999 to 2002). This article seeks to identify and examine the rising trend in the number of ACL injuries in females in our institution over this period. **Materials and Methods:** Two hundred and fifty-nine patients with ACL reconstructions were identified and their casenotes were retrieved from the medical records office. Of these, 13 were females. **Results:** The number of ACL reconstructions has increased from 9 cases to 144 cases a year from 1999 to 2002. Over this period, 13 female cases (3 in 2001 and 10 in 2002) with an age range of 13 to 38 years were performed in our institution. Their injuries were mainly sustained from a bad landing or during pivoting on 1 leg. There were 8 patients (61.5%) with prior conditioning and experience and 5 without (38.5%). The mean number of years of prior training was 4.4 years. Of these 8, 4 were netball players. All were competitive players either at the school or club level and they were all playing as goal attackers. **Conclusion:** Linear regression analysis shows a significant increase in the number of ACL reconstructions performed for females in our institution over this time period. Netball was a common sport in our series. This suggests a likely relationship between netball and ACL injuries. All the patients were playing as goal attackers. The area of court covered and frequency of jump-stop and sudden deceleration activities could be a cause.

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**Key words:** Articular ligament, Arthroscopic surgical procedures, Knee injuries

### Introduction

Female athletes are at a greater risk for injuries involving the anterior cruciate ligament (ACL) than their male counterparts in high schools and colleges in the United States.<sup>1,2</sup> Noyes et al<sup>1</sup> reported that 78% of all ACL injuries were non-contact in nature and they most often occurred on landing from a jump, while performing a cutting action, or upon sudden deceleration. This is seen in sports where males and females play on similar surfaces, rules and activity levels such as basketball and soccer.<sup>3</sup> We have noticed an increase in the number of ACL injuries in females in our institution and this study draws a profile of this group of patients.

### Materials and Methods

This is a retrospective clinical review of the cases of ACL reconstruction performed in our institution over a period of

4 years from 1999 to 2002 (Table 1). The patients were identified and their casenotes were retrieved from the medical records office. There were 259 cases, of which 13 were females. Their casenotes were studied and the patients were interviewed over the telephone.

ACL tear was diagnosed either clinically, by radiological diagnosis (i.e. magnetic resonance imaging) or prior arthroscopy. A patient was diagnosed to have an ACL tear or insufficiency when the Lachman test was positive (a 5-mm to 10-mm anterior displacement of the tibia) with or without a positive pivot shift. This was compared with the other knee on generalised ligamentous laxity.

A patient was defined to have prior conditioning or experience in his or her field of sport if he or she had participated competitively and had been training for  $\geq 1$  year.

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Table 1. Number of Anterior Cruciate Ligament Reconstructions Performed

Year	Male	Female	Female-to-male ratio
1999	9	0	0
2000	25	0	0
2001	78	3	0.0384
2002	134	10	0.0746

### Statistical Analysis

A linear regression analysis was performed to investigate if there was a linear trend in the female proportion of ACL reconstructions from 1999 to 2002. The proportion in each year was weighted by the total number of ACL reconstructions in that year out of the total number of cases done over the 4-year period.

### Results

The mean age at diagnosis of ACL tear was 23 years (range, 13 to 38 years). Nine left knees (69.2%) and 4 right knees (30.8%) were operated upon. Functionally, all patients had ACL insufficiency, which was confirmed intra-operatively. The mean time to surgery from the point of injury was 30.2 months (range, 1 to 120 months).

All 13 patients sustained their injuries during non-contact activities, from a bad landing or whilst pivoting on 1 leg. Eight patients (61.5%) had prior conditioning and experience and 5 (38.5%) did not. The mean number of years of prior training was 4.4 years (range, 1 to 10 years). Of the 8 patients with prior experience, 4 were netball players, 2 were rugby players, 1 was a taekwondo athlete, and 1 was a roller hockey player. Three netball players were playing for their school while the other was representing her recreational club. Three sustained their injuries during competition and the last was injured during training. The rugby players sustained their injuries during competition. The 5 patients who did not have prior conditioning and experience sustained injuries in squash, kickboxing aerobics exercise, volleyball, wakeboarding and touch rugby (Table 2).

Intraoperatively, staples were used to anchor the graft at the tibial side in all patients. Eleven patients had an endobutton while 2 had rigid fix for the femoral side. All had semitendinosus and gracilis graft. The median graft size was 8 mm (range, 6.5 to 8mm).

Postoperatively, only 2 patients had gone back to their sport. They were from the group that had prior conditioning and experience. These were patients that were playing the

Table 2. Characteristics of the Female Patients

No.	Age (y)	Injury side	Sport	Prior training	Duration of prior training	Mechanism of injury	Time to surgery (mo)	Postoperative results
1	38	Left	Squash	No	NA	Pivoting on 1 leg	108	Not returned to squash but started jogging
2	30	Left	Kickboxing	No	NA	Awkward landing	5	Not returned to kickboxing or any other sport
3	24	Left	Volleyball	No	NA	Awkward landing	12	Not returned to volleyball or any other sport
4	27	Right	Wakeboarding	No	NA	Awkward landing	18	Not returned to wakeboarding or any other sport
5	21	Left	Touch rugby	No	NA	Pivoting on 1 leg	12	Not returned to touch rugby or any other sport
6	14	Left	Netball	Yes	2 years	Awkward landing	6	Not returned to netball but started jogging
7	17	Left	Netball	Yes	7 years	Awkward landing	6	Not returned to netball or any other sport
8	13	Right	Netball	Yes	1 year	Awkward landing	3	Not returned to netball but started jogging
9	22	Left	Rugby	Yes	5 years	Pivoting on 1 leg	12	Not returned to rugby or any other sport
10	25	Right	Netball	Yes	10 years	Awkward landing	12	Not returned to netball but started jogging
11	27	Left	Taekwondo	Yes	3 years	Slipped and fell	120	Not returned to taekwondo but started jogging
12	19	Right	Rugby	Yes	1 year	Pivoting on 1 leg	1	Returned to rugby 5 months post-reconstruction
13	22	Left	Roller hockey	Yes	6 years	Tripped and fell	78	Returned to roller hockey 4 months post-reconstruction

NA: not applicable

sport competitively prior to the injury and cited early return to sport as a main reason for the surgery. Surprisingly, the netball players had not returned to their sport.

### Discussion

From the linear regression analysis, the proportion of females increased by 0.0296 (95% CI, 0.011 to 0.048;  $P < 0.05$ ) each year. This suggests the likelihood that the number of ACL reconstructions amongst females in our institution is rising.

The authors believe that the rise may be a reflection of a possible rise in the number of ACL injuries in females in Singapore. Other possible reasons include increased preference for surgeons to perform reconstructive surgery, greater awareness of sports injuries amongst Singaporeans, greater awareness of available treatment modalities and increased willingness of patients to undergo surgery as a result of this increased awareness and greater desire for patients to return to their competitive sports. On the other hand, greater participation in competitive sports is 1 contributing factor to this trend. Changing sex roles could also account for this rise. Similar to the other studies,<sup>1,2</sup> our patients sustained their injuries from non-contact activities. They did not sustain their injuries from trauma due to contact with another player.

Many studies have suggested that females are more prone to knee injuries, particularly ACL tears. They suggest that there is a multi-factorial reason for their injury pattern,<sup>4</sup> which includes extrinsic and intrinsic factors.

Intrinsic factors include width of the femoral notch or condylar size,<sup>5-7</sup> female hormonal changes,<sup>8-12</sup> decreased potential for dynamic stabilisation of the female knee joint and proprioception deficits and coordination imbalances in female athletes.<sup>13,14</sup>

Extrinsic factors on the other hand include differences in knee kinetics between males and females in stop-jump,<sup>15</sup> shoe and surface interface<sup>2</sup> and prior conditioning and experience.<sup>16</sup> Current research in soccer suggests that the demands of the game on women are similar to those placed on men, including the distance covered, exercise intensity and physical and physiologic characteristics.<sup>16</sup> The rapid increase in new sports programmes in recent years has introduced players who have less experienced in the rigours of collegiate soccer. As a result, these new participants are more susceptible to ACL injuries.

In our study, 8 (61.5%) of our 13 patients had prior conditioning and experience. However, this was confounded by selection bias, as patients who play competitively are more exposed to such injuries and are more likely to report their injuries. The 5 females who did not have prior conditioning and experience in our series were participating in their sport on a recreational basis and were not involved

in any competitive sport.

An interesting finding was the long time to surgery (mean, 30.2 months). The long lead time may be due to a delay in the diagnosis of ACL injuries in females which are uncommon in Singapore. Another plausible cause is the instability arising from ligamentous laxity and hence prolonged physiotherapy. For those who had surgery, it was usually performed at the request of the patients as they wish to resume their sports. This was a departure from previous experience when females were willing to give up their sports after sustaining their injuries.

Netball was a common sport in our series. However, there are few studies of ACL injuries in female netball players. A descriptive study on netball players by Hopper et al<sup>17</sup> showed that few injuries occurred at the knee joint (8.3%) and only 1.8% of these injuries were diagnosed as injury to the ACL. In their study, ankle injuries (84%) were the most common, with 67% of these injuries diagnosed as lateral ligament sprains. Jump-stop and sudden deceleration activities occur commonly during netball games. Such activities are known to be important contributors to ACL injuries. In our series, all 4 patients were goal attackers and they cover the attacking two-thirds of the court. They are often involved in jump-stop and sudden deceleration activities during the attacking phase of the game. Our series suggests that more ACL reconstructions were done for netball players. Again, this could represent a selection bias as these competitive players are more likely to seek surgical treatment. However, from our postoperative results, none of our netball players have gone back to their sport. None reported any giving way of their injured knees and all are still undergoing rehabilitative physiotherapy.

### Conclusion

Our study notes a rise in the number of ACL reconstructions amongst females over 4 years. A larger proportion of our patients have prior conditioning and experience but selection bias is a likely confounder. We have also detected a long time to surgery. Our series serves as an impetus for more studies on ACL injuries in females, especially in netball players, in terms of prior training and experience, position of player and relation of injury side to side of pivoting leg.

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