Anterior cruciate ligament tear in Hong Kong Chinese patients

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A B S T R A C T

Objective: To investigate the associations between patient sex, age, cause of injury, and frequency of meniscus and articular cartilage lesions seen at the time of the anterior cruciate ligament reconstruction.

Design: Case series.

Setting: University affiliated hospital, Hong Kong.

Patients: Medical notes and operating records of 672 Chinese patients who had received anterior cruciate ligament reconstruction between January 1997 and December 2010 were reviewed. Data concerning all knee cartilage and meniscus injuries documented at the time of surgery were analysed.

Results: Of the 593 patients, meniscus injuries were identified in 315 (53.1%). Patients older than 30 years were more likely to suffer from meniscal injury compared with those younger than 30 years (60% vs 51%, P=0.043). Longer surgical delay was observed in patients with meniscal lesions compared with those without (median, 12.3 months vs 9.1 months, P=0.021). Overall, 139 cartilage lesions were identified in 109 (18.4%) patients. Patients with cartilage lesions were significantly older than those without the lesions (mean, 27.6 years vs 25.1 years, P=0.034). Male patients were more likely to have chondral injuries than female patients (20.1% vs 10.9%, P=0.028). The risk of cartilage lesions was increased by nearly 3 times in the presence of meniscal tear (P<0.0001; odds ratio=2.7; 95% confidence interval, 1.7-4.2).

Conclusions: Increased age and surgical delay increased the risk of meniscal tears in patients with anterior cruciate ligament tear. Increased age, male sex, and presence of meniscal tear were associated with an increased frequency of articular lesions after an anterior cruciate ligament tear.

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New knowledge added by this study

- This study served to identify the risk factors for meniscal and cartilage injuries in patients with anterior cruciate ligament (ACL) tear.

Implications for clinical practice or policy

- Patients with ACL deficiency should be informed about the increased risk of meniscus injuries associated with surgical delay.

Introduction

Anterior cruciate ligament (ACL) tear is one of the commonest sport injuries seen in clinical practice, and such injury is often associated with meniscal and chondral lesions. It is widely believed that early surgery can prevent such lesions in ACL-deficient patients, and probably help avoid the most dreadful complication of early osteoarthritis of the knee.[1] Despite multiple studies conducted to evaluate the relationship between intra-articular injuries and ACL tear, such associations among Asians, especially Chinese, have not been extensively studied.

Data show that females are more susceptible to ACL injury than their male counterparts,[2-4] but lower risk of other intra-articular injuries in females was observed in some studies.[5] Furthermore, a study showed that the incidence of meniscus tear was associated with the mechanism of ACL injury[6]; however, other studies were not able to show a significant relationship between the type of sports causing injury and the incidence of meniscal and chondral lesions.[7]

The objective of this study was two-fold. Our first aim was to report the meniscal and chondral lesions that accompany ACL tears in a large Chinese population. Our second aim was to test for relationships between the aforementioned lesions and patient sex, age, surgical delay, and causes of ACL injury.

Methods

A database that recorded all patients who had

前十字韌帶撕裂的香港華籍患者

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目的：在進行前十字韌帶重建手術時研究關節軟骨損傷與以下因素的關係：患者性別和年齡、受傷原因，以及半月板損傷頻率。

設計：病例系列研究。

安排：香港一所大學附屬醫院。

患者：回顧1997年1月至2010年12月期間曾接受前十字韌帶重建手術共672名病人的醫療和手術紀錄。對於手術進行時有關膝蓋軟骨和半月板受傷的數據進行了分析。

結果：共593名被納入研究範圍的病人中，有315名（53.1%）半月板受傷的患者。與30歲以下的患者比較，30歲以上的患者較高機會有半月板損傷（60%比51%，P=0.043）。觀察所得，與半月板無受傷的患者比較，半月板受傷的患者手術延期的情況較長（中位數：12.3比9.1個月，P=0.021）。整體而言，有109名（18.4%）患者共139例軟骨損傷。軟骨有損傷的患者比無損傷的年齡明顯較大（平均年齡：27.6歲比25.1歲，P=0.034）。男性比女性較易有軟骨損傷（20.1%比10.9%，P=0.028）。如同時有半月板撕裂的情況，軟骨損傷的風險會增加接近3倍（P<0.0001；比值比=2.7；95%置信區間：1.7-4.2）。

結論：前十字韌帶撕裂的患者中，年齡較大和手術延遲會增加半月板撕裂的危機。曾有前十字韌帶撕裂的患者，年齡較大、男性和有半月板撕裂的出現均與關節病變頻率增加有關。

received ACL reconstruction in our hospital since 1997 was reviewed. Overall, 672 Chinese patients who had received the surgery between January 1997 and December 2010 were identified. Their medical notes and operating records were reviewed. Data concerning the patient sex, age, causes of injury, elapsed time from injury to surgery, and all knee cartilage and meniscus injuries documented at the time of surgery were analysed.

Exclusion criteria were: patients who had radiological evidence of osteoarthritis (Kellgren-Lawrence grade 3 or 4); a concomitant grade III medial collateral ligament, lateral collateral ligament, or posterior cruciate ligament deficiency (evaluated and recorded by means of examination with the patient under anaesthesia at the time of surgery); any revision procedure involving the ACL; or knee dislocation.

The time of the initial ACL injury was determined from the patient's history. This included a definite incident of a single twisting injury, with the knee giving away with a 'pop' sound, gross knee swelling, and inability to resume the sport or walking. The nature of this injury was further verified with the hospital medical notes, or records of the primary attending physician, when available. Patients were considered potential candidates for ACL reconstruction if any two of the following criteria were satisfied: (1) instability during pivoting movements; (2) signs of ACL deficiency, including a positive Lachman test, anterior drawer test, or a positive pivot shift test; and (3) evidence of an ACL tear on magnetic resonance imaging (MRI).

The presence of cartilage injuries and meniscal lesions was confirmed in the operating room by means of knee arthroscopy. Several independent variables were studied: patient sex, age at the time of surgery, surgical delay (defined as the duration in months between the index ACL injury and reconstruction), and causes of ACL injury.

Statistical analyses

Data analysis was performed using the Statistical Package for the Social Sciences (Windows version 15.0; SPSS Inc, Chicago [IL], US). Student's *t* test was used to compare the means of the age. Mann-Whitney *U* test was used to compare the means of the length of surgical delay. Fisher's exact test was used to evaluate the categorical variables. Binary logistic regression was used to calculate the independent effects of individual factors. A P value of <0.05 was considered to be statistically significant.

Results

Of 672 patients who received ACL reconstruction, 79 were excluded (7 with concomitant high-grade ligament deficiency, and 72 with revision ACL surgery) and 593 patients were considered for analysis. These included 483 (81%) males and 110 (19%) females. There were 297 (50%) right and 296 (50%) left knees. Their mean age at the time of surgery was 26 years (range, 13-51 years), and their median length of surgical delay was 10.5 months (range, 0.4-241.8 months).

Most of the patients had had their injuries during sports activities (89.5%), with soccer (n=226, 42.6%) and basketball (n=163, 30.7%) being the two most common sports (Tables 1 and 2). The age distribution of patients having meniscal and cartilage injuries is shown in Table 3. The incidence of intra-articular lesions in different sports activities leading to injury is shown in Table 4.

Meniscus injuries were identified in 315 (53.1%) patients. There were 146 (24.6%) isolated lateral tears, 123 (20.7%) isolated medial tears, and 46 (7.8%) bilateral tears.

Patients older than 30 years were more likely to suffer from meniscal injury versus those younger than 30 years (60% vs 51%; P=0.043 by Fisher's exact test). Longer surgical delay was observed in patients with meniscal lesions versus those without such lesions (median, 12.3 months vs 9.1 months; P=0.021 by Mann-Whitney *U* test). Also, patients with medial meniscal tear had a longer surgical delay than those with lateral meniscal tear (median, 16.7 months vs 9.0 months; P<0.001, Mann-Whitney *U* test).

TABLE 1. Causes of injury

	No. (%) of patients
Sports	531 (89.5)
Activity of daily living	15 (2.5)
Work injury	18 (3.0)
Road traffic accident	10 (1.7)
Miscellaneous	19 (3.2)

TABLE 2. Type of sports activity causing anterior cruciate ligament tear

	No. (%) of patients
Soccer	226 (42.6)
Basketball	163 (30.7)
Taekwondo	12 (2.3)
Snow sports	16 (3.0)
Rugby	14 (2.6)
Badminton	9 (1.7)
Handball	8 (1.5)
Hockey	10 (1.9)
Volleyball	16 (3.0)
Miscellaneous	57 (10.7)

TABLE 3. Age distribution of patients who had meniscal and cartilage injuries

Age-group (years)	No. of patients	No. (%) of patients	
		Meniscal tear	Cartilage injury
≤20	127	67 (52.8)	20 (15.7)
21-30	326	164 (50.3)	57 (17.5)
31-40	116	72 (62.1)	22 (19.0)
≥41	24	12 (50.0)	10 (41.7)

TABLE 4. The incidence of intra-articular lesions in different sports activities leading to injury

	No. (%) of patients		
	Soccer (n=226)	Basketball (n=163)	Other sports (n=142)
Meniscal tear	124 (54.9)	86 (52.8)	69 (41.5)
Lateral	59 (47.5)	49 (57.0)	27 (39.1)
Medial	52 (41.9)	26 (30.2)	24 (34.8)
Both	13 (10.5)	11 (12.8)	18 (26.1)
Cartilage injury*	44 (19.5)	31 (19.0)	24 (16.9)
Patella	5 (8.5)	2 (5.3)	3 (12.5)
Femoral	38 (64.4)	27 (71.1)	18 (75)
Tibial	16 (27.1)	9 (23.7)	3 (12.5)

* Some patients might have more than one cartilage lesions

However, no significant associations were observed between sex, causes of injury, type of sports, and presence of meniscal lesions.

Overall, 139 cartilage lesions were identified in 109 (18.4%) patients. There were 16 patella (11.5%) lesions, 92 (66.2%) femoral condyle lesions, and 31 (22.3%) tibial plateau lesions. Patients with cartilage lesions were significantly older than those without the lesions (mean, 27.6 years vs 25.1 years; P=0.034 by Student's *t* test). Female patients were less likely to suffer from chondral injuries than male patients (10.9% vs 20.1%; P=0.028 by Fisher's exact test). Female sex was found to be independently associated with incidence of cartilage injury in binary logistic regression (P=0.029; odds ratio [OR]=0.475; 95% confidence interval [CI], 0.243-0.929) [Table 5]. Presence of meniscal tear was associated with a 3-fold increased risk of cartilage lesions (P<0.001 by Fisher's exact test; OR=2.7, 95% CI, 1.7-4.2).

No significant association, however, was found between surgical delay, causes of injury, type of sports, and cartilage lesions.

Discussion

Our study showed that longer surgical delay was present in patients with meniscal lesions, a finding that concurs with data from other published literature. Although Slauterbeck et al,[5] Piasecki et al,[8] and O'Connor et al[9] reported that female patients had a lower rate of meniscus injury than male patients, such association was not observed in our study which recruited a lower proportion of female patients; similar observation was made in the study by Murrell et al.[10]

It is postulated that in acute ACL injury, excessive anterolateral rotation of the tibia on the femur traps the lateral meniscus between the posterolateral aspect of the tibial plateau and the central portion of the lateral femoral condyle. The lateral meniscus is susceptible to a tear when the tibia reduces. However, the scenario is different in patients with chronic ACL deficiency. Recurrent anterior translation of tibia on the femur results in increased stress on the more stably fixed medial meniscus due to the coronary ligaments, leading to a subsequent medial meniscal tear.[11] Our study found that ACL-deficient patients with medial meniscus

TABLE 5. Binary logistic regression for the factors associated with risk of cartilage injury

Variable	Regression coefficient	P value	Odds ratio	95% Confidence interval
Female sex	-7.44	0.029	0.475	0.243-0.929
Age	0.27	0.079	1.028	0.997-1.059
Surgical delay	0.003	0.457	1.003	0.996-1.009

tear had a mean of 9 months longer surgical delay than those with lateral meniscus tear. Mitsou and Vallianatos[12] reported that the incidence of medial meniscal tears increased from 17% in patients with ACL reconstruction within 3 weeks of injury to 48% in those who had surgery of more than 6 months after injury; such risk was not observed in lateral meniscus tears. O'Connor et al[9] found that patients who underwent ACL reconstruction more than 2 years after injury had only 1.5 times increased risk in lateral meniscus injuries, but 2.2 times increased risk in medial meniscus injuries.

In our study, males were found to have higher incidence of cartilage defect than females, but there was no significant difference in terms of meniscal lesions. Slauterbeck et al[5] found that male sex was associated with an increased risk of meniscal and chondral lesions in ACL-deficient patients. In a study by Piasecki et al,[8] female high-school athletes were found to have fewer meniscal tears (while playing soccer) and a reduced number of intra-articular injuries to the medial femoral condyle while playing basketball, but such associations were not observed among amateur athletes. So far, there has been little research on sex differences in articular cartilage injuries accompanying ACL tears. Granan et al[13] reported that cartilage lesions were nearly twice as frequent if there was a meniscal tear, and similar observations were found in our study.

The association of age with meniscus tear and cartilage injury with intact ACL is less extensively studied. In a cross-sectional MRI study of nearly 1000 individuals from the general population who were aged 50 to 90 years, 31% of knees were found to have a meniscal tear and the incidence increased with age. It was shown that 21% of the 50- to 59-year-old subjects had a meniscal tear, compared to 46% of subjects aged 70 to 90 years.[14] In several large-scale retrospective studies which reviewed the articular cartilage defects during knee arthroscopy, the incidence of isolated chondral lesions without associated intra- and extra-articular knee lesions ranged from 30% to 36.6%.[15-18] No significant statistical associations, however, were found between age and the cartilage lesions.

Studies have shown that individuals who participate in vigorous physical activities are more disabled by an ACL injury than those who are relatively sedentary. Paul et al[6] reported an association between the mechanism of an ACL injury (jumping and non-jumping) and the incidence of concomitant meniscus injuries, but other authors failed to show such associations. In our study, since more than half of the patients were injured while playing soccer or basketball, an analysis was performed to evaluate if the soccer and basketball players suffered from lesions that were different from those sustained from other causes or during other sports activities. However, type of sports was not associated with any of the parameters we studied. A larger sample including patients with other causes of injury will be needed to prove if there are differences among other sports activities.

Another limitation of this study was that patients receiving conservative treatment for their ACL injury were not recruited in the present study. This could lead to potential bias as their risks of meniscal and articular injuries could not be estimated. We are also aware that more sophisticated systems to evaluate the meniscal and chondral lesions, eg the Cooper's classification[19] and the ICRS (International Cartilage Repair Society) classification system,[20] could be used to map the lesions, so as to provide more precise anatomical description and details of the lesions.

Compared with other studies, which report surgical delay ranging from 1.2 to 13 months,[5-7,9-11] patients in our series had a longer surgical delay. Patients may have postponed the waiting time for surgery or imaging including MRI. It was unclear if patients would suffer from repeated knee injuries, or the activities in which the patients were involved before the surgery would have any effect over the findings of our study.

Currently, there is intense debate concerning the optimal timing for ACL reconstruction.[21,22] Different surgeons have different personal preferences. Some prefer early surgery while others are in favour of an optimal period of rehabilitation before considering surgery. Frobell et al[23] concluded in his randomised controlled trial that "In young, active adults with acute ACL tears, a strategy of rehabilitation plus early ACL reconstruction was not superior to a strategy of rehabilitation plus optional delayed ACL reconstruction." According to Richmond et al,[22] however, Frobell's conclusion is flawed; they believe that prompt operative intervention reduces long-term osteoarthritis after knee ACL tear. No matter what approach the surgeons prefer, our patients with ACL tear should be well informed about the risks and benefits of conservative management versus surgical reconstruction, so they can make their best decision with the best information on hand.

Conclusions

Increased age and surgical delay were associated with meniscal tear in patients with ACL tear, and longer surgical delay was observed in patients with medial meniscal tear. Increased age, male sex, and presence of meniscal tear were all associated with chondral lesions after an ACL tear. Cause of injury or type of sports activity leading to ACL injury was not associated with intra-articular lesions.

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