Return to sports and re-rupture rate following anterior cruciate ligament reconstruction in amateur sportsman: long-term outcomes

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ABSTRACT

BACKGROUND: The aim of this study was to retrospectively evaluate patient satisfaction, the return-to-sport rate and activity level at a long-term follow-up in a large cohort of amateur sportsmen who underwent primary ACL reconstruction.

METHODS: a total of 218 patients who underwent primary ACL reconstruction between 2004 and 2011, were successfully recontacted and retrospectively reviewed at an average follow-up of 10.5 years (range, 7 to 14 years). All surgeries were performed by one single surgeon. All of them underwent primary ACL reconstruction with autogenous hamstring tendon grafts. Assessment included Knee Osteoarthritis Outcome Score (KOOS) score, International Knee Documentation Committee (IKDC) Subjective Knee Form, Tegner activity level. Patients were also asked what kind of injury they sustained (either direct or indirect trauma), what kind of sport they were performing when they got injured, at what time they did return to sports and which sport they practised before and after surgery.

RESULTS: Fourteen patients underwent re-rupture. In 11 cases, this was due to a new trauma occurring at an average time of 22.9 (SD 23.8) months following primary surgery. In 3 cases rupture occurred during rehabilitation period. Mean postoperative KOOS score was 88.5 (SD 8.5), while mean IKDC subjective score was 87.5 (SD 10.9). At the time of follow-up, most patients (214 subjects, 98%) were participating in sport. 156 subjects returned to pre-injury level (71.6%).

CONCLUSIONS: The study reported long-term favourable subjective outcomes in amateur sportsman following ACL reconstruction, with a low re-rupture rate and a high percentage of subjects (93.6%) returning to sports participation 12 months after surgery. Most patients (71.6%) were able to return to their preprimary level of activity and sport. Younger age at the time of ACL reconstruction positively affected return to sports; however, younger patients were significantly more likely than older patients to undergo re-rupture.

Key words: anterior cruciate ligament; ACL reconstruction; return to sports

TEXT

Introduction

Anterior cruciate ligament (ACL) rupture is a frequent injury among sportsman, with an annual incidence of 68.6 per 100,000 person-years[1] and most commonly occurs during sports involving jumping and landing, sudden stops or changes in direction, such as soccer, basketball, football and downhill skiing[2]. ACL surgery is recommended for patients who have symptomatic objective patholaxity following ACL lesion, as it is essential for restoring joint stability and functional capacity and is therefore indicated in patients aiming to return to sports participation, especially to sports that require cutting and pivoting[3]. Return to sports

following ACL surgery, and the capacity of resuming sporting activities comparable to those engaged prior to the traumatic injury, is a major concern for young active patients undergoing ACL surgery[4-6].

Commonly reported outcome measures following ACL reconstruction are point scales, but limited information exist concerning return to sport rate and patient satisfaction. Several studies have shown return-to-sport rates after primary ACL reconstruction ranging between 43% and 75%, however most of them had either a small cohort or a short follow-up, and results were different depending on the level of sport activity performed[7-11].

The aim of this study was to retrospectively evaluate patient satisfaction, the return-to-sport rate and activity level at a long-term follow-up in a large cohort of amateur sportsmen who underwent primary ACL reconstruction using hamstring tendon autografts.

Materials and methods

Patients recruitment

A cohort of 218 amateur sportsman who underwent primary ACL reconstruction between 2004 and 2011, were successfully recontacted and retrospectively reviewed at an average follow-up of 10.5 years (range, 7 to 14 years). All surgeries were performed by one single surgeon. Written informed consent was obtained. The study was conducted according to the guidelines expressed by the Ethical Committee of the Institute.

Surgical technique

Preliminary arthroscopic inspection was performed in order to confirm the diagnosis. Hamstring tendon autografts were harvested with a tendon stripper through an incision over the pes anserinus on the anteromedial (AM) aspect of the tibia and then prepared to form a 4-

stranded replacement graft. The tibial and femoral tunnels were drilled with an arthroscopically assisted transtibial technique. After the remnants of the torn reconstructed ligament were removed, the tibial tunnel was drilled with the aid of a guide (Acufex; Smith & Nephew, Andover, MA, USA) at a 55° angle in the horizontal plane on the tibial plateau. The femoral tunnel was then drilled with the knee flexed from 90° to 120° in the intercondylar notch posterior and lateral on the medial aspect of the lateral femoral condyle to a depth of 30 mm and a diameter matched to the width of the prepared graft, at the 11 o'clock position in a right knee and at the 1 o'clock position in a left knee. Then, the graft was fixed proximally with the use of a Tightrope device (Arthrex, Naples, FL, USA). Distal locking was achieved through a BioRCI screw (Bioadsorbable Rounded Cannulated Interference; Smith & Nephew), having a diameter 1 or 2 mm larger than that of the graft, while the knee was kept at 20° of flexion under maximal manual tension.

Rehabilitation protocol

For the first 4 weeks, walking with partial weight bearing was allowed with the use of 2 crutches. Patients were encouraged to regain proprioception with the use of a balance board and complete knee flexion and extension. Closed kinetic chain exercises were performed for the first 3 months, and thereafter open kinetic chain exercises were started. Swimming and indoor cycling were permitted after 12 weeks, return to sports was allowed after 6 months, after straight-line running and jumping were started.

Follow-up assessment

Assessment included Knee injury and Osteoarthritis Outcome Score (KOOS)[12], International Knee Documentation Committee (IKDC) Subjective Knee Form[13] for patient subjective statement, and Tegner activity scale for patient activity level[14]. These scores have shown

adequate test-retest reliability, content validity, and internal consistency[15-17]. Patients were also asked what kind of injury they sustained (either direct or indirect trauma), what kind of sport they were performing when they got injured, and which sport they practised before and after surgery. In addition they were asked whether they had performed any sport since their surgery, what kind of sporting activity and when they resumed. All patients were asked what kind of level of sports participation they reached after surgery.

Statistical analysis

Data extracted were analyzed using the program IBM SPSS Statistics for Windows®, Version 21.0 (IBM Corp., Armonk, NY, USA). The normal distribution of the measured variables was verified using the Shapiro-Wilk test. Parametric data were analysed using Student's t-test for independent variables, and non-parametric data analysed using the Mann-Whitney test. We used the Chisquared test to analyze categorical variables. Correlations were performed using Pearson's test for parametric data and Spearman's rank order correlation for non-parametric data. For all tests, differences with $P < .05$ were considered statistically significant.

Results

Demographic data

A total of 218 patients were recruited for the present study. There were 174 (79.8%) male and 44 female (20.2%). Mean age at surgery was 26.6 years (SD 9.8). Mean time from injury to surgery was 12.4 months (SD 15.5) 185 patients sustained an indirect injury, while 33 patients a direct injury. 112 were injured while performing contact sports and 84 during non-contact sports. Twenty-two were injured while performing activities other than sport (Table 1).

Subjective knee function

The mean overall KOOS score increased from a preoperative mean of 62.7 (SD: 8.5) to 88.5 (SD 8.5), showing a statistically significant difference (P<.001). IKDC subjective score significantly improved (P<.001) from 29.9 (SD: 10.1) to 87.5 (SD 10.9) (Table 2). No major complications were reported. No subjective loss of motion or strength nor long-term significant harvesting morbidity were reported at follow-up.

Re-rupture rate

Fourteen patients underwent re-rupture (Table 3). In three cases rupture occurred during the first six months of rehabilitation period due to an aggressive rehabilitation method or to a premature and unauthorized return to cutting and pivoting sports. In 11 cases, re-rupture was due to a new injury following sports participation. Patients who underwent re-injury returned to sports after an average time of 7 months (SD: 2.3); no statistically significant differences were observed when comparing this data to average time to return to sports in patients who did not undergo re-rupture (9.5 months, SD: 5.4, p=0.08). Repeat rupture occurred in 15.9% (10/63) of patients practicing soccer and 9% (1/11) of patients practicing basketball (Table 3).

Sex appeared to have no influence on repeat rupture (p=0.36). Patients in the age group <25 years reported the highest re-rupture rate (10/64, 15.6%) compared to patients aged 26-35 (3/76, 3.9%) and over 35 (1/78, 1.3%). The result was statistically significant (p<0.001).

Return to sport and activity level.

The median pre-injury Tegner score was 7 (range 1 to 10) which decreased to 6 (range 1 to 10) postoperatively ($p<0.001$).

At the time of follow-up, most patients (214 subjects, 98%) were participating in sport. The most common activity participated before injury was soccer (41.7%) followed by skiing (24.3%). At follow-up still the most practiced sport was soccer (28,8%), although an increase in sports not involving cutting and pivoting was reported: the number of subjects practicing swimming increased from 6 (2.8%) to 20 (9.2%), while runners increased from 7 (3.2%) to 12 (5.5%). The type of sports made before and after surgery are reported in detail in Table 4. Overall, 156 subjects returned to pre-injury level (71.6%).

At 6 months postoperatively, return to sports rate was 35.3% (77/218), while 12 months after surgery, 204 patients (93.6%) had returned to sport activity without restrictions.

Men were more likely than women to have attempted to return to sport by 12 months after surgery (94.3% Vs. 90.9%), although the difference was not statistically significant ($p=0.64$). Women resumed sports activity after a mean period of 10.6 months (SD: 5.8) after surgery, while men after an average time of 9 months (SD: 5.1) ($p=0.08$)

Patients with a longer time from injury to surgery reported average inferior values of KOOS, Tegner and IKDC scores as demonstrated by Spearman's non-parametric correlation test.

Younger patients were not significantly more likely than older patients to have attempted to return to sport by 12 months after surgery ($p=0.9$).

Patients returning to sports at 6 months reported average KOOS and IKDC score of 87.7 (SD:9.3) and 86.3 (SD: 12.6) respectively which did not statistically differ from those reported by patients returning to sports 1 year after surgery (average KOOS score 88.9, SD: 8.1, IKDC 88.2, SD: 9.9, $p=0.85$). Similar results have been reported for Tegner activity level ($p=0.96$).

Discussion

This study shows favorable results for return to sports following primary ACL reconstruction in a cohort of amateur sportsman concerning subjective knee function, as well as ability to resume sports activities.

After an average time of 10.5 years from surgery, mean postoperative KOOS score was 88.5 (SD 8.5), while mean IKDC subjective score was 87.5 (SD 10.9). Rupture rate was 6.4% (14 on 204 patients), as previously reported in literature for hamstring ACL reconstruction[18].

Most patients who underwent repeat rupture were 25 years or younger; this supports the observation that younger age represents a risk factor leading to repeat ACL tear in agreement with findings of Shelbourne et al [19,20], Gifstad et al[21], and Persson et al [22] who reported a decreased re-rupture risk in older patients. In addition, in our case series, sex did not influence re-rupture rate, as previously reported in literature[19-24]. Interestingly, it has to be noticed that a relevant percentage of subjects (21%) underwent re-rupture during the rehabilitation period and before resuming sports activity, either because of wrong application of the rehabilitation protocol or due to accidents unrelated to sports activity. This may be due to a lack of communication between surgeons and physiotherapist, or to incautious behaviour by younger patients who, as observed, were more likely to undergo repeat ruptures.

The ability of resuming the same level of sporting activities is a major concern in the active population with an ACL tear[4-6]. In our case series, 71.6% of patients were able to return to their preprimary level of activity and sport. This result is in line with that of other studies with similar follow-up[25,26].

Ardern et al. in a recent meta-analysis reported a relatively low rate of return to competitive sports following ACL reconstruction (55%) despite a high rate of return to any sports participation (81%), and of return to pre-injury sports participation level of 65%[27], similar to

how reported by Kvist et al (56%) in a previous systematic review[9]. In a recent paper by Lai et al, 83% of elite athletes returned to sports following ACL reconstruction[28]; Nwachukwu et al reported an 87% of return to sports rate after ACL reconstruction, with approximately 89% of the subjects returning to prior level of competition[29]. Similarly, Brophy et al reported that 72% of soccer players returned to play at a mean of one year after surgery, with 85% of them reaching the same level of competition[7]. However, different results have been reported between amateurs and professionals, and some papers supports the findings that less than 50% of the patients undergoing ACL surgery returned to practicing sports at preinjury level [8,10].

The time at which a subject is ready to resume sport activity represent one of the most important issues in patients following ACL reconstruction[30,31]. Usually a cut-off of 6 months is recommended before returning to sports to allow for proper graft incorporation and rehabilitation[32,33]. Recently published papers reported a 100% reinjury rate for sportsman resuming sports before 5 months since surgery[34]. In our case series 77 patients (35.3%) returned to sports 6 months postoperatively, while 204 patients (93.6%) were able to return to sport within 12 months after surgery, although in 33.4% it took more than a year before returning to knee-strenuous sports. These findings suggest that a period of rehabilitation superior to the usually recommended 9- to 12-month period might be needed for return to sports following ACL surgery[31,32,35-37]. In addition, like previous literature, this study indicates that younger age at the time of ACL reconstruction positively affected return to sports[27,35]. These findings suggest that timing to resume sports activities varies from one individual to another, and therefore return to sports should be tailored according to patient's characteristics and type of activities. Future prospective studies are needed to guide surgeon and physicians to establish appropriate timing to return to sports with an individual-based approach.

Limitations of this study include its retrospective nature, the absence of a control group and the fact that the outcome measurement relies on self-reported questionnaires.

Conclusions

The study reported long-term favourable subjective outcomes in amateur sportsman following ACL reconstruction, with a low re-rupture rate and a high percentage of subjects (93.6%) returning to sports participation 12 months after surgery. Most patients (71.6%) were able to return to their preprimary level of activity and sport. Younger age at the time of ACL reconstruction positively affected return to sports; however, younger patients were significantly more likely than older patients to undergo re-rupture.

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NOTES

Conflicts of interest. None

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TABLES

Table 1

Patient Demographics and Anthropometric Data

No. of patients	218
Sex	
Male	174
Female	44
Mean time from injury to surgery (SD) (mo)	12.4 (15.5)
Type of injury	
Direct	185
Indirect	33
Activity practiced at injury	
Contact sport	112
Non-contact	84
Other than sport	22
Age at surgery (SD) (yr)	26.6 (9.8)

SD: standard deviation

Table 2

Overview of the results of clinical assessment

	Pre-operative	Post-operative	p value
KOOS score (mean, SD)	62.7 (SD: 8.5)	88.5 (SD: 8.5)	$p < 0.001$
IKDC subjective score (mean, SD)	29.9 (SD: 10.1)	87.5 (SD: 10.9)	$p < 0.001$
Tegner activity level (median, range)	7 (range 1-10)	6 (range 1-10)	$p < 0.001$

SD: standard deviation; KOOS: Knee injury and Osteoarthritis Outcome Score;

IKDC: International Knee Documentation Committee (IKDC)

Table 3

Results of return to sports and re-rupture rate following ACL surgery

Return to pre-injury rate	156/218 (71.6%)
Time to return to sports (mean, SD) (months)	9.3 (SD 5.2)
Re-rupture rate	16/218 (6.4%)
Incidence of re-rupture according to sex Male Female	 13/174 (7%) 1/44 (2%)
Incidence of re-rupture according to age groups (years) <25 25-35 >35	 10/64 (15.6%) 3/76 (3.9%) 1/78 (1.3%)
Incidence of re-rupture according to sport practiced Soccer Basketball Athletics Cycling	 10/63 (15.9%) 1/11 (9%) 1/12 (8%) 1/12 (8%)

ACL: anterior cruciate ligament; SD: standard deviation

Table 4

Sport activity before ACL injury and at follow-up

	Pre-injury	Follow-up
Soccer	91	63
Skiing	53	51
Basketball	14	11
Volleyball	14	12
Tennis	2	3
Jogging	15	23
Hiking	1	4
Swimming	6	20
Cycling	7	12
Martial arts	5	2
Athletics	6	12
Dancing	1	1
No sports	2	3

ACL: anterior cruciate ligament