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Return to sports activity following combined reconstruction of anterior cruciate ligament and anterolateral ligament

Štefanija Kolačko[1,2,3]*, Goran Vrgoč[4,5], Jurica Predović[6,7], Tomislav Kottek[4], Monika Trčak[8]

[1]Department of One day surgery, University Hospital "Sveti Duh", Zagreb, Croatia, [2]Department of Nursing and Palliative Medicine, Faculty of Dental Medicine and Health Osijek, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia, [3]Department of Health care, University of Applied Health Sciences, Zagreb, Croatia, [4]Department for Orthopedic Surgery, University Hospital "Sveti Duh", Zagreb, Croatia, [5]Department of Sports and Exercise Medicine, Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia, [6]Department of Ophthalmology and Optometry, Faculty of Dental Medicine and Health Osijek, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia, [7]Department of Ophthalmology, University Hospital "Sveti Duh", Zagreb, Croatia, [8]Department of Clinical Immunology, Rheumatology and Pulmonology, University Hospital "Sveti Duh", Zagreb, Croatia

ABSTRACT

Introduction: Anterior cruciate ligament (ACL) injuries are increasingly common among young people, especially active athletes. This study aims to retrospectively assess long-term results following ACL and anterolateral ligament (ALL) reconstruction, with a focus on rehabilitation, return to sports activities, patient satisfaction, and the impact of ALL and ACL injury on the s' daily life and sports activities.

Methods: The study included 140 patients treated at the Day Surgery Unit of the "Sveti Duh" Clinical Hospital. All participants underwent ACL and ALL reconstruction.

Results: The median Lysholm score for respondents with combined ALL and ACL injuries was 72 (range 8-100), compared to 79 (range 36-100) for those with isolated ACL injuries. A total of 63.6% of respondents resumed their sport after surgery and rehabilitation, while 5% completely ceased participation. The ACL-return to sport after injury scores, which measure the psychological response after injury, indicated no significant differences in psychological readiness to return to sports depending on the type of injury. Overall, 62.9% percent of respondents were fully satisfied with their rehabilitation outcomes, while 3.6% expressed limited satisfaction.

Conclusion: Although knee function was significantly impaired in patients with combined ACL and ALL injuries, 62.9% of all respondents reported being satisfied with their rehabilitation outcomes. Among those with combined injuries, 36.4% expressed confidence in returning to their pre-injury level of athletic activity.

Keywords: Anterior cruciate ligament; anterolateral ligament; ligament reconstructions; orthopedics; rehabilitation; sports; surgery

INTRODUCTION

Biomechanical studies have identified the anterolateral ligament (ALL) as a key passive stabilizer of the knee during internal rotation (1). Following ligament rupture, reconstruction of ALL may lead to excessive restriction of internal rotation, which may cause excessive loading of the knee joint.

Historically, the ALL was first described in 1897 by French anatomist Paul Segond (2), who observed "pearl-fibrous bands" under tension during excessive internal knee rotation. This early finding by Segond marked a foundational step in understanding the anatomical and functional significance of the ALL. This relatively small but significant structure is located on the anterolateral aspect of the knee joint and plays an important role in knee stability and biomechanics. Segond's insights were only the beginning, and further research deepened the knowledge of the anatomy and role of the ALL. Despite intermittent recognition in anatomical literature, it was not until 2013 that Claes et al. provided a comprehensive anatomical description of this structure (3).

In recent years, there has been a shift in approaches to the treatment of anterior cruciate ligament (ACL) and ALL injuries (4-6). There is a growing need for prospective clinical studies to determine the objective indications and justification for combined anterior cruciate and ALL reconstruction. This change in approach is based on the desire to achieve better stability of the knee joint and reduce the risks of re-injury (7,8).

Understanding the role of the ALL is becoming increasingly important in the treatment of ACL injuries (9,10).

*Corresponding author: Štefanija Kolačko, University Hospital "Sveti Duh," Sveti Duh 64, 10000 Zagreb, Croatia,
E-mail: skolacko@kbsd.hr

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UNIVERSITY OF SARAJEVO
FACULTY OF HEALTH STUDIES

Learning about the interaction between these two ligaments can aid in the development of new surgical techniques and rehabilitation programs that will ensure optimal recovery and return to activity for athletes. It is important to conduct further research to identify the most effective treatment methods and to make progress in the area of ACL and ALL injuries (11-13).

The primary aim of the study is to investigate the effects of ACL and anterior collateral ligament injuries in young and athletically active participants on their daily lives and their return to sporting activities after surgery and rehabilitation, as well as their satisfaction with the measures taken.

METHODS

This cross-sectional study was conducted after approval by the Ethics Committee of the Day Surgery Unit of the "Sveti Duh" Clinical Hospital (No. 01-885/8).

The research included participants aged 18-40 who were treated at the Day Surgery Unit of the "Sveti Duh" Clinical Hospital. After pre-operative treatment and medical indication, the participants came for the anterior cruciate reconstruction surgery or the anterior cruciate and ALL reconstruction. All participants included in the research were professionally trained in some of the sports: Gymnastics, hockey, basketball, handball, football, skiing, or tennis. The survey included 140 participants. The research was conducted from May to June 2023. The criteria for the inclusion of participants in the research were patients coming for anterior cruciate or anterior cruciate and ALL reconstruction surgery.

For the purposes of this research, two standardized validated questionnaires (Lysholm knee test and ACL-return to sport after injury [RSI] questionnaire) were used.

The first part of the questionnaire contained 5 items related to the socio-demographic characteristics of the respondents, age, line of work, gender, the sport they play, and whether they have continued to play that sport after surgery.

The second part of the questionnaire contained 8 items related to the assessment of knee joint function (Lysholm knee test), pain, instability, stiffness, swelling, limping, climbing stairs, squatting, and the need for support. The Lysholm knee questionnaire produces a composite score from 0 (no function) to 100 (complete knee function).

The third part of the questionnaire assessed the athlete's emotions, self-confidence, and risk assessment when returning to sports after injury. The ACL-RSI scale consisted of 12 items, ultimately scoring from 0 to 100, with a higher score indicating a positive psychological response.

In the fourth part of the questionnaire, the respondents' satisfaction with rehabilitation after injury was assessed. It consisted of a single item, and respondents selected one of five response options on a Likert-type scale ranging from 1 (not at all satisfied/confident) to 5 (completely satisfied/confident).

Categorical variables are presented as absolute and relative frequencies. Differences between categorical variables were assessed using the Chi-square test. The normality of numerical data distribution was evaluated with the Shapiro–Wilk test. Continuous variables are reported as medians with interquartile ranges. Differences between continuous variables were analyzed using the Mann–Whitney U test, while comparisons across three-time points were performed using the Friedman test. All p-values were two-tailed, and a significance threshold was set at $\alpha = 0.05$. Statistical analyses were conducted using MedCalc® Statistical Software, version 22.006 (MedCalc Software Ltd., Ostend, Belgium; https://www.medcalc.org; 2023).

RESULTS

A total of 140 participants took part in the study. Of these, 70 (50%) had isolated ACL injuries, while the remaining 70 (50%) had combined injuries to the ACL and the ALL.

Regarding gender distribution, 107 participants (76.4%) were male and 33 (23.6%) were female, with no significant difference between injury types.

Among all respondents, the most commonly practiced sport was football, reported by 72 (51.4%) individuals, followed by handball with 29 participants. A total of 89 respondents (63.6%) continued participating in their sport. In terms of occupational activity, 60 respondents (42.9%) reported working in physically demanding jobs, whereas 30 (21.4%) were employed in less physically strenuous roles (Table 1).

The median age of the participants was 26 years, ranging from 18 to 53 years. Notably, individuals with isolated ACL injuries were significantly older compared to participants with combined ACL and ALL injuries (Mann–Whitney U test, $p = 0.003$) (Table 2).

Among participants with combined ACL and ALL injuries, the median Lysholm knee score was 72, with a range from 8 to 100. In comparison, those with isolated ACL injuries demonstrated a score range of 36-100, with a median of 79. Based on these values, the findings indicate that knee function was significantly more impaired in participants with combined ACL and ALL injuries compared to those with isolated ACL injuries (Mann–Whitney U test, $p = 0.03$) (Table 3).

Of the total number of respondents, regardless of injury type, 51 (36.4%) expressed full confidence in their ability to perform at their previous level of athletic activity. In contrast, 13 respondents (9.3%) reported low or no confidence. Six respondents (4.3%) believed they would likely reinjure their knee if they resumed sport participation, whereas the majority - 57 respondents (40.7%) - did not share this concern. In addition, 79 respondents (56.4%) reported no anxiety about returning to sport, irrespective of injury type. Similarly, 62 respondents (44.3%) were completely confident that their knee would remain stable during sport, and 101 (71.4%) of them were mostly or fully convinced that they could participate without worrying about their knee (Table 4).

A total of 88 respondents (62.8%) reported that they rarely or never found it frustrating to consider their knee condition in relation to sport. Among all participants, 18 respondents (12.8%) reported being completely or occasionally afraid of reinjuring their knee. Furthermore, 72 respondents (51.4%) were confident that their knee would withstand physical stress, while 6 (4.3%) expressed uncertainty or doubt. Nineteen respondents (13.5%) reported

TABLE 1: Basic Characteristics of the Participants

Basic characteristics	Number (%) of respondents in relation to the type of injury			*p**
	ACL and ALL	ACL	Total	
Sex				
Men	55 (78.6)	52 (74.3)	107 (76.4)	0.55
Women	15 (21.4)	18 (25.7)	33 (23.6)	
Age (years)	25 (23-29)	31 (23-41)	26 (23-32)	**0.003**
*Mann–Whitney U test				
What sport have you played?				
Gymnastics	0	1 (1.4)	1 (0.7)	0.45
Hockey	2 (2.9)	3 (4.3)	5 (3.6)	
Basketball	6 (8.6)	9 (12.9)	15 (10.7)	
Football	36 (51.4)	36 (51.4)	72 (51.4)	
Handball	19 (27.1)	10 (14.3)	29 (20.7)	
Skiing	3 (4)	6 (9)	9 (6)	
Tennis	4 (6)	5 (7)	9 (6)	
Are they still actively engaged in sports?				
Yes 42 (60)	42 (60)	47 (67.1)	89 (63.6)	0.48
No 28 (40)	28 (40)	23 (32.9)	51 (36.4)	

*χ^2 test. ACL: Anterior cruciate ligament, ALL: Anterolateral ligament. Bold values indicate statistical significance (p<0.05)

TABLE 2: Evaluation of the functionality of the knee with regard to injury type

Lysholm knee test	Median (interquartile range)		*p**
	ACL and ALL	ACL	
Knee function (Lysholm knee test)	72 (54-87)	79 (67-92)	**0.03**

*Mann–Whitney U test. ACL: Anterior cruciate ligament, ALL: Anterolateral ligament. Bold values indicate statistical significance (p<0.05)

complete or occasional fear of unintentionally injuring their knee during sport, with no significant difference observed based on injury type (Table 5).

Surgical treatment and rehabilitation completely prevented 7 respondents (5%) from returning to the sport, whereas 54 respondents (38.6%) stated that these factors did not hinder them at all. Sixty-seven respondents (47.9%) were fully confident in their athletic performance post-recovery, and 57 (40.7%) reported feeling completely at ease while engaging in their sport, regardless of the injury sustained (Table 6).

The ACL-RSI questionnaire ranges from 0 to 100, with higher scores indicating a more positive psychological response to returning to sport. Analysis of the ACL-RSI scores revealed no significant difference in psychological readiness to return to sport based on injury type (Table 7).

Regarding satisfaction with rehabilitation, 88 respondents (62.9%) reported being completely satisfied, 38 (27.1%) were mostly satisfied, 9 (6.4%) were neutral, and 5 (3.6%) reported being only slightly satisfied. No significant difference in satisfaction levels was observed in relation to the type of injury (Figure 1).

The Tegner activity scale was used to assess participants' activity levels prior to injury, following surgery, and at the time of the survey. No significant differences in Tegner scores were observed between injury types at the post-operative or present time points. However, pre-injury scores were significantly higher among participants with combined ACL and ALL injuries compared to those with isolated ACL injuries (Mann–Whitney U test, $p = 0.001$).

TABLE 3: Self-assessment of return to sport after injury (1/3)

Lysholm knee test	Number (%) of participants			*p**
	ACL and ALL	ACL	Total	
Are you confident that you can perform at your previous level of sport?				
Not at all confident	7 (10)	6 (8.6)	13 (9.3)	0.95
Slightly confident	7 (10)	6 (8.6)	13 (9.3)	
Neither confident nor unconfident	17 (24.3)	15 (21.4)	32 (22.9)	
Mostly confident	16 (22.9)	15 (21.4)	31 (22.1)	
Completely confident	23 (32.9)	28 (40)	51 (36.4)	
Do you think you will re-injure your knee if you return to sport?				
No, I don't think so	26 (37.1)	31 (44.3)	57 (40.7)	0.87
I'm not sure	15 (21.4)	14 (20)	29 (20.7)	
I don't know	13 (18.6)	12 (17.1)	25 (17.9)	
Possibly	12 (17.1)	11 (15.7)	23 (16.4)	
Definitely	4 (5.7)	2 (2.9)	6 (4.3)	
Are you nervous about returning to sport?				
Not at all nervous	36 (51.4)	43 (61.4)	79 (56.4)	0.85
Slightly nervous	14 (20)	11 (15.7)	25 (17.9)	
Neutral	11 (15.7)	9 (12.9)	20 (14.3)	
Usually nervous	5 (7.1)	4 (5.7)	9 (6.4)	
Very nervous	4 (5.7)	3 (4.3)	7 (5)	
Are you confident that your knee will remain stable during sport?				
Not at all confident	8 (11.4)	6 (8,6)	14 (10)	0.88
Slightly confident	7 (10)	5 (7.1)	12 (8.6)	
Neutral	13 (18.6)	12 (17.1)	25 (17.9)	
Mostly confident	14 (20)	13 (18.6)	27 (19.3)	
Completely confident	28 (40)	34 (48.6)	62 (44.3)	
Are you confident you can participate in sport without worrying about your knee?				
Not at all confident	7 (10)	3 (4.3)	10 (7.1)	0.53
Slightly confident	8 (11.4)	6 (8.6)	14 (10)	
Neutral	8 (11.4)	7 (10)	15 (10.7)	
Mostly confident	16 (22.9)	14 (20)	30 (21.4)	
Completely confident	31 (44.3)	40 (57.1)	71 (50.7)	

*χ^2 test. ACL: Anterior cruciate ligament, ALL: Anterolateral ligament

In both groups, a significant decline in activity level was noted post-operatively compared to the pre-injury period (Friedman test, $p < 0.001$) (Table 7).

TABLE 4: Self-assessment of return to sport after injury (2/3)

Lysholm knee test	Number (%) of participants			*p**
	ACL and ALL	ACL	Total	
Do you find it frustrating to have to think about your knee when participating in sport?				
Not at all	28 (40)	30 (42.9)	58 (41.4)	0.99
Rarely	15 (21.4)	15 (21.4)	30 (21.4)	
Occasionally	16 (22.9)	15 (21.4)	31 (22.1)	
Sometimes	6 (8.6)	6 (8.6)	12 (8.6)	
Very much so	5 (7.1)	4 (5.7)	9 (6.4)	
Are you afraid of re-injuring your knee while playing your sport?				
Very afraid	5 (7.1)	3 (4.3)	8 (5.7)	0.59
Slightly afraid	6 (8.6)	4 (5.7)	10 (7.1)	
Neutral	16 (22.9)	14 (20)	30 (21.4)	
Sometimes afraid	22 (31.4)	19 (27.1)	41 (29.3)	
Not at all afraid	21 (30)	30 (42.9)	51 (36.4)	
Are you confident that your knee will withstand physical pressure?				
Definitely not	4 (5.7)	2 (2.9)	6 (4.3)	0.70
Probably not	3 (4.3)	3 (4.3)	6 (4.3)	
Not sure	13 (18.6)	11 (15.7)	24 (17.1)	
Probably yes	18 (25.7)	14 (20)	32 (22.9)	
Definitely yes	32 (45.7)	40 (57.1)	72 (51.4)	
Are you afraid of accidentally injuring your knee while playing your sport?				
I'm completely afraid	6 (8.6)	3 (4.3)	9 (6.4)	0.59
I'm afraid sometimes	6 (8.6)	4 (5.7)	10 (7.1)	
Neutral	8 (11.4)	6 (8.6)	14 (10)	
Slightly afraid	19 (27.1)	17 (24.3)	36 (25.7)	
Not at all afraid	31 (44.3)	40 (57.1)	71 (50.7)	

*χ^2 test. ACL: Anterior cruciate ligament, ALL: Anterolateral ligament

TABLE 5: Self-Assessment of return to Sport After Injury (3/3)

Lysholm knee test	Number (%) of participants			*p**
	ACL and ALL	ACL	Total	
Do thoughts about surgery and rehabilitation prevent you from playing sports?				
Yes, completely	5 (7.1)	2 (2.9)	7 (5)	0.52
Yes, sometimes	13 (18.6)	9 (12.9)	22 (15.7)	
Neutral	15 (21.4)	13 (18.6)	28 (20)	
Possibly	14 (20)	15 (21.4)	29 (20.7)	
Not at all	23 (32.9)	31 (44.3)	54 (38.6)	
Are you confident in your ability to perform well in your sport?				
Not at all confident	3 (4.3)	2 (2.9)	5 (3.6)	0.83
Occasionally confident	7 (10)	6 (8.6)	13 (9.3)	
I don't think about it	14 (20)	11 (15.7)	25 (17.9)	
Somewhat confident	16 (22.9)	14 (20)	30 (21.4)	
Completely confident	30 (42.9)	37 (52.9)	67 (47.9)	
Do you feel relaxed when participating in your sport?				
Not at all	3 (4.3)	2 (2.9)	5 (3.6)	0.86
Slightly	10 (14.3)	9 (12.9)	19 (13.6)	
Neutral	14 (20)	14 (20)	28 (20)	
Mostly	18 (25.7)	13 (18.6)	31 (22.1)	
Completely	25 (35.7)	32 (45.7)	57 (40.7)	

*Mann–Whitney U test. ACL: Anterior cruciate ligament, ALL: Anterolateral ligament

DISCUSSION

This study on the return to sports activity following reconstruction of the ACL and ALL included 140 participants, of whom 70 (50%) had an isolated ACL injury, while the remaining 70 participants (50%) had a combined ACL and ALL injury. Of the total sample, 107 respondents (76.4%) were male and 33 (23.6%) were female, with no significant difference in injury type between genders. The mean age of the respondents was 26 years, with a range from 18 to 53 years. Participants with ACL injuries were significantly older than those with combined ACL and ALL injuries (Mann–Whitney U test, p = 0.003). According to research data from the University of Pittsburgh, the incidence of ACL injuries in the United States is approximately 85/100,000 people aged 16-39, underscoring the high prevalence of these injuries among young athletes and recreational players (14).

Among participants at the Day Surgery Unit of the "Sveti Duh" Clinical Hospital, football was the most commonly played sport (72 respondents, 51.4%), followed by handball (29 respondents, 20.7%). During the study period, 89 respondents (63.6%) continued to engage in their respective sports. A similar study conducted in the United States aimed to estimate the incidence of ACL tears and found notable differences in injury rates between male and female athletes, with higher injury rates in women across several sports.

Training programs were shown to reduce the incidence of ACL injuries in football by 24%, while no effect was observed in basketball (15).

In our study, significant differences were observed in knee symptoms and function between participants with combined ACL and ALL injuries and those with isolated ACL injuries. Analysis of Lysholm knee test scores revealed that participants with combined injuries had significantly impaired knee function. These findings align with those of a U.S.-based study evaluating surgical outcomes in

TABLE 6: Assessment of return to sport after injury

Knee function (Lysholm knee test)	Median (interquartile range)		*p**
	ACL and ALL	ACL	
Knee function (Lysholm knee test)	59 (50-69)	65 (56-69)	0.07

*Mann–Whitney U test

TABLE 7: Tegner activity scale scores at three-time points by type of injury

Tegner score	Median (interquartile range)		*p**
	ACL and ALL	ACL	
Tegner score before injury	8 (7-9)	7 (6-8)	**0.008**
Tegner score after surgery	7 (6-8)	7 (6-8)	0.43
Tegner present score	6 (5-7)	6 (5-7)	0.79

*Mann–Whitney U test. ACL: Anterior cruciate ligament, ALL: Anterolateral ligament. Bold values indicate statistical significance (p<0.05)

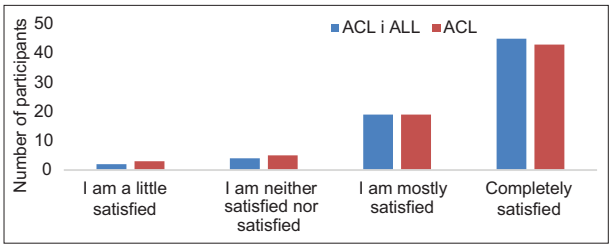

FIGURE 1. Distribution of respondents according to satisfaction with rehabilitation after injury. ACL: Anterior cruciate ligament, ALL: Anterolateral ligament.

patients with ACL injuries. That study showed that surgical treatment resulted in a higher percentage of excellent/good outcomes on the International Knee Documentation Committee (IKDC) scale compared to non-operative management (58% vs. 20%). In addition, surgically treated patients more frequently returned to full work capacity (72% vs. 52%) and full sports participation (29% vs. 10%).

When comparing different surgical approaches to repairing knee structures, outcomes on the Lysholm test and IKDC were similar across methods (88% vs. 87% and 51% vs. 48%, respectively). However, posterolateral corner repairs had a higher failure rate (37% vs. 9%), and cruciate ligament repairs resulted in reduced joint stability, limited range of motion, and a lower rate of return to pre-injury activity (0% vs. 33%). Early surgical intervention was associated with better Lysholm scores (90% vs. 82%), more excellent/good IKDC ratings (47% vs. 31%), and higher sports activity scores (89% vs. 69%) according to the Knee Assessment Questionnaire (16).

In the present study at the Day Surgery Unit of the "Sveti Duh" Clinical Hospital, psychological readiness to return to sport was assessed using the ACL-RSI scale. Results indicated no significant differences in psychological outcomes based on injury type. Regarding satisfaction with rehabilitation, 63% of respondents reported being completely satisfied, and this proportion did not vary significantly by injury group.

A separate study from the University of Florida examined failure rates after revision ACL reconstruction. While functional outcomes were satisfactory, the authors emphasized the importance of providing psychological support during the post-operative period (17). Data from the first 460 participants of the multi-center ACL revision study cohort provided additional insights into the complexity of revision procedures and highlighted the need for enhanced rehabilitation strategies (18).

In conclusion, ACL injuries have a profound impact on athletes' knee function, career longevity, and capacity to return to sport. Effective rehabilitation is essential for successful recovery, and psychological support should be prioritized to ensure athletes regain confidence and feel secure during their return to physical activity (19,20).

CONCLUSION

Based on the conducted research and obtained results, it can be concluded that knee function was significantly impaired in participants with combined ACL and ALL injuries ($p = 0.03$). Despite this, surgery and rehabilitation completely prevented only 5% of respondents from playing sports, while 38.6% reported that these factors did not hinder their sports participation. Furthermore, 36.4% of respondents believed that they could return to their previous level of athletic activity regardless of injury type. Overall, 62.9% of participants reported being fully satisfied with their rehabilitation outcomes, with no significant differences in satisfaction based on the type of injury.

STUDY LIMITATION

The relatively small sample size in our study underscores the need for future large-scale studies to validate these findings.

FINANCIAL DISCLOSURE

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DECLARATION OF INTEREST

Authors declare no conflict of interest.

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